THURSDAY, APRIL 22, 1897.

RELIGIOUS SUPERSTITIONS OF NORTHERN INDIA.

The Popular Religion and Folk-Lore of Northern India. By W. Crooke, B.A. Two volumes. Vol. i. pp. 294; vol. ii. pp. 359. (Westminster: Archibald Constable and Co., 1896.)

THESE two volumes are a reproduction, on a larger scale, of a work written in 1894, by Mr. W. Crooke, of the Bengal Civil Service. The author employed the interval, so he tells us, in collecting fresh information in the course of the Ethnographical Survey of the North-west Provinces of India, the results of which will be separately published. This new edition contains a mass of most important and extremely interesting matter, ably dealt with by a thoroughly competent authority, in whom are combined the rare qualities of careful and accurate research with an intimate knowledge of the habits and customs of the people of Northern India. The value of the work is further enhanced by excellently executed photographs of shrines and other sacred places, a complete bibliography, and a carefully-prepared index.

The first volume deals chiefly with the "godlings," or inferior deities commonly worshipped by the masses, which are distinct from the high gods described in the Vedic hymns, and the Triad, or Trinity, whose attributes are set forth in the Purânas and other sacred works of the Brâhmans. The reader is no doubt aware that the earlier and more philosophic forms of Hinduism are not now, if they ever were, the religion of the people. The older creed is buried under an enormous overgrowth of demonolatry, fetishism and kindred forms of primitive religion, not described in books, nor patronised by high-caste priests, but living in oral traditions, and forming the daily cult of almost all classes of society in modern India. It is this form of Hinduism, and the folk-tales and customs associated with it, that the author has brought to light and placed before the English reader. Religion, as the author shows, went through the same phases of growth in Christian Greece and Rome that Hinduism has undergone in India.

The popular deities of modern India are described under five main headings—the godlings of nature, the heroic and village godlings, the godlings of disease, the sainted dead, and the malevolent dead. To illustrate each of these subjects the author has taken examples not only from those castes which call themselves Hindu, but also from those tribes which it is convenient to describe as aboriginal, or non-Aryan, and which have not yet been drawn within the vortex of Hinduism. Among the godlings of nature the author includes the Sun (Suraj Narâyan), the Moon (Chandra or Sama), the demon of the moon's eclipse (Râhu), the rainbow, the Milky Way (known to some as the pathway of the snake, to others as the course of the heavenly Ganges), mother earth, thunder and lightning, the sacred junctions of rivers, sacred wells and lakes, hot springs, waterfalls, sacred mountains, hail and whirlwind, aerolites, &c. Among all those godlings of nature some stand higher in the list of benevolent deities than the great rivers, especially the Ganges and the Jumnâ. The Ganges, known as Gangâ Mâi, or "Mother Ganges," in the mythologies has a divine origin. According to one account she flows from the toe of Vishnu, and was brought down from heaven by the incantations of the saint Bhâgiratha, to purify the ashes of the 60,000 sons of King Sâgara, who had been burnt up by the angry glance of Kapila, the sage. By another story, she descends in seven streams from Siva's brow, and by a third account she is the daughter of Himâvat, the impersonation of the Himalayan range.

The heroic village godlings make a numerous class; and Muhammadans, in spite of their professions of rigid orthodoxy, have sainted heroes, to whom they make offerings and prayers, no less than Hindus. In fact, the same hero is often worshipped by the followers of both creeds. Of this there are two notable examples. One is Khwâja Khizr, a saint of Islâm, who presided over the well of immortality, and directed Alexander of Macedon in his vain search for the blessed waters. The fish is his vehicle, and hence the emblem of a fish became the family crest of the late royal house of Oudh. Out of this Muhammadan saint the Hindus have evolved a water-god, to whom they have given the name of Râja Kidar, by a process of change from Khwâja Khizr. In this capacity he has become the patron deity of all the boating and fishing castes, Hindu and Muhammadan. The other example is that of Ghâzi Miyân, whose shrine is situated at Bahraich, in the north of Oudh. "His real name," says the author, in page 207, "was Sayyid Sâlâr Masaud, and he was nephew of Sultân Mahmûd of Ghazni." It would have been more correct, however, if he had said that his real name is Shahîd (or "Martyr") Masaud, which was corrupted in popular ignorance to Sayyid, or descendant of the prophet. Sultân Mahmûd did not profess to be a Sayyid; and his nephew Sâlâr received the title of "Shahîd," or Martyr, from the fact that in A.D. 1033 he was killed in battle by the Hindus of Bahraich. Mr. Crooke suggests the following hypothesis in explanation of the fact that his shrine is worshipped by Hindus, to whom he was a bitter enemy, no less keenly than by Muhammadans.

"There is some reason to believe that this cultus of Masaud may have merely succeeded to some local worship, such as that of the sun, and in this connection it is significant that the great rite in honour of the martyr is called the Byâh or marriage of the saint, and this would associate it with other emblematical marriages of the earth, and sun or sky, which were intended to promote fertility. Masaud, again, is the type of youth and valour in military Islâm, and to the Hindu mind assumes the form of one of those godlike youths, such as Krishna or Dûlha Deo, snatched away by an untimely and tragical fate in the prime of boyish beauty."

It says much for Mr. Crooke's penetration that the hypothesis he has suggested is verified by the family records of a neighbouring Hindu Râja. What is now known as the shrine of Sayyid Sâlâr was originally the temple of the Infant Sun, worshipped under the name of Bâla Arka ("the rising sun"). It was near this spot that the filibuster was slain and buried. Amongst Hindus the propensity to hero-worship is so strong that veneration for the sun-godling was gradually absorbed in that

of the deified Muhammadan saint, whom their ancestors had slain. All through the year pilgrims frequent this shrine, but the special anniversary of his worship occurs in the month of May, one of the hottest months of the year, when the crush of pilgrims struggling to leave some offering at the tomb is so great that the consequences are sometimes fatal. A thermantidote was fixed a few years ago at the back of the tomb, to supply a current of cool fresh air to persons entering in at the front. This the pilgrims declare is the holy breath of the saint breathing on them; and they go round to the back of the tomb and pay worship to this thermantidote.

The godlings of disease are described in full detail in Chapter iii. Most of these are goddesses, various forms of Kâlî, the goddess of death. The most conspicuous are Sîtalâ, the goddess of small-pox; and Marî Bhavânî, the goddess of cholera. The latter shares her honours with another form of the cholera godling, who is a male, and is called Hardaul Lâla. He is chiefly worshipped north of the Jumnâ. It is noticeable that there is no godling to represent the plague that is now raging in the Bombay Presidency, implying, what is the fact, that this fell disease has never before been known in India. If it should become an endemic it will no doubt be personified, and another godling will then be added to the already overcrowded pantheon.

The reader will find much to interest him in the second volume, but we have no space to go into details. In pp. 13–14, he will find some curious facts about the use of a horse-shoe for securing good luck, and warding off the evil eye. The custom of nailing against a door horse-shoes that have been accidentally picked up is as common in India as in England: "the great gate of the mosque at Fatehpur Sîkri is covered with them, and the practice is general at many shrines." It is interesting also to find that customs similar to that of throwing rice at a bride as she leaves the church are widely prevalent in India.

Mr. Crooke devotes several pages to the subject of human sacrifice (vol. ii. pp. 167–176). There is no reason to doubt that this custom prevailed among the early Aryans of India. The Tantras enjoin human sacrifices to Chandikâ. The folk-tales of India abound in stories of human sacrifice; and in the time of Sir John Malcolm there was a tribe of Brâhmans called Karhâda, which had a custom of annually sacrificing a young Brâhman to their deities. All over India there is a very strong tradition that new buildings, bridges, tanks, and wells should be secured against evil by the blood of some human victim.

The reader of these fascinating volumes cannot fail to be deeply interested in their perusal; he will also realise what a wide field of research is open to the methodical and careful observer of Indian modes of life, of their religious beliefs and superstitions. It is extremely creditable to Mr. Crooke that such a valuable work should have been compiled in the intervals of the scanty leisure of a District Officer's life in India. It is to be hoped that officials in other provinces of that vast empire, with its countless tongues, races and tribes, may be induced to follow in Mr. Crooke's worthy footsteps.

It is a matter of considerable surprise that the Government of India, instead of establishing an ethnological bureau whose entire work shall consist in collecting the traditions and customs of the people in each of the various provinces, should have allowed private individuals, already overburdened with work, to carry on such important researches at their own cost, and in the short intervals of hard-earned leisure. In this connection we would allude to the labours of Mr. Denzil Ibbetson, the author of "Panjâb Ethnography"; to Colonel Dalton's "Ethnology of India"; to the important summary on the caste-system of the North-west Provinces and Oudh, monographs on the Kanjar, Mushera, Thâru, and other tribes, with sundry ethnographical treatises written by Mr. J. C. Nesfield; to Mr. Risley's "Tribes and Castes of Bengal"; to Mr. Eustace Kitt's "Compendium of Castes"; and to other similar works by eminent Indian officials, who have so largely contributed to the literature relating to the folk-lore, traditions, and religious beliefs of the people of India.

PRIMITIVE MAN IN EGYPT.

Recherches sur les Origines ae l'Égypte. L'Âge de la pierre et les Metaux. Par J. de Morgan. Pp. xiv + 270, large 8vo. (Paris: Leroux, 1896.)

THE excavations which have been carried on in Egypt during the last twenty years have had as their object the acquisition of antiquities rather than the scientific investigation of the numerous problems anent the early Egyptians and their predecessors, which still, unfortunately, remain unsolved. It cannot be denied that public interest in the work depended largely upon the value of the facts which could be deduced from the study of Egyptian antiquities in their relation to the history of the sojourning of the children of Israel in Egypt, and it is only quite lately that attempts have been made to treat the various branches of Egyptology from a comparative point of view. Moreover, a mistaken idea had gone abroad about the ability of the Egyptologist to settle the difficulties which constantly cropped up, and the philologist was thought to be able to give a final answer to every question which was propounded to him.

It is now quite clear that the knowledge of the Egyptians is a subject sufficiently large to admit of the useful occupation of purely scientific men in addition to the philologist; and the sooner this fact is generally recognised the sooner we may hope that fresh light will be thrown upon the dark and somewhat mysterious past of the early Egyptians. A limit must be reached some day in philological knowledge of Egyptian archæology, and our hope for further facts must rest upon those who are able to put before us the interpretation of the story of Egypt's past, which is written in her mountains and mud.

It will be remembered that the labours of Mariette and Maspero were devoted entirely to the collecting of antiquities, and to the publication of texts and papyri, and to the general administration of the Egyptian Museum of Bûlâk and Ghîzeh. Their successor, however, M. J. de Morgan, has approached the duties of his post with a larger view of their possibilities, and he has devoted himself to the consideration of the ancient country of Egypt rather than to its language. The results of his excavations have, notwithstanding, been important, and the jewellery of Dahshûr will for long claim the attention of all lovers

of art and of all admirers of technical skill in the working of metals.

It is our purpose not to discuss these results, but to draw attention to his geological investigations which he describes in the work before us, for here we have presented a series of facts which have been brought together by a trained observer of physical phenomena, and a number of deductions which claim the careful thought of those who deal with the science of anthropology.

By the aid of "black and white" maps, we have a brief account of the early geological changes which took place in Western Asia and resulted in the formation of Egypt, and the old course of the Nile now called "the river without water," and its relation to the bases are fully described; this is followed by an account of the gradual development of the Nile as we know it, and the causes which produced the fertile lands on each side of it. The first peoples who lived on the latter were the autochthonoi, who perfected the art of stone polishing: who became almost civilised, and who were known by the historical Egyptians as the "followers of Horus"; these M. de Morgan divides into two classes, *i.e.* palæolithic and neolithic. Of palæolithic man many remains have been found, and four places, at least, where it is certain that he flourished are now well known, and many examples of his stone work are figured on pp. 57–66 of M. de Morgan's book.

Passing next to the remains of neolithic man, we find that numerous sites, both in Lower and Upper Egypt, produce objects which prove his skill and knowledge; these are here described with care, and the deductions which are to be made from the objects on each are soberly stated.

Without going into details, M. de Morgan proves with tolerable certainty that we have authentic remains of the historic Egyptians of the first and second dynasties, and there are many objects known to him which he would attribute unhesitatingly to the period immediately preceding. Here, naturally, comes an account of M. Amélineau's discoveries, which have stirred up a great deal both of interest and strife, and a statement of the excavator's own views on the subject has been given from his paper entitled *Les Nouvelles fouilles d'Abydos*, Angers, 1896. Whether the objects found in the tombs at Amrah, near Abydos, belong to as early a period as M. Amélineau asserts; or whether they come from what M. de Morgan calls "tombes de transition," and are to be attributed to the kings of the autochthonoi of the time of the first and second dynasties; or whether they belong to a much later period, as Brugsch Bey, Maspero and Petrie declare, cannot be decided off-hand; but there is no doubt whatever that they are exceedingly ancient, and that they form a sort of half-way stage between the antiquities of the sixth dynasty and those of the period somewhat anterior to the reign of Menes. At all events, they form a factor which must be reckoned with, and they are not to be lightly pooh-poohed without careful study; we agree with M. de Morgan that they are of royal origin, and that they indicate a transition period when both polished stone and metals were used as materials for weapons.

Following these considerations, M. de Morgan shows by a figure how the skeleton, vases, &c., were arranged in the tombs of Amrah, and some hundreds of drawings illustrate the flints and other objects found therein. The painted vases are, naturally, the antiquities to which the attention of most readers will be drawn, and it seems tolerably certain that few archæologists in the present state of the case will agree in their deduction as to date and period. With the advent of the historical Egyptian, neolithic man disappeared in Egypt, and then came into being the monuments which have long excited the wonder and admiration of the whole civilised world.

But where did this Egyptian come from? M. de Morgan agrees with many in thinking that he came from Asia, and he looks upon Chaldea or Southern Babylonia as his probable home; but many will be surprised to learn that the *fellah*, or peasant countryman, whom many experts have regarded as the lineal descendant of the Egyptian who built the pyramids and temples, is the product of the mingling of the autochthonoi with Nubians and Egyptians. In an "Appendix" Dr. Fouquet, the famous craniologist, gives the results of his examination of nineteen boxes of bones from Amrah, and, though asking his readers to suspend their judgment for the moment, he seems to be on the whole inclined to believe generally in the great antiquity assigned to the tombs and their owners by MM. de Morgan and Amélineau. M. de Morgan's book bristles with interesting points, but many are unfortunately debateable, and there can be no doubt that some of his views will be rejected by his fellow-workers. The value of his book consists not only in the newness of the facts which he produces, but also in the carefulness of his arrangements of them and the deductions therefrom; and something is to be said for the honesty which he displays in discussing subjects with which he is well acquainted, and in leaving those of which he has no special knowledge to the investigations of experts.

OUR BOOK SHELF.

Magnetic Fields of Force. By Prof. H. Ebert. Translated by Dr. C. V. Burton. Part i. Pp. xviii + 297. (London: Longmans, 1897.)

THE author's preface points out the advantage of investigating the different phenomena of magnetism from the conceptions of Faraday, which were further developed by Maxwell and Helmholtz. Special prominence is given to the principle of the lines of force, the field as being the seat of the energy, and the symmetry of the field.

Part i. is intended as an introduction to the subject, and is quite elementary. The book is divided into two sections, of which the first treats of the phenomena of magnetism, and the second of the phenomena of the galvanic current and electro-magnetism.

The first section deals with the properties of artificial magnets, and describes several easy experiments which illustrate clearly the various principles. It also contains much general information on the magnetic effects which are met with in nature. In contrast to the rest of the book, there are a few places where the explanations are very confusing. Thus, on page 131, the following definition is given of magnetic induction:—"The magnetic condition is determined by the number of lines of force per unit of cross sectional area, the important magnitude thus measured being called the magnetic induction. In order to arrive at the equation $B = 4\pi I + H$ the usual method of cutting a gap in a uniformly

magnetised toroid is adopted, and then the following statement is made. "Then in accordance with § 99 there will be $4\pi I$ lines of force passing across each square centimetre of the gap, and these continue their course to the same number through the substance of the toroid." The latter part of this statement is wrong if we allow that the force at every point of the field can be calculated from the law of inverse square, for the surface distribution of magnetism on the opposite faces of the gap is + and − I ; so that if the gap is narrow the force in the gap is $4\pi I$, but is zero at every other part of the field, including the substance of the toroid itself. Apart from this, the book itself contains a statement which directly contradicts the idea of there being any force inside a uniformly magnetised toroid, for on page 120 the following sentence occurs. "Since such a toroid neither emits nor absorbs lines of force, it is without magnetic influence. In its interior also it may be shown that its magnetic force vanishes."

The second section contains a full account of the elementary properties of the electro-magnetic field of force. The diagrams showing the directions of the lines of force in the various cases are especially instructive, and are arranged in a manner that would assist the student to form a mental picture of the position of the lines of force for simple conductors.

Questions involving mathematics are avoided throughout the whole book, so that it would be ill-suited for a student who could arrive at all the results by the application of simple mathematics. There is, unfortunately, a large number of students who learn physics without having a mathematical training, and they will no doubt find in Part i. much useful information, and experimental proofs of the various properties of magnetic forces due to magnets or electric currents.

A list of errata would have been useful, as there are a few misprints, as on pages 81 and 86, in the dimensions of the units.

Part i. only contains the elementary theories ; but in Part ii. the author intends to treat of the more advanced branches of the subject which come under the head of induction and electrical oscillations. J. S. T.

A Study of the Sky. By Herbert A. Howe. Pp. xii + 335. (London : Macmillan and Co., Ltd., 1897.)

IN these pages the author presents his readers with a popular and general account of the more prominent features of the heavens, and describes how astronomers have been able to gather such information. After a short historical sketch of the founders of astronomy up to the end of the eighteenth century, a series of chapters is devoted to the various constellations, showing how each particular one may be recognised, and at what time of year it is best visible: the diagrams accompanying these will be found very distinct, and undoubtedly useful. The author then devotes a chapter to the character of the astronomer, acting on the idea that the personality of the observer is a powerful factor in his scientific utterances. The illustrations accompanying this chapter are restricted to American astronomers, and will be of special interest to those who know the works, but have not made the acquaintance, of celestial investigators, across the Atlantic. Reference is next made to the astronomer's implements and observatories : in this the great refractors of America, and a description of the preparation of the lenses, are dealt with, followed by a very sparse account of spectrum analysis. A few pages are devoted to the measurement of time, and the general features of the solar surface are next generally described. Some excellent lunar reproductions are inserted in the text relating to the moon and eclipses, and the planets come in for a good share of description, reference being made to most of the recent work done in this branch of observational astronomy. The progress made in celestial photography is well illustrated in those sections dealing with comets, nebulæ and stars ; but the information is at times somewhat scanty—as, for instance, the dismissal of stellar spectra in about one hundred lines. As a whole, the book is well worth perusal, and its value is considerably enhanced by the wealth of excellent illustrations throughout. The general reader, as well as the student, will find in it much that is interesting.

The Clue to the Ages. Part I. *Creation by Principle.* By Ernest Judson Page. Pp. xii + 282. (London : Baptist Tract and Book Society.)

THERE are species, varieties, and sub-varieties of human societies and human character, just as there are of structural organisms. Says the author : "The recorded histories of the centuries are as geological strata in which are imbedded the records of the origin of species of character, by which to test, and, if necessary, correct Darwin's theory. Regarding differing ecclesiastical and national types as true species and varieties of character, the question arises—Does the Evolutionary Hypothesis sufficiently account for the Origin of Species? My answer is most emphatically that species of human character have not arisen, and do not arise, according to Darwin's theory." Having proved to his satisfaction that evolution is insufficient to explain social development, the author propounds an alternative theory which he submits to the kind consideration of an indulgent public.

Who's Who, 1897. Edited by Mr. Douglas Sladen. Pp. viii + 823. (London : Black, 1897.)

THIS is certainly a most useful book to have on a library table ; for it is a hand-book of not only those who inherit distinction, but also of those who are officially prominent, and others whose ability has brought them before the public. Information may also be obtained regarding the Royal Family, Army, Navy, the Government, Universities, Church, &c.—in fact, all societies and institutions with which we are brought into daily contact. There is also a complete list of the Fellows of the Royal Society, and a useful table of pseudonyms. We notice that the short biographies, which form the greater part of the book, include a large number of scientific men. The book is very neatly got up, is bound in a good flexible cover, and is excellently printed.

LETTERS TO THE EDITOR.

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

The Caucasus.

I AM very reluctant again to trespass on your columns, but "J. W. G.'s" note, in NATURE of April 8, leaves me no alternative. It contains, at least, one assertion which ought not to pass uncorrected in any scientific journal. I refer to the following sentence :—

"The fact that the Caucasian place-names are derived from different languages had not been overlooked ; but the rules laid down by the R.G.S. Committee, to which Mr. Freshfield refers, admit the principle in such cases of accepting the spelling of a standard national gazetteer or of official survey maps."

In reply to this statement, I have to point out that the rules adopted and promulgated by the Royal Geographical Society in 1891, and confirmed in 1894, say exactly the contrary. I quote the two rules applicable in the case of the Caucasus, which are those on which I have endeavoured to act.

"The true sound of the word, as locally pronounced, will be taken as the basis of the spelling."

"In the case of native names in countries under the dominion of other European Powers in whose maps, charts, &c., the spelling is given according to the system adopted by that Power, such orthography should, as a rule, be disregarded, and the names spelt according to the British system, in order that the

proper pronunciation may be approximately known. Exceptions should be in cases where the spelling has become by custom fixed, and occasionally it may be desirable to give both forms."

We write of Caucasus and Georgia, not Kavkaz and Grusia. But other legitimate exceptions in the Caucasian Provinces it might be hard to find. The fact that in the case of India the Society, for reasons of convenience, accepted the system, closely kindred to its own, already adopted and embodied in Hunter's Official Gazetteer, can be in no way to the point in the case of the dominions of another Power. I can discover no reasonable ground whatever for the confusion of mind into which my critic has fallen. DOUGLAS W. FRESHFIELD.

Alpine Club, April 9.

"A Gigantic Geological Fault."

IN the very interesting description, by Captain A. H. McMahon, of the features of the country on the southern borderlands of Afghanistan, which appears in the *Geographical Journal* for this month (April 1897, p. 393), he gives an account of a remarkable trench, or depression, running in a nearly N.N.E. and S.S.W. direction along the borders of Registan, which he was able to trace for 120 miles, but which may extend for a much greater distance through that wild region, and he clearly identifies it as the line of a large fault dividing a district composed of sedimentary rocks on the east, from one formed of igneous rocks on the west. On reading this account, the resemblance of this line of fracture to that of the Jordan-Arabah Valley at once suggested itself to my mind. The resemblance is nearly complete as regards the latter, from the head of the Gulf of Akabah as far as the northern end of the Dead Sea, at least; except in this respect, that in the case of the Jordan-Arabah fault the sedimentary rocks occur on the west side, and the igneous rocks on the east. But the author has surely been misinformed as regards the statement, that "the length of this fault (which he traced) exceeds that of any fault-line as yet discovered on this earth" (p. 403). As far as actual observation goes, that of the Jordan-Arabah Valley is much longer; for, measured only from the head of the Gulf of Akabah to the base of Hermon, it has a length of 270 miles or more; while there can be little doubt that it ranges still further north into the valley of Cœle-Syria. In the opposite direction, it may well be supposed that it follows the Gulf of Akabah for an unknown distance. It will thus be seen that the fault-line of the Jordan-Arabah Valley is very much longer than that of the border of Registan, described by Captain McMahon, as far as actual observation is concerned. But I am very far from asserting that either the one, or the other, exceeds in length that of any fault-line yet discovered. EDWARD HULL.

Effects of Electrical Discharge on Photographic Plates.

IN your issue of January 21, you published a note of mine on certain effects produced by charged conductors on sensitive plates. In the case of the radiograph of wire skeletons, I find that this is not an electrical effect, but is, in accordance with my alternative suggestion, undoubtedly due to the unequal loading of the film with silver particles, which set themselves in the pattern shown in the illustration when the gelatine is raised to a temperature near its melting point.

The images of coins have been referred to by Mr. Brown and Mr. Sanford in their interesting letters, published January 28 and March 25 respectively (pp. 294, 485).

I am also indebted to Prof. Smith, of Oxford, for a description and specimen of his beautiful "Inductoscript," in which very perfect images of coins and other objects are obtained by charging them inductively.

In cases of brush discharge, such as that of the coins figured in illustration of my note, much of the effect is undoubtedly due to the luminous and ultra-violet radiation; but this seems hardly to cover the whole ground. Both Prof. Smith and Mr. Sanford have got results which seem to point to some more direct electrical action, the latter having secured images of coins imbedded in gutta-percha and other insulators. To test this, I have placed a sensitive plate between two sheets of ebonite about $\frac{1}{16}$ of an inch thick, which were placed upon a brass face-plate, and a coin laid upon the upper ebonite plate. The positive pole of the coil was connected with the brass plate, and the negative with the coin, and current passed for about two minutes. On development, an image of the coin came out, showing the design and a radiating halo, but out of focus and somewhat blurred, as might have been expected, as the coin was separated from the plate by the thickness of the ebonite sheet. This seems to point to some action other than that of the luminous discharge, which was plainly visible on the upper surface of the ebonite round the coin.

It would be interesting to know the arrangement of condenser used by Mr. Sanford. JAMES I'ANSON.

Fairfield House, Darlington, April 13.

Curved Knives.

IT may interest your correspondent, Dr. Otis T. Mason, to know that the curved "drawing-knife" described by him has representatives in Western (British) India. The Kolis (fishing races) of the Bombay coast wore lately, and some still wear, knives made by local blacksmiths, of which the blade, 2 to 3 inches long, was shaped and edged like that of an English gardener's knife. There was no hilt, but a tang curved reversely to the blade, ending in a little curl. The whole figure was that of a manuscript capital S, with the lower curve heavily drawn and a fine finish at the top. Through the curl was passed a soft lanyard, and the whole worn round the neck, the knife hanging like a locket a little below the collar-bone. The way in which a man, holding the thin tang between the thumb and forefinger, or between two finger-knuckles, would cut anything, from a cable to a fish's head, was the more wonderful, as he would often prefer bringing his breast near the object to unsling his knife. These knives are now passing out of use, displaced by old English and German clasp-knife blades, still without the hilts. The form must be very ancient, as bronze knives or razors of much the same shape are figured in most books about the European Bronze Age, and in Du Chaillu's "Viking Age." I am inclined to suspect a flint origin for this form of tool. Flint flakes in Western India, from Sind to the Konkan, often show a curved inner edge with traces of use. And if any one tries to cut wood with a hiltless flake of the sort, he will find the inner edge the most efficient. The Indian farrier's "drawing-knife" is shaped like a sickle, squarely truncated to avoid the chance of injuring the horse's foot (just as the English farrier's knife is turned to one side for the same reason). Its hilt is a mere roll of coarse tape, but the grip of the hand is often that shown in Dr. Otis Mason's illustration.

The various *hafted* knives of India, with interior edges, belong to another class; but the handle shown in this plate seems to be just an improvement on the simple blades mentioned above, and a very creditable one too. W. F. SINCLAIR.

102 Cheyne Walk, Chelsea, April 9.

Electrical Vibrations of Mercury.

THE following observations were made with a globule of mercury, about 1½ cms. in diameter, placed in a photographic developing dish containing some ordinary tap water, the mercury being well covered with water. A 4-volt accumulator of 6 ampère-hours' capacity supplied the current. Two wires from the terminals served as anode and kathode: the kathode had a short piece of fine wire attached, and this was so adjusted that it only just touched the mercury.

(1) When the circuit was completed by dipping the anode into the water, the mercury, after a few seconds, became visibly flattened.

(2) If the circuit was broken, or the mercury became detached from the kathode, it at once regained its original shape.

(3) When the circuit was completed, and the mercury becoming flattened broke away, it was thrown into a regular and continuous vibration.

(4) The frequency and amplitude of the vibrations depended on the distance of the anode from the kathode, the frequency and amplitude increasing as the anode was brought nearer.

(5) If the current was reversed, thus making the kathode an anode, the vibrations were not produced.

(6) The vibrating mercury generally retained its circular shape, but sometimes it became almost square, or took the shape of a cross, which seemed to be produced by a rapid motion alternating at right angles.

(7) The water was thrown into circular waves, which corresponded to the vibrations of the mercury.

(8) If the circuit was broken, and an interval of time was allowed to elapse, and then again completed, a decided lag was observed between the "making" of the circuit and the flattening of the mercury. If no appreciable lapse of time took place between "make" and "break," the response was instantaneous.

42 Henslowe Road, East Dulwich. ERNEST BRAUN.

REFLECTOR AND PORTRAIT LENS IN CELESTIAL PHOTOGRAPHY.

IT has been much discussed recently, whether the reflector is preferable to a portrait lens in celestial photography. It may be known to the readers of NATURE that I am interested in this subject, since I believe I was the first to use the portrait lens for the purpose of seeking for large and wide-spread nebulæ.

No doubt the reflector has many advantages over the portrait lens—advantages which Dr. Roberts has often dwelt upon. In consequence of the small absorption of light, the lack of the different surfaces, and the absolute correction for chemical rays, the focal pictures with the reflector must theoretically be much better than with the doublet. The two last-named points are especially effective; for the star discs are made much smaller and increase much slower than with the portrait lens. I have shown that the lenses themselves are the reason for the increase of star discs in the film (*Photogr. Corresp.*, 1892), therefore I fully understand the advantages of the reflector.

With my 6-inch Voigtländer portrait lens, the discs of the smallest stars in the Milky Way have a diameter of 6 to 8 seconds of arc; I think with a good reflector such discs may have a much smaller diameter.

I do not know the diameter of the smallest star discs on plates taken with Dr. Roberts' 20-inch reflector; we may believe, however, that in his best pictures the sharpness of the image is much greater than with my 6-inch portrait lens.

As to the light-gathering power—regarding the proportion of aperture to focal length the same in the two cases—there are two reasons why it is greater with the reflector than with the portrait lens. Besides the greater absorption of light in the glass of the lens, in the latter the discs of images are larger, and therefore not so intense. But the reflecting power of the mirror is always soon diminished through the influence of oxidation, and therefore the reflector does not surpass the portrait lens practically as much as would be expected.

The advantages which exist for small reflectors over small portrait lenses increase accordingly to the diameters; the absorption in the portrait lens becomes rapidly greater and the sharpness less, and thus the *large* mirror will surpass *encore plus* the *large* doublet.

In spite of this, the portrait lens is much superior to the reflector for the work of seeking and charting feeble and extended nebulosities.

The lens takes a much larger field of the sky than the mirror. This is known to be the reason why the portrait lens should be used exclusively for the photography of minor planets, of comets, for making charts, and especially for general views of the Milky Way. This last point has been taken up (*Monthly Notices*, R.A.S., vol. lvii. No. 1) by Prof. Barnard against Dr. Roberts. Barnard shows that the portrait lens is far better adapted to give the general structure of the Milky Way than the mirror, in which the field is so small.

FIG. 1.—The nebulæ of Orion.

I was sure of this from the beginning, and afterwards all my plates showed that there is still another reason for preferring the portrait lens to the reflector; a reason which, depending likewise upon the large field, would alone have decided me to use even a big portrait lens instead of a reflector.

When photographing regions of sky covered with feeble and extended nebulosities, only feeble and extended darker parts are obtained upon the plate. These can only be seen if there are besides these parts other

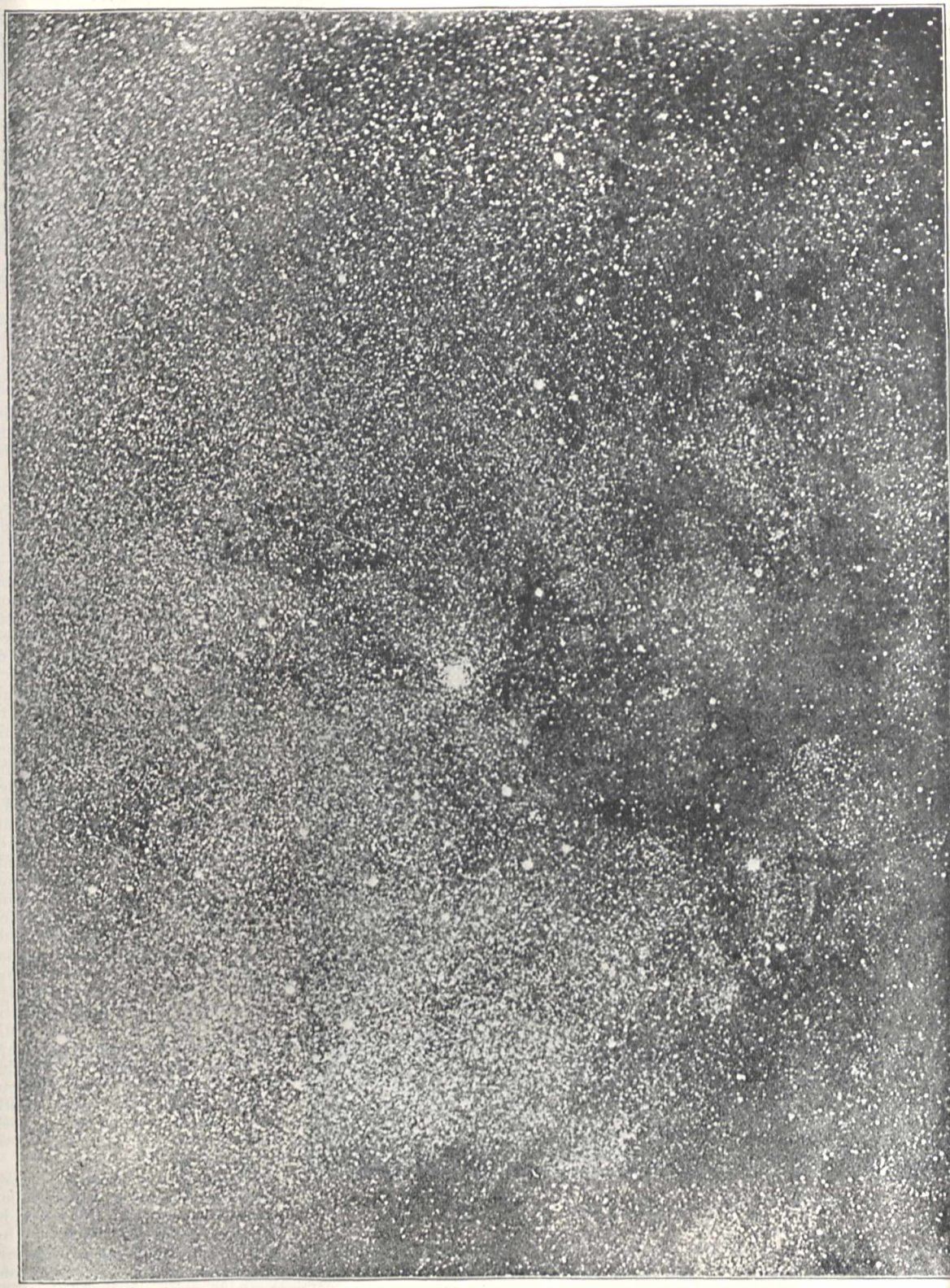

Fig. 2.—Messier 11, in Scutum.

parts on the plate free from nebulous matter, and therefore appearing lighter.

The nebulosities only are clearly visible, if the borders between nebula and dark sky are followed across a large surface. It follows that this can be done only with large fields, and will never be possible with the reflector; therefore, in this case, the portrait lens is preferable to the reflector.

With a mirror I should not have found the large nebulæ in Cygnus, the large nebulosities of Taurus, of Cassiopeia, of Aquila, of Orion, and of many other regions. I only could find them on the ample field of the portrait lens.

The very small doublets—for instance the small lantern lenses, which have been used by myself, and afterwards by Prof. Barnard—are in certain cases inferior to larger lenses. The smaller lenses crowd the nebulous masses, hide the rifts, and consequently make the trains of nebulosity less clear than a slightly larger portrait lens would do.

FIG. 3.—Nebula of Andromeda.

If the plates are not exposed long enough, various devices have to be employed to discover the faint nebulosities on the plate. One simple way of doing this, is to press the plate in a printing-frame upon smooth white paper, and to examine it in the sunlight. In this way I found the nebulosities in Taurus, and the America nebula for the first time, on plates which were exposed for only a very short time. A second way is to use a monochromatic light to examine the plates; then slight differences in brightness can be easily seen.

Orion was a good subject for the finding of such diffused nebulæ. Besides the well-known nebulæ around ζ and θ Orionis, and besides the many small nebulæ, there are feeble and widespread nebulosities, some of which have been discovered by Profs. W. Pickering, Barnard, and the writer, with the aid of portrait lenses. These would still be unknown but for the portrait lens, because a plate taken with a reflector would cover only a minute part of the nebulosities, and there would be no parts free from nebulosity in this small field, to be compared with the nebulous parts.

I may here remark that I discovered easily the interesting connection between the nebulæ of θ Orion and ζ Orion (Fig. 1). This seems a most important example of the connection of two large and far distant nebulæ; and because the connection is effected over a wide field, it promises to bring new light on the knowledge of the situation of the nebulæ in the universe. Fig. 1 is a slightly enlarged print of a plate of this part of the sky, taken with a 6-inch Voigtländer lens of 30-inch focus.

The broad long-spread train of nebulosity, which appears in this marvellous bay running from ζ Orionis nearly in a straight line against S.S.E., becomes broader and broader growing southwards, and at the same time fainter and fainter. It makes a wide curve, and runs much more south than the brighter parts of the θ Orion nebula. Now, in every direction we see streams of nebulosity running from north, east, and south from the ζ nebula to the θ nebula. Especially from the north come down many lacerated and finely-drawn ribbons of nebulosity connecting the ζ Orion nebula with the θ nebula. The most marvellous connection is by the above-named broad stream, which runs much more south than the θ nebula, and passes over to it from south-east in a large arch.

Besides these nebulæ lie very extended relatively bright nebulosities to the west of the θ Orion nebula, connected with it by many streams; and also mighty nebulosities are situated to the east of the circular train, which comes down from ζ Orion nebula. These are likewise connected together at almost every possible place.

The picture is a beautiful and marvellous one, yet we see only the roughest connections and streams.

It needs long-sustained efforts and much work before we shall be able to know this region, so that we can

reproduce the pictures of the portrait lens as a chart of it.

This is an example of what portrait lenses have given us in quite a new direction. If we find out, as in this case, that two such nebulæ are connected, in spite of their being far distant on the sky, this gives us the impulse for quite a new comprehension of the universe; and all the theories of this kind have to be given up in favour of a new one.

I gave other examples of such large nebulæ several years ago in *Knowledge*, and perhaps they are still in the memory of some of the readers.

An example of the connection of a cluster with the Milky Way, and the general structure of a part of the same, is given in Fig. 2. The cluster is Messier 11, in Scutum, exposure 3¼ hours, enlarged part of the original plate. It will be seen at first sight, that those mighty masses of faint stars and star dust show the most interesting stratifications and connections. The cluster looks like the centre of a moved system. We see here at a glance, that it would have been impossible to get such views of star streams with the small field of a reflector.

I use this opportunity to state that I made last year several improvements in finding and reproducing nebulous masses, using a method of strengthening the image by reprinting it. It is possible—by printing the original plate successively on other plates—to reinforce the feeble contrasts between the nebulosities and the background of sky, so that one can see at a glance such nebulæ on the reproduction, of which the traces are only to be suspected on the original plate. It looks very curious to see side by side the original and the reproduced negative. My friend Prof. Naegamvala, to whom I communicated the method last year, has published something about this matter in the *Journal* of the British Astronomical Association (vol. vii. No. 3). He and Mr. Lunt had great success with the nebula M.8, using this method. The reprinting ought to be done upon slow plates in over-exposing, and, in developing, very slow developers should be used.

I give here (Fig. 3) the twice reprinted reproduction of a plate of the Andromeda nebula, as an example of the results obtained. The original (of four hours' exposure with a 5-inch aplanatic lens, made in 1891) was very faint, so that it would have been impossible to make a good print of it. It is not possible to go further on in this way, because the grain becomes troublesome. But using transferrotype-collodion-paper or dry-collodion-plates, the process can be repeated several times. The process used for reproduction is unable to make a satisfactory comparison between the first and second reproduction of the nebula, so only one illustration is given.

For another example I give the outer-nebulæ of the great Orion nebula (θ), which are reproduced here the first time (Fig. 4). We see many interesting streams of nebulosity all around, which never thus can be given at once by a reflector. The print is from an enlargement of a negative of 4½ hours' exposure, with a 6-inch portrait lens.

FIG. 4.—The surrounding nebulæ of the Great Orion nebula.

In spite of using this small 6-inch lens, nearly all detail visible in brighter parts photographed on Dr. Roberts' photographs is quite well visible here. It must be possible to get, within a certain limit, detailed pictures of nebulæ by portrait lenses. No doubt, a good and large reflector will give much more detail; but the difference between reflector and portrait lens is not so great as is often supposed. The sharpness of the image of the portrait

lens is better than is assumed by various astronomers; I found it about ten times greater than it is given, for instance, by Prof. Wilsing in his recently-published paper in *Astr. Nachr.*, No. 3400.

The weak point in photographing stars and nebulæ is not in the instrument; it is in the plate. We know that the Pleiades are surrounded by wide-spread nebulosities, shown by Prof. Barnard and myself. Now for four years I have been working at a chart of this nebulous region, but it has been impossible to get to an end till now. In this case the plates did not allow it; either they were not sensitive enough, so that I got nothing, or if they were, they had streams or spots looking exactly like nebulæ. I made several dozens of exposures of the Pleiades, some of twelve hours' exposure, containing beautiful nebulosities, but no plate has been sufficient. All of them show, besides the true nebulosities, more or less artificial nebulæ, making it impossible to find out exactly the structure of the true nebulosities. Thus we need often a large number of plates to get the true nebulosities ready for charting. This is now the chief question for celestial photography.

Photographs of small nebulæ taken with portrait lenses often show much detail; for instance, the nebulæ near γ Cassiopeiæ, called by Barnard the "fan-shaped" nebulæ. These nebulæ were photographed the first time

FIG. 5.—Fan-shaped nebula in Cassiopeia.

by myself, December 30, 1893, and described in the *Astr. Nachr.*, No. 3214. Prof. Barnard obtained them several weeks later, and he showed that these nebulæ represent a good example for the advantages of portrait lenses over reflectors in discovering nebulæ, because Dr. Roberts did not find them on his plates. Now these nebulæ seem to me of the greatest importance for the comprehension of the genesis of stars; and especially for the theories of Mr. Lockyer, these will be found very interesting objects. Several years ago I gave in *Astr. Nachr.*, No. 3217, an illustration of one of those nebulæ [$0^h\ 52^m + 60°\ 5'$ (1860)], and the sketch is reprinted here (Fig. 5). I have shown that the nebula looks like a tornado, in the concentrated part of which the stars are formed, and that thus the chain formed by the stars may be understood.

There we have the point where our small portrait lenses fail, and where the reflector finds its place. The lens has found the nebula, and given the first idea of its constitution; but the large mirror will bring out here the details necessary for our knowledge. It is the same as with the small spiral nebulæ, of which Dr. Roberts' plates have shown us the true form.

To me it is quite incomprehensible how it was possible to begin a dispute about the use of the portrait lens in celestial photography. The portrait lens has given us so much, that it is now too late to discuss its efficiency.

The doublet finds the nebulæ—I will not speak of comets, planets, &c.—and throws light upon the ways in which the large nebulous streams spread over enormous parts of the sky. The charting and following of these streams forms now one of the most important problems of astronomy. Therefore this instrument is absolutely necessary for us. It brings us also to a certain high degree of knowledge of the finer detail, though not nearly so high as the mirror. But with portrait lenses not too large we can expose very long, and over several nights, so that we can get traces of nebulæ and stars, which we can never find with the large reflector, because such very long exposures are not quite possible with a reflector, for technical reasons.

For these points the reflector has to recede. It is true the portrait lens will often photograph certain objects as nebulous, which will be found later formed by smallest stars. But the pictures of the reflector show, likewise, at many places nebulosities which, I am sure, are composed of relatively bright stars. An example of this effect has been given by Prof. Barnard, for the case of Dr. Roberts' plates (*Monthly Notices*, lvii. No. 1). The difference between the two instruments in this direction is not a very great one, and because the portrait lens is absolutely necessary to us in so many problems shown here, we have to use it as often as we can for these purposes, and to leave the reflector to work out the finest details of special points. MAX WOLF.

Heidelberg, Astrophys. Observatory, March 1897.

THE TWENTY-FIFTH ANNIVERSARY OF THE FOUNDATION OF THE NAPLES ZOOLOGICAL STATION.

ON April 14 was celebrated, with great ceremony and *éclat*, the twenty-fifth anniversary of the foundation of the Zoological Station at Naples by Dr. Anton Dohrn. To the general outside public, the eventful day itself was heralded by the appearance in the Bay, just opposite the Zoological Station, of the entire fleet of the Station, drawn up in line, and gaily decked with bunting. This consisted of the two steamers, the *Johannes Müller* and the *Frank Balfour*, and five small fishing-boats. In addition, the Italian Government sent a guard of honour in the shape of a second-class cruiser, the *Fieramosca*, which remained in attendance all day.

In the Station itself all was excitement and expectancy. In the morning, a deputation consisting of one German one Italian, and one Englishman, who were supposed to represent the naturalists of each nationality at present working at the Station, waited on Dr. Dohrn, and offered appropriate congratulations, each speaking in the language of his nation. Dr. Dohrn, on replying, successfully evaded linguistic difficulties by beginning his speech in German, continuing it in Italian, and finishing it in English. The same deputation also waited upon and congratulated Dr. Hugo Eisig, Dr. Dohrn's senior assistant, who has been associated with him since the foundation of the Station.

The grand ceremony itself began at two o'clock. The visitors, on arrival, first assembled in the library, and then passed on to the meeting-room, which was situated on the ground floor of the smaller building. This was the largest room available, and it held about one hundred and twenty people. Needless to say, every available seat was occupied. At one end of the room was a small platform and desk, from which the various speakers in turn delivered their discourses. Just above the desk was hung a specially-painted picture, representing the Bay of Naples, and in the foreground a symbolical figure resting against a block of stone, on which was inscribed, "Al Prof. Dohrn ed ai suoi cooperatori," and the fact of the twenty-fifth anniversary. On a shelf running round the end of the room were arranged the various addresses

and telegrams received by Dr. Dohrn. Amongst others, I noticed addresses coming from Munich, Frankfort, St. Petersburg, Moscow, Danzig, Turin, the Société Helvetiques, and the Society of Naturalists in Naples. England was represented by a beautifully-illuminated address from the Royal Society, and also by addresses from the Marine Biological Association, Plymouth, the Cambridge Philosophical Society, and the Board of Biology and Geology at Cambridge.

The speeches themselves, though very interesting, were somewhat lengthy withal. As the audience consisted mostly of Germans and Italians, the speeches were arranged so as to be spoken more or less alternately in either language. The proceedings were opened by Prof. Todaro, of Rome, who referred at some length to Spallanzani, who had engaged in marine biological work on these very shores. He was followed by Prof. His, who gave some account of the history of the Station since its foundation. He also read an address signed by nearly two thousand naturalists, from almost every country in Europe. The next to speak was Prof. Waldeyer, of Berlin, who brought an address from the Berlin Academy, and who mentioned the fact that he was the first student to work at the Station, at a time when the resources and equipment were very different from those of the present day. He also dilated on the manifold uses, in many departments of science, to which a Marine Zoological Station can be put. Next came the Syndic of Naples, who presented Dr. Dohrn with the freedom of the city; and then Admiral Palumbo, the Under-Secretary of State, made a short speech. The Minister of Public Instruction, who followed, presented Dr. Dohrn with an order, the "Grand ufficiale della corona d'Italia," and brought the congratulations of King Humbert.

Thus far the proceedings had been very stiff and formal, and even solemn in their nature, so the German Ambassador from Rome endeavoured to instil a little humour into his speech. In this there was frequent reference to the Kaiser, who sent his best wishes, and mentioned his interest in science. The Ambassador remarked, also, that Italy and Germany, closely connected by political ties, had an additional bond of friendship in the Stazione Zoologica.

Then came the speech of the day, from Dr. Dohrn himself. This was, of course, spoken in German, but copies of it, printed in Italian, were circulated amongst the Italian members of the audience. This admirable and highly-interesting speech was of somewhat more than half-an-hour's duration. Dr. Dohrn said that he had himself intended to make this day merely an occasion for recalling the memories of persons connected with the Station, and also the scope of the Institute; but his friends had desired to celebrate it with more ceremony, and for this he begged them to accept his most profound gratitude. He referred in very feeling terms to his father, but for whose liberality it would have been impossible to bring his enterprise to a successful issue. Biologists, he remarked, continually speak of protoplasm, the basis of all things living, the substratum of all animal and vegetable life. But there is in man, also, a psychical protoplasm. It was this psychical protoplasm in which was originated the first idea of the Stazione Zoologica, and this he owed to his father. Next to his native forests in Pomerania, the strongest passion of his father was for Italy, with its ancient culture, with the splendour of its renaissance, and its ancient music.

Dr. Dohrn then offered his grateful thanks to the people of Naples for allowing him to found his Station there, his especial thanks being due to the late Profs. Paolo Panceri and Salvatore Trinchese, of the Naples University. It was owing to Panceri's influence with the municipal authorities and the Government that a site for the Station was obtained in the *villa nazionale*. His thanks were no less due to the Italian Government for their moral and material assistance. Fortunately, also, the Station was able to rely upon the tower of strength expressed in the words "Kaiser und Reich." Thus the Emperor William I. presented a considerable gift to the Station; whilst in the early days of its foundation, the time of difficulties, not a year passed but that the unfortunate Emperor Frederick wished to be informed as to its progress. Similarly, also, had the Kaiser William II. shown his sympathies. Also, King Victor Emanuel and King Humbert have extended their protection to the station.

Great, also, are the thanks due to the Imperial Government and the German Parliament. In accordance with an ancient custom, which comes from England, the mother of Parliamentary *régime*, proposals regarding demands on the exchequer may be initiated by the Government. On the strength of a petition signed by Helmholtz, Virchow and Dubois-Reymond, the German Parliament granted a large annual subsidy, which they gradually increased to 2000*l.* a year.

No less was his gratitude due to his English friends, for their help in the grave crisis which attended the Station at its origin. It will be to the lasting glory of the Station that it was largely subscribed to by Darwin. How great, also, were his (Dr. Dohrn's) thanks to his father for his liberality, and likewise to his father-in-law, who allowed him to use his wife's *dot*, which had been destined for furnishing their house, to pay debts on the Station. But the Station was always provided with everything necessary for research, and this appealed much more to his wife's heart than the furnishing of her own house.

It was impossible to thank every one to whom thanks were due, but to three corporations—the Academy of Sciences of Berlin, the British Association for the Advancement of Science, and the Smithsonian Institution of Washington—the prosperity of the Station was largely due, for their subsidising "tables" at the Station.

Finally, in the name of the Stazione Zoologica, were especial personal thanks due to his collaborators, particularly to Dr. Hugo Eisig, the first collaborator with him at the Station, and one who threw in his lot with him when the actual foundation of the Station was yet but a chance. And lastly, to all those who by their presence had set a sanction on these festivities, Dr. Dohrn wished to offer his most profound thanks for the great honour they had done him.

This brought the meeting to a close. In the evening the guests and members of the staff of the Zoological Station were entertained by Dr. Dohrn at dinner, at which in all some sixty people sat down. The speeches were again many in number, but were shorter and more humorous in nature.

H. M. VERNON.

EDWARD DRINKER COPE.

THE death of Prof. Cope, of Philadelphia, which took place on April 12, has removed the man who, since Louis Agassiz, has been the greatest influence in American biology.

Born in Philadelphia on July 28, 1840, he passed from the University of Pennsylvania to Heidelberg, where he took the degree of Ph.D. in 1864. In that year he was appointed Professor of Natural Science in Haverford College in his native city, but resigned the post three years later, partly by reason of ill-health. During the years 1871 to 1873 he joined many geological exploring expeditions to Kansas, Wyoming and Colorado, and from 1873 to 1878 he was engaged in field-work with the Wheeler Survey of the United States Government. The Hayden Survey also had his services as vertebrate palæontologist. The results of his work in connection with these Surveys were published by the Government in many fine volumes—*e.g.* "The Vertebrata of the

Cretaceous Formations of the West," 1875; "The Vertebrata of the Tertiary Formations of the West," 1883; and "The Extinct Vertebrata obtained in New Mexico," 1877. It was in recognition of this work that, in 1879, he was awarded the Bigsby Medal of the Geological Society of London. The loss of a portion of his private fortune led Cope, in 1889, to accept the professorship of Geology and Mineralogy at Pennsylvania University. This post he held till 1895, when he was transferred to the professorship of Zoology and Comparative Anatomy. In that year also he was elected President of the American Association for the Advancement of Science. From 1878, with A. S. Packard, and from 1887, with J. S. Kingsley, he was a chief editor of the *American Naturalist*, a journal that has had its periods of financial difficulty and irregular publication, but which, under Cope's direction, has always been interesting, vigorous and independent, playing a much-needed part in a country where so much scientific work is under the control of political placemen.

Cope's zoological work has lain among the Vertebrata, especially their lower Classes. Beginning in 1859, with a paper on "The Primary Divisions of the Salamandridæ," published by the Philadelphia Academy, the stream of contributions poured out by him has reached a total of over four hundred. By his study of recent and fossil forms in conjunction, he has thrown much light on the history of the Reptilia and Amphibia, leading to many profound changes in classification. Two of his most important essays in this direction were those published so long ago as 1865-66: "On the Primary Groups of the Batrachia Anura" and "On the Arciferous Anura." His work on the extinct ancestors of the Amphibia, the direct progenitors also of the Mammalia, was some of the most successful and suggestive that he accomplished. His important paper on "The Systematic Relations of the Fishes" was published by the American Association in 1871; much of the material on which this was based was the famous collection of skeletons made by Prof. Josef Hyrtl, of Vienna, and acquired by Cope for his own museum. Cope was one of the first to deduce the Ungulata from ancestors with quadri-tubercular molars, and with five-toed, plantigrade feet. This was in 1874; and it was he too, who, some ten years later, was the first to maintain that this type of molar in the upper jaw was derived from a tri-tubercular type, while in the lower jaw it was derived from a quinque-tubercular type, or a tri-tubercular type with a heel supporting two additional tubercles. The additions to, and the discussions that have taken place around, this theory are well known. Cope's discovery of Phenacodus, the celebrated fossil ancestor of the Ungulata, proved in his masterly hands "an important event in the history of our knowledge of the evolution of the Mammalia." The sub-order to which it belongs, the Condylarthra of the Lower Eocene, "stands to the placental Mammalia in the same relation as the Theromorphous order does to the Reptilian orders. It generalises the characteristics of them all, and is apparently the parent stock of all excepting, perhaps, the Cetacea."

It was not, however, Cope's technical zoological work in the domain of Vertebrata, excellent though it was, that made him such an influence in American biology; it was his constant application of his results to wider philosophical problems, especially of evolution, both physical and metaphysical. He, more than any one (though the name of Alpheus Hyatt should not be passed by), has been the founder of that peculiarly American school of thought which has no doubt met with much opposition on both sides of the Atlantic, but which nevertheless has promoted discussion and investigation along many lines. Cope's main contributions to the philosophy of biology were first brought together in that volume of suggestive essays entitled "The Origin of the Fittest" (Macmillan: London and New York, 1887), while his conclusions were summarised, and his present position stated in the "Primary Factors of Organic Evolution" (Open Court Co., Chicago, 1896). That position, as was abundantly evident from Dr. Russel Wallace's review of the last-named book in NATURE (vol. liii. p. 553), did not win the approval of our English ultra-Darwinians, nor, indeed, were the views of the American school easily approved by Darwin himself. But abuse and ridicule cannot hinder the admission that the conclusions (or speculations, if you will) of Cope and others did lead to the discovery and scientific coordination of many undoubted facts, having much bearing on questions of descent. Moreover, many of Cope's audacious hypotheses are now the commonplaces of evolutionists. It is nearly thirty years since his establishment of the doctrine that the development of new characters has been accomplished by an acceleration or retardation in the growth of the parts changed; an idea expressed independently by later workers as the earlier or later inheritance of acquired characters (Cænogenesis, Haeckel). Thus, the adult of an ancestral individual is the exact parallel of a younger stage in its descendant—a limitation of, and yet an advance on, Von Baer's statement of inexact parallelism. Cope, too, was the first to point out that genera—as genera then were understood—were "homologous groups" descended from other "homologous groups"; as we now say, genera are polyphyletic. Retaining the old boundaries of a genus, he regarded it as a grade of evolution. Nowadays there are some who maintain such orders, families and genera, though fully appreciating their polyphyletic origin; while others believe that a group of organisms once proved polyphyletic can no longer be regarded as a unit of classification. These latter workers seek to classify organisms according to their true lines of descent, and they therefore elevate as diagnostic other characters than those so regarded by their predecessors, characters as a rule less obtrusive and of less physiological importance. Whether the older view of Cope, powerfully expressed by Huxley in our own country, or this newer view ultimately prevail, the credit of first putting the problem is due to Cope.

More Lamarckian than Lamarck, Cope rendered the "besoin" of the French philosopher by "effort," regarding animals as in some sort working out their own salvation. The definiteness of variation, in which he believed, and the definiteness of evolution, which all accept, he imagined to be due to the action of a "growth-force" ("bathmism"), thus approaching the views of Naegeli. This force acts, according to Cope, through a kind of unconscious memory, with which faculty the reproductive cells are endued. Thus, as the result of his apparently mechanical conception of the details of evolution, he came at length, along a road that was all his own, to the conclusion of many a philosopher: "that consciousness as well as life preceded organism, and has been the *primum mobile* in the creation of organic structure . . . that the true definition of life is, *energy directed by sensibility, or by a mechanism which has originated under the direction of sensibility.*"

F. A. B.

NOTES

IT has been felt by many entomologists, for some time past, that several of our more interesting and local British insects are in danger of extermination from over-collecting. Accordingly, the Council of the Entomological Society of London appointed a representative Committee to consider the matter. The Committee found themselves unable to recommend any means of affording protection by enactment, as has been done for birds, or even by approaching landowners to induce them to check collecting on property where such species occur. In many cases such insects are found on poor and uncultivated lands belonging to small proprietors, to whom the presence of an army of collectors is a source of profit. It was suggested, however,

that the opinion of entomologists might be stimulated, and an impulse given to their endeavours, by the formation of an association for the protection of such insects. Accordingly, such an association has been formed under the auspices of the Entomological Society, and the following memorandum has been numerously signed. "We the undersigned, being desirous of protecting from extermination those rare and local species of insects which are not injurious to agriculture nor to manufactures, do hereby agree, by our own example and by the exercise of our influence over others, to discourage the excessive collection and destruction of those species of insects which, from their peculiar habits, are in danger of extermination in the United Kingdom. We further agree to accept for the purposes of this Association such list of species in need of protection as shall be drawn up, and, if necessary, from time to time amended by the Committee of the Entomological Society of London appointed to that end." The Association is open to any one interested in the preservation of our indigenous insect-fauna. The Hon. Secretary is Mr. C. G. Barrett, 39 Linden Grove, Nunhead.

MISS CATHERINE WOLFE BRUCE, of New York City, to whom astronomy all over the world is indebted for liberal and intelligent benefactions, proposes to found a gold medal, to be awarded not oftener than once a year by the Astronomical Society of the Pacific, for distinguished services to astronomy. The medal is to be international in character, and may be given to citizens of any country, and to persons of either sex. The design for the obverse of the medal is the seal of the Astronomical Society of the Pacific. The medal is to be 60 mm. in diameter. The reverse is to bear the inscription: "This medal, founded A.D. MDCCCXCVII, by Catherine Wolfe Bruce, is presented to —— (name) for distinguished services to Astronomy —— (date)." The Astronomical Society regularly awards a bronze medal, also, founded in 1890 by the late Joseph A. Donohoe, for the discovery of each unexpected comet.

THE fourth annual exhibition of the New York Academy of Sciences was held in the Museum of Natural History, on April 5 and 6. Exhibits were made in fourteen departments; but as the catalogue fills 54 pages, limits of space forbid us giving even an enumeration of the more important. The astronomical exhibit included reproduction of plates of clusters and nebulæ, taken at Arequipa, Peru, with the Bruce photographic telescope; prints from photographs of stars, at the Yerkes Observatory of the University of Chicago; and copies of photographs of the moon, at the Lick Observatory, the latter including negatives from enlarged photographs used in making the Lick Atlas of the Moon, which is to contain a map 36 × 38 inches in diameter when completed. Conspicuous in the chemistry exhibit was an array of electric furnaces, including the one used by Moissan in his address before the Academy last October. In the electrical exhibit were included some fine pieces of apparatus, notably Pupin's circuit-breaker and induction-coil, which gives a 30-inch spark. It would require a separate article to do justice to the section of physics, owing to the many new and valuable forms of apparatus shown. One of the exhibits consisted of a row of seven Bunsen burners, with aluminium tubes, to show (*a*) the seven spectrum colours with the evaporated salts; (*b*) to produce monochromatic light in considerable quantities; (*c*) to produce a pure Bunsen flame of great intensity as a light for photography, and illustrating its high actinic intensity; (*d*) to heat long tubes, as a substitute for a combustion furnace. Among the exhibits in the zoological section were a map and a relief model of the Zoological Park of New York City, which has finally been definitely located in Broux Park, in the trans-Harlem portion of the city, a locality well adapted for the purpose. A salient feature of the exhibit in this section was the large and diversified collection from the Pacific Coast, made by the Columbia University Expedition of 1896.

WE regret to see the announcements of the deaths of Dr. Eduard Freiherr v. Haerdtl, professor of theoretical astronomy in the University of Innsbruck; Dr. J. Breitenlohner, professor of meteorology and climatology in the Agricultural High School, Vienna; Dr. A. A. van Bemmelin, director of the Zoological Garden at Rotterdam; and Dr. J. F. James, known for his writings in palæontology, botany, and geology.

NOTWITHSTANDING rather boisterous weather, the usual Easter expeditions of the Liverpool Marine Biology Committee have been carried on with success, and the Port Erin Biological Station has never been so full of workers as it has been, and will be, during the whole of the present month. During the actual Easter vacation, the rather limited accommodation has been more than fully occupied. The Lancashire Sea-Fisheries steamer, *John Fell*, has been at Port Erin, and several dredging excursions have been made in it. Spawning fish were procured to the west of the Isle of Man, and the tanks in the Biological Station now contain developing lemon soles and witches, and a cross between the megrim and the cod.

THE success which has attended in Germany the introduction of the system of "pot experiments," as a means of elucidating problems of agricultural science, has at various times engaged the attention of the Chemical Committee of the Royal Agricultural Society. More especially has this been the case, since the bequest made to the Society by the late Mr. E. H. Hills—"for the investigation of the value and uses of the rarer forms of ash in the cultivation of crops for the use of stock and for human food"—called for the setting on foot of a definite plan of experimental inquiry. With a view of seeing how this inquiry could be best carried out, Dr. Voelcker visited the Agricultural Experimental Stations in Germany, and, acting upon his advice, the Chemical Committee have recommended that the inquiries directed under the Hills Bequest be carried out by the system of "pot experiments," in conjunction with "field experiments," as already conducted by the Society at the Woburn Farm. The sum of 1035*l.* required to establish the pot-culture station has been voted by the Society, and it has also been decided to make an annual grant of 200*l.* to the Chemical Committee to supplement the annual income of 200*l.* from the Hills Bequest, and so enable researches other than those covered by the bequest to be carried on at the same time. The report of the Chemical Committee will be found in the current number of the *Journal* of the Royal Agricultural Society.

AT the last meeting (April 14) of the Russian Geographical Society, Baron Osten Sacken read a telegram which he had received from Sven Hedin, the well-known Swedish traveller in Central Asia, announcing that he had crossed Tibet (Northern Tibet) by following a route which lies somewhat to the south of General Pyerstoff's route; during that journey he discovered 23 new salt lakes, four of which are of considerable size. Notwithstanding the great difficulties of the journey, and the loss of 44 beasts of burden out of 50, all collections are safe. From Tibet, Sven Hedin went through Mongolia to Pekin, and towards the end of May he expected to be in St. Petersburg.

THE month of March is proverbially stormy, and this year it was exceptionally so, as not less than seventeen distinct depressions, or areas of atmospheric disturbance, were experienced over these islands, and in some cases the storms were of exceptional violence. The Pilot Chart of the North Atlantic Ocean, published by the Hydographic Office of Washington, states that the month was marked by some exceptionally severe weather over the North Atlantic, especially in the higher latitudes, where the gales followed each other so rapidly that the bad weather

was almost continuous, while on some days a full hurricane was recorded. A few of the captains of vessels reported that they had never before encountered such a long period of unusually severe weather. A glance at the chart shows that at least three of the storms crossed from the American to the British coasts. It is interesting to note that the barometric pressure in the vicinity of the Azores, from February 18 to March 14, was constantly above the normal, varying from 30·3 to 30·7 inches; consequently the weather during the same period for that region, and to the southward, was generally fine, the cyclones, or low-pressure areas, following the usual course of passing to the northward of the Atlantic anti-cyclone or area of high barometric pressure.

PROF. H. C. BUMPUS has critically examined more than 1700 eggs of European and American sparrows, in order to determine the differences between them. The results of his observations were recently communicated to the American Morphological Society. It was found that the American eggs presented a much greater amplitude of variation, both in shape and colour, than the European, that they were smaller, and were also of a strikingly different shape. The large proportion of extreme colour variation found to exist in the case of American eggs is not only interesting in itself, but when the figures are compared with those representing extreme variation in *shape*, the significance of both results is enhanced. Not only is the preponderance of variation among American eggs very obvious, but in both cases, in shape and in colour, it is almost precisely the same. Prof. Bumpus concluded that the data, whether gathered from comparisons of length, ratio of breadth to length, shape or colour, all point in the direction of a general structural modification. The observations have thus an important bearing upon the current theories of degeneration, panmixia, &c.

IN connection with the paragraph referring to injurious effects apparently produced by X-rays (p. 541), Mr. J. Lynn Thomas, assistant surgeon to the Cardiff Infirmary, calls our attention to a note he contributed on the subject to the *British Medical Journal* (March 27). He is of the opinion that these affections are the result of the strong currents in the vicinity of the tubes, and not due directly to the X-rays. Mr. Thomas also says he has noticed that different regions of the glass of a Röntgen lamp in action are under varying electrostatic stresses; the dark half of the lamp, as a rule, attracts light bodies, such as pith-balls, more strongly than the half through which the X-rays emanate. Sometimes the pith-balls are attracted and repelled at a great speed from the glass on the dark side, whilst they are attracted only upon the apple-green side.

THE bacteriological diagnosis of typhoid fever, as such, has long been a matter of difficulty; but since the introduction of Widal's ingenious application of Pfeiffer's sero-diagnosis of cholera, there seems to be a hope of obtaining some definite clue to the bacterial verification of this disease. Widal takes the blood of a patient suspected to be suffering from typhoid fever, and he mixes ten drops with a recent broth-typhoid-culture, and examines a drop of this mixture under the microscope. If the blood is really derived from a typhoid patient, the bacilli, instead of presenting the usual appearance, are seen to be gathering together in innumerable small heaps throughout the microscopic field. This behaviour of typhoid bacilli is claimed by Widal to be specific to the presence of typhoid blood, and is not exhibited in the presence of blood taken in other kinds of disease. The power of typhoid blood to produce this characteristic result on the bacilli is dependent upon the condition of the patient, for as recovery progresses it is not so marked; thus, whereas during the illness the reaction is visible when only one drop of blood is added to sixty or eighty drops of typhoid broth, at a later stage of recovery it will not bear so much dilution, and the proportion varies from one drop of blood to twenty, ten, or even less of broth. Prof. Pfuhl has made many interesting control experiments in typhoid diagnosis by means of Widal's method, and fully confirms his results; he has, moreover, succeeded in still further simplifying the process, and describes his work in a recent number of the *Centralblatt für Bakteriologie*.

THE scientific exploration of lakes has been renewed in Russia by the exploration of Lake Chudskoye, or Peipus, in the lake district of North-west Russia; and Lake Charkhal, which lies in the Kirghiz Steppe, to the south-east of Uralsk, and has thirty-two miles of circumference. The results of both are given, with maps, in the last number of the *Izvestia* of the Russian Geographical Society (xxxii. 4). Lake Chudskoye was studied in detail, as regards the configuration of its bottom, the distribution of temperature in its water, and the chemical constitution of its bottom deposits. As to the exploration of Lake Charkhal, by several members of the Ural Naturalists' Society, it may be taken as a model for similar studies. It was made by several persons at once, and while some of them mapped the lake and the surrounding country, others measured its depths, and others again studied its fauna and flora. The chief point of interest with regard to the fauna is that the herring which was found in the lake was not, as subsequent comparisons proved, the common Caspian herring (*Clupea Caspia*, or *Cl. kessleri*), as might have been expected, but was nearest to the small herring which inhabits the northern tributaries of the Black Sea, and was described by Nordmann, in his *Faune pontique*, as *Clupea cultriventris*. A special variety is consequently established: *Cl. cultriventris*, var. *Tscharchaliensis*. The question now arises, how could it have penetrated into Lake Charkhal? Occasionally the lake is still in communication with the Ural River: so it was in 1887; but the *Cultriventris* herring, which is a brackish-water species, is never met with either in the Caspian Sea or in its tributaries. The most probable hypothesis would thus be that Lake Charkhal is a *Relictensee*, as German geographers say; that is, a remainder from the old Ponto-Caspian Sea. The Charkhal *Leuciscus rutilus*, var. *Heckelii*, is also nearer to the Black Sea variety than to the Caspian variety. Passing by other interesting remarks about the fauna of this lake—its ice formation, the oscillations of its level, and fishing (3000 to 17,000 cwt. every year)—we only remark that its flora is extremely poor; no living algæ could be obtained by dredging, but the bottom of the lake is full of decaying plants, carried thither by the rivers.

THE influence of music upon the respiration, the heart, and the capillary circulation is the subject of a paper, by MM. A. Binet and J. Courtier, in the *Revue Scientifique* (February 27). Experiments were made upon a well-known musical composer, and the investigators endeavoured to determine effects produced by musical sound alone, as distinct from those due to emotions aroused by pieces associated with dramatic incidents or words. Isolated notes, chords in unison, and discords were first tried. Both major chords struck in a lively manner and discords quickened the respiration, the latter more especially. Minor chords tended to retard respiration. When melodies were tried it was found that all, whether grave or gay, produced quickened respiration and increased action of the heart. The lively tunes produced the greatest acceleration. Where the sound was wholly uncomplicated by emotional ideas, as in single notes or chords, the heart's action was accelerated, but not in so marked a degree as when a melody either grave or gay was played. During operatic pieces, or those well known to the subject, the acceleration attained its maximum. The influence of music on the capillary circulation was tested by a plethysmograph attached to the right hand. The capillary tracings showed that a slight

diminution of pulsation was usually produced by musical sounds, the effect being very small when sad melodies were played, but well-marked when lively airs were played.

THE popularity of Darwin steadily grows in Russia—the last edition of his chief works, by Madame Popoff, being evidently intended for a very large circulation. It includes, in two octavo volumes, the autobiography, the voyage of the *Beagle*, the origin of species, the descent of man, and the expression of the emotions, translated from the last editions by Profs. Beketoff, Timiryazeff, and A. Kovalevsky, with a portrait of Darwin, and is sold at the very low price of nine shillings (4 roubles 50 copeks) for the two volumes. Another edition of separate works of Darwin is published at the same time by a scientific review (*Nauchnoie Obozreniye*). It is also worthy of note that an abridged translation of Buckle's "History of Civilisation," very well produced in one volume by M. Notovich, and published in a cheap two-shilling edition, went through nine editions, which were rapidly followed by five one-shilling editions.

THE evolution of money is a fascinating study, and has been ably dealt with by Prof. Ridgeway in his "Origin of Metallic Currency and Weight Standards." The last contribution to this history is a paper, by Dr. A. Götze, in *Globus* (Band. lxxi. p. 217), in which he shows that some silver bars, excavated by Schliemann from the second lowest layer at Hissarlik, are of the same general form as the flat bronze axe-heads. Their shape precludes their being ornaments, and the material of which they are made prevents their having been used as implements; they were, therefore, probably used as a medium of trade. Numerous bronze axe-heads have been found, along with ring-money, in such a way as to suggest that they were employed as a medium for barter. The conclusion, therefore, is that the actual axe-head formed a popular unit for barter. This was later copied in silver, and even in iron, as Dr. Götze proves, to serve as a regular currency; the final term in the series, as Prof. Ridgeway has pointed out, is the axe-inscribed coinage of Tenedos. Dr. Götze also suggests that the "tongue of gold," looted by the luckless Achan from Jericho (Joshua vii. 21, 24), was a similar golden model of a bronze celt or axe-head.

THE Anthropological Reports of the Horn Expedition to Central Australia forms not the least valuable result of that notable expedition. Dr. Stirling undertook the anthropological investigations of the Arunta tribe in the McDonnell Ranges, and he has performed his task in a very satisfactory manner. Careful observations, such as these, of a tribe as yet scarcely influenced by civilisation, cannot fail to be of value, even though the opportunities afforded to the explorers were not as ample as could have been wished. We learn that Prof. Baldwin Spencer has since spent several months with this tribe, and his investigations will doubtless supplement those of the Horn Expedition. Dr. Stirling has wisely incorporated some very valuable ethnographical notes by F. J. Gillen, special magistrate and sub-protector of aborigines. In addition to observations on the social organisation, religion, initiation and other ceremonies, corrobboree, and habits of life, the ornaments, weapons, and implements are carefully described. The gesture language is recorded and illustrated by sketches. Three coloured plates are devoted to representations of rock drawings. One very satisfactory feature of the Report is the prominence given to physiological and medical observations; few travellers have the necessary knowledge of, or interest in such matters. The Report is illustrated with twenty capital plates; many of these are half-tone blocks from photographs by Mr. Gillen. Some of these illustrate various ceremonies, the initiatory rites being the most fully represented. This is just the class of work that is so urgently needed at the present day, and we trust that other wealthy Australians will feel it their duty to fit out anthropological expeditions before it is too late.

THE *Annales* of the Central Physical Observatory of St. Petersburg for the year 1895, forming two large quarto volumes, have just been issued. They include an appendix, recommended by the recent Meteorological Conference in Paris, viz. a list of the periodical publications in Russia containing meteorological observations. By direction of the Imperial Academy of Sciences, the explanatory text is now in French, instead of German, and the preface contains a useful note upon the French orthography of Russian geographical names. This will be of much assistance in transliteration and pronunciation. Somewhat similar directions were given in our columns on February 27, 1890; notwithstanding this, we generally find that in English the equivalent for the Russian sound *zh* is rendered by *j* (which would be correct in French), and that *v* is rendered by *w* (which would be correct in German). On July 1 a fire unfortunately occurred in the building for absolute magnetic observations, and most of the instruments were destroyed, but the records were continued in another building with other instruments. The daily weather chart issued by the Central Physical Observatory extends over an immense area, embracing Vardö, in latitude 60° N.; Malta, in the south; the west coast of Ireland, and the limits of Eastern Siberia. Telegraphic reports are received from 186 stations, and weather charts are constructed thrice daily; when necessary, storm warnings are issued to the ports in the Baltic, the Black Sea, and the Sea of Azov. The new Director of the Russian Meteorological Service is General M. Rykatchef, well known as the author of several valuable discussions in maritime meteorology.

ONE of the most important functions of the Agricultural Experiment Stations in the United States, is to give farmers a better knowledge of the scientific principles underlying their work. To this end two excellent little *Bulletins* (Nos. 139-140) have lately been distributed by the Michigan State Agricultural College Experiment Station. Their subjects are: "Bacteria: what they are, and what they do"; and "Ropiness in Milk"; and the author is Dr. C. E. Marshall. The science of bacteriology has entered into such an intimate relation with the farmer, because of its connection with the dairy, the soil, the diseases of animals and plants, and his surroundings, that some knowledge of it has become indispensable to him, if he wishes to keep up with the times. This knowledge the Michigan Experiment Station proposes to give to the agriculturists of the State by means of short and simply-written bulletins, to be issued from time to time. The first bulletin of the series contains a good general account of bacteria, and the means of studying them. This paves the way for the reports of experiments, such as are contained in the bulletin on ropiness of milk. The Station has, in fact, undertaken to publish, by means of these bulletins, a general survey of bacteriology, with special reference to those phases of the science applicable to agricultural interests. The influence of such bulletins as these, in educating the farmer, cannot be over-estimated. It would be to the advantage of British agriculture if useful and accurate scientific information of the same character could be disseminated by agencies similar to the agricultural experiment station in the United States.

THE additions to the Zoological Society's Gardens during the past week include two Grey Ichneumons (*Herpestes griseus*) from Ceylon, presented by Mr. R. J. Davis; a Bauer's Parrakeet (*Platycercus zonarius*) from Australia, presented by Dr. Clement Godson; two Common Cassowaries (*Casuarius galeatus*) from Ceram, deposited; four Shovellers (*Spatula clypeata*), three Common Teal (*Querquedula crecca*), European purchased.

OUR ASTRONOMICAL COLUMN.

REFRACTION AND THE APPARENT DIURNAL MOVEMENTS OF STARS.—The question of the apparent change of positions of stars due to refraction as the hour angle varies, becomes of importance when long intervals of time are taken into account. In photographing the stars, it is generally usual to "stand by" and make all the necessary small adjustments, due to atmospheric refraction, with the hand. A method has, however, been recently suggested and worked out by Dr. A. A. Rambaut, by which the rate of the driving clock may be so adjusted as to take into account these minor discrepancies when a high state of accuracy is desired for stars at large hour angles (*Monthly Notices*, vol. lvii. No. 2). This method does not, of course, take into consideration local or temporary changes in the refraction, but the perfectly regular and systematic change as the star increases or decreases its altitude. For a telescope to follow a star with absolute precision, a clockwork must be constructed which would drive the instrument at an ever-varying rate according to the formula given by Dr. Rambaut. This, however, cannot be practically achieved, and would, further, be unnecessary, as a close approximation is all that is needed in practice. By a system of curves obtained from the above-mentioned formula, and treated graphically, it has been found that a uniform rate, *if suitably chosen*, will not in ten minutes introduce an error amounting to one-twentieth of a second, which is within the limits of the accidental errors of a good equatorial clock. By prolonging the exposure beyond the period for which a uniform rate is admissible, the rate must be altered to one now more suitable. A series of weights, skilfully employed in controlling the action of a pendulum in connection with the driving clock, will allow the different rates to be easily produced. Dr. Rambaut describes a graphical method for obtaining the length of exposure during which a uniform rate may be used. This he finds most convenient in practice for short exposures, and he relates that he can turn his telescope, with the greatest confidence, from a star at its upper culmination, to follow which a star must lose at the rate of from 18 to 100 seconds or more a day, and one at its lower culmination, gaining at the rate of 70 or 80 seconds a day, and he finds "the telescope will follow both with equal accuracy." It may be remarked that this method is practically intended to be utilised when photographs for the detection of stellar parallax are in question, as it is only then that they must be obtained when the stars have a considerable hour angle.

"BULLETIN ASTRONOMIQUE DE FRANCE."—The April number of this monthly contains, among other things, an interesting article, by Camille Flammarion, on the planet Venus, more special attention being paid to the observations which have indicated the presence of an atmosphere. There is also an account of Mr. Percival Lowell's recent observations on the surface markings, and the subsequent determination of the period of rotation, mentioned previously in this column. *A propos* of our note last week, on the question of the adoption of France of Greenwich time, we find that the following resolution was voted by the assembly at the meeting of the French Astronomical Society, on March 3 last, the proceedings of which are here recorded:—"La Société astronomique de France, considérant qu'au Congrès de Washington la proposition du méridien de Behring, qui avait un caractère eminemment géographique, impersonnel et d'ordre universel, n'a pas été adoptée, ne juge pas à propos d'en adopter un autre, qui n'a à aucun degré le caractère auquel la France est toujours restée fidèle dans les réformes dont elle a pris l'initiative." This number of the *Bulletin* contains also several communications relating to the moon, and another beautiful reproduction from one of Loewy and Puiseux's lunar negatives is given, which, for amount of detail and fine contrast, is strikingly eautiful.

PROF. EDUARD HAERDTL.—The Professor of Astronomy at Innsbruck, Prof. Eduard Freiherr von Haerdtl, whose death (*Astr. Nach.*, No. 3416) we regret to record, was born in the year 1861 at Penzing, near Vienna. After finishing his Gymnasium studies in 1880, he selected mathematics and astronomy as his chief pursuits at the Vienna University. He was one of the most apt pupils of Th. von Oppolzer, whose work he vigorously took up, and afterwards so ably continued. In 1892 Haerdtl was promoted to the Professorship of the Innsbruck University. Endowed with a great capacity for carrying out astronomical computations, his dissertation "Beiträge zur Assyrischen Chronologie" was followed by other publications, chief of which was the investigation of the movement of Winnecke's comet. The prize of the Copenhagen Academy of Sciences he won with an interesting essay, entitled "Skizzen zu einem speciellen Fall des Problems der drei Körper," after which he busied himself with the terms of long period in the movement of the moon, and shortly before his death with Winnecke's comet again. Full of such promise, and cut off at the early age of thirty-six, not only has astronomical science lost a man who seemed destined to enrich her with many valuable contributions, but his circle of friends mourn the loss of a kind and true "Kamerad."

ON ELECTRICAL PROPERTIES OF FUMES PROCEEDING FROM FLAMES AND BURNING CHARCOAL.[1]

§ 1. MANY experimenters have investigated the electrical properties of flames and incandescent solids. The methods usually employed have been (1) to examine the electric conductivity of different parts of the flame;[2] (2) to measure the difference of potential between platinum wires in different positions in the same flame;[3] (3) to find the leakage of a charged conductor when placed near, or in view of, a flame or an incandescent solid;[4] (4) to observe the leakage of a conductor, raised to a red or white heat, by an electric current, and electrically charged while it is surrounded by different gases;[5] and (5) to observe the production of electrification or diselectrification by a glowing wire, through which a current is passing, in neighbouring insulated conductors separated from it by different gases.[6]

§ 2. This short communication divides itself into three separate inquiries: (1) to test by one of our electric filters[7] the electric quality of the fumes from different flames and burnings (this method has not, we believe, been tried before); (2) to observe the difference of potential between a copper plate and a zinc plate when the fumes from different flames and burnings at different distances from the plates passed between them and round them; and (3) to observe the leakage between two parallel metal plates with any difference of electric potential when the fumes from flames and burnings were allowed to pass between them.

§ 3. To test the electrification of fumes from different flames and burnings, the arrangement shown diagrammatically in Fig. 1 was used. The flame is kept burning at the mouth of a large vertical iron funnel A, closed at its upper end; and the heated air, along with the products of combustion, is drawn off by an air-pump through a small aperture, B, near the upper end. Before reaching the pump the air has to pass through three circular pieces of brass wire gauze, D, one centimetre apart, which are fixed across the funnel about 5 centimetres below the exit tube B; and through a worm of block-tin pipe, 90 centimetres long, which is kept surrounded by cold water in a vessel C. The electrification was tested by a quadrant electrometer (sensitiveness of the electrometer 111 scale divisions per volt), and an electric filter F. The filter F was of block-tin tube, 5 centimetres long and 1 centimetre bore, and full of fine brass filings kept in position by a plug of cotton-wool and a piece of brass wire gauze at each end. Between the filter and the air-pump is a T-shaped piece of glass tubing with lower end of the vertical tube dipping into a basin of mercury. This served as a pressure gauge to indicate the difference of air pressures on the two sides of the filter when the air-pump was worked. The flame, the iron funnel, the worm, and the case of the electrometer are all metallically connected.

[1] By the Right Hon. Lord Kelvin, G.C.V.O., F.R.S., and Dr. Magnus Maclean. Paper read at a meeting of the Royal Society, Edinburgh, on April 5.

[2] Account of experiments in Wiedemann's "Lehre von der Elektricetät," vol. iv. B. Carl's *Rep.*, xvii. pp. 269–294, 1881. J. J. Thomson, *Phil. Mag.*, pp. 358, 441, 1890.

[3] Hankel, *Phil. Mag.*, p. 542, December 1851; *Phil. Mag.*, p. 9, January 1860. Elster and Geitel, *Wied. Ann.*, vol. xvi., 1882; also *Phil. Mag.*, September 1882. Maclean and Goto, *Phil. Mag.*, August 1890.

[4] Guthrie, *Phil. Mag.*, p. 308, April 1873. Giese, *Wied. Ann.*, vol. xvii. Schuster, Lecture Royal Institution, February 22, 1895.

[5] Guthrie, *Phil. Mag.*, p. 237, October 1873.

[6] Elster and Geitel, *Wied. Ann.*, xxxvii. p. 315, 1889; Elster and Geitel, *Wied. Ann.*, xxxviii. p. 27, 1889.

[7] Kelvin, Maclean, Galt, "Electrification and Diselectrification of Air," *Proceedings* of the Royal Society, London, vol. lvii., February and March 1895; also B.A. Report, 1895.

4. The following flames and burnings were tried :—

(1) Candle.
(2) Paraffin lamp.
(3) Spirit flame.
(4) Portable electrometer matches.
(5) Coal-gas (Bunsen flame).
(6) Hydrogen flame.
(7) Glowing charcoal.
(8) Glowing coals.

§ 5. The method of experimenting was to place the burning substance in position at the bottom of the funnel, to insulate the quadrant of the electrometer in connection with the electric filter, and to start working the air-pump at the rate of one stroke per three seconds. The time of each experiment was ten minutes (200 strokes of the air-pump). The results obtained are given in the following table. In testing the electrometer matches, four matches were stuck in holes in a metallic plate, and the plate connected by a wire to the case of the electrometer. These matches, according to a suggestion made more than thirty years ago by Faraday, are made of white blotting-paper soaked in a solution of nitrate of lead, and rolled up with paste into little rods of about five millimetres diameter. The hydrogen was generated in an ordinary Woulffe's bottle from zinc and hydrochloric acid. The rise of the dilute hydrochloric acid in the long vertical tube through which the acid was admitted, indicated the pressure under the nozzle, above which the hydrogen was burning.

§ 6. In the case of the charcoal and coal, the burning fuel was placed at the bottom of the iron funnel in a thin rectangular metallic vessel with small holes perforated in the bottom and in the sides. A wire from the case of the electrometer passed through one of these holes, and was thrust into the burning fuel. It was noticed that when the burning charcoal was first put in position below the funnel it always produced negative electrification, which ultimately changed to positive. Thus, in four experiments, the electrification, which was at first negative, became positive after 8, 10, 14, and 18 minutes respectively. On investigation it was found that as long as any flame[1] was visible in the burning charcoal the electrification was negative ; but as soon as all the flame disappeared, leaving only the red glow, the electrification became positive. To test this the heated

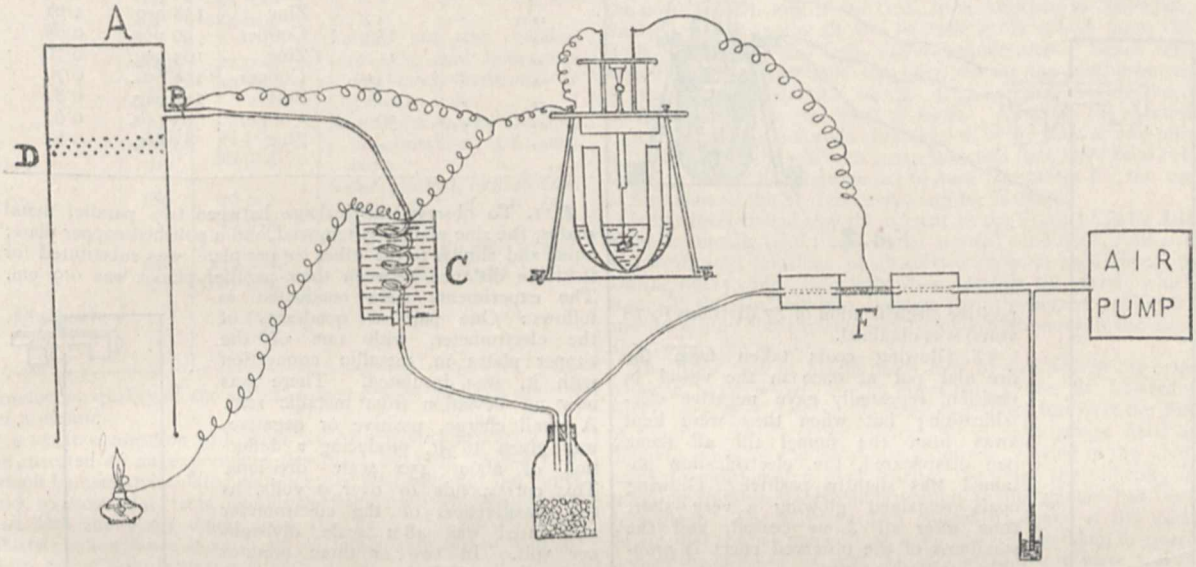

FIG. 1.

Sensitiveness of the electrometer, 111 *scale divisions per volt.*

	Number of experiments.	Mean deflection in scale divisions of electrometer.	Potential in volts.
(1) One candle	2	90 neg.	0·81 neg.
(2) One paraffin lamp ...			
(*a*) without glass funnel	2	84 ,,	0·76 ,,
(*b*) with glass funnel ...	2	30 ,,	0·27 ,,
(3) One spirit lamp ...	4	109 ,,	0·99 ,,
(4) Four portable electrometer matches ...	2	224 ,,	2·03 ,,
(5) One Bunsen flame ...	4	30 ,,	0·27 ,,
(6) One hydrogen flame	At low pressure gave small negative; at higher pressures large positive. No electrification was found from the jet at any pressure when not burning.		
(7) Charcoal	Both gave negative electrification when there was a flame ; and both gave positive electrification when they were glowing without flame.		
(8) Coals			

[1] In a paper on "Electrification of Air by Combustion," by Magnu Maclean and Makita Goto, communicated to the Philosophical Society of Glasgow on November 20, 1889, is a statement of results of many observations to find the potential to which the insulated quadrant of a quadrant electrometer is raised when in metallic connection with various kinds of flames and fires. It is there said : "The effect of an ordinary lucifer match is very interesting. While the match is burning with a flame the deflection indicates positive electrification ; but after the flame ceases the electrification becomes negative, the effect now being that of glowing charcoal." The following table is quoted from the paper. In some cases the burnings lasted so short a time that quantitative determinations of the potential were not obtained. It is *conceivable* that all of the complementary opposite electricity separated from that which went to the electrometer in those experiments went to uninsulated solids in the neighbourhood. The experiments described in the text demonstrate that some of it was lodged in the air and fumes proceeding from the fire or flame.

Substances giving flames or burnings.	Electrification of insulated fuel.	Greatest observed potential in volts.
Charcoal	Negative	3·0
Lucifer match, wood, and paper glowing	,,	3·0
Hydrogen	,,	0·6
Iron burning in vapour of sulphur	,,	—
Copper ,, ,, ,, ,,	,,	—
Paraffin lamp	Positive	0·6
Alcohol lamp	,,	0·3
Sulphur	,,	2·0
Phosphorus exposed to air ...	,,	1·5
Magnesium	,,	—
Iron burning in oxygen ...	,,	
Lucifer match, wood, and paper burning with flame	,,	—
Bisulphide of carbon	,,	0·6
Sulphuric ether	,,	0·9
Turpentine	,,	0·5
Bees-wax	,,	0·7
Camphor	,,	

charcoal was kept away from the funnel till all flame had disappeared. Then the vessel was put in position, and the deflections obtained in two experiments were—

51 scale divisions positive in 10 minutes.
100 ,, ,, ,, ,, ,,

§ 7. Next an experiment was made with the burning charcoal put in position while a flame was visible. The flame remained visible for 7 minutes, and in that time a negative electrification of 34 divisions was obtained. Then the deflection came back to the metallic zero in one minute, and in 10 minutes more a positive electrification of 87 divisions (0·78 volts) was obtained.

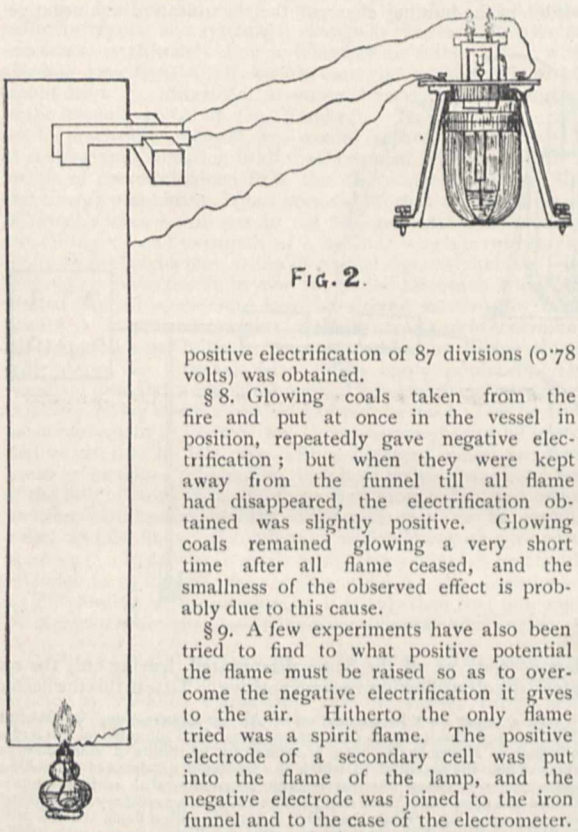

FIG. 2.

§ 8. Glowing coals taken from the fire and put at once in the vessel in position, repeatedly gave negative electrification; but when they were kept away from the funnel till all flame had disappeared, the electrification obtained was slightly positive. Glowing coals remained glowing a very short time after all flame ceased, and the smallness of the observed effect is probably due to this cause.

§ 9. A few experiments have also been tried to find to what positive potential the flame must be raised so as to overcome the negative electrification it gives to the air. Hitherto the only flame tried was a spirit flame. The positive electrode of a secondary cell was put into the flame of the lamp, and the negative electrode was joined to the iron funnel and to the case of the electrometer. The results obtained are not very regular, but we found that one storage cell was not sufficient to overpower the electrifying effects of the spirit flame. With one cell we got 45 divisions negative in 10 minutes, instead of 109 divisions with metallic connection; with two cells we got 10 divisions positive in 10 minutes; and with six cells we got 83 divisions positive in 4 minutes.

§ 10. The filter, pump, and worm were now removed, and two plates—one of polished copper, and the other of polished zinc—were fixed 0·9 centimetre apart in a block of paraffin, as represented in Fig. 2. The arrangement was such that either plate could be insulated, while the other was kept in metallic connection with the case of the electrometer. Observations were made to find the deflection from metallic zero with one plate insulated, and fumes from different flames and burnings at different distances from the plates passing up between them. This may be called the fumes-zero. When the top of the flame was within 5 or 6 centimetres from the plates, the results were very irregular. The results in the following table for spirit flame are in accordance with what Maclean and Goto obtained from unguarded fumes from a spirit lamp 30 centimetres below the plates, as stated in their paper published in the *Philosophical Magazine* for August 1890. The effect is of the same kind as if the plates were connected by a drop of water.[1]

[1] Kelvin, 'Electrostatics and Magnetism,' §§ 413 414, pp. 332, 333.

Sensitiveness of the electrometer 136 *scale divisions per volt.*

Flame.	Distance of top of flame below the plates in centimetres.	Metal connected to insulated terminal of electrometer.	Difference between fumes-zero and metallic zero in scale divisions.	Potential in volts.
Spirit lamp ...	23	Copper	81 pos.	0·60
,, ...	,,	Zinc	101 neg.	0·74
,, ...	11	Copper	53 pos.	0·39
,, ...	,,	Zinc	76 neg.	0·56
Paraffin lamp without glass funnel	7	Copper	141 pos.	1·04
,, ...	,,	Zinc	138 neg.	1·01
,, ...	15	Copper	90 pos.	0·66
,, ...	,,	Zinc	103 neg.	0·76
,, ...	23	Copper	108 pos.	0·79
,, ...	,,	Zinc	112 neg.	0·82
,, ...	30	Copper	83 pos.	0·61
,, ...	,,	Zinc	83 neg.	0·61

§ 11. To observe the leakage between two parallel metal plates, the zinc plate was removed, and a polished copper plate, equal and similar to the other copper plate, was substituted for it. The distance between their parallel planes was 0·9 cm. The experiments were conducted as follows: One pair of quadrants of the electrometer, with one of the copper plates in metallic connection with it, was insulated. There was now no deviation from metallic zero. A small charge, positive or negative, was given to it, producing a deflection of about 450 scale divisions. This corresponds to over 9 volts, as the sensitiveness of the electrometer now used was 48·2 scale divisions per volt. In two or three minutes the ordinary leakage of the arrangement was observed. This did not amount to more than one division, or at most two divisions, per minute. Then the flame was lit, and readings were taken every half-minute. This was done with the variations in the funnel described in the last column of the following table, and illustrated by Fig. 3. For comparison, the numbers in the following table show the leakage for two minutes after the reading was 300 scale divisions (6·2 volts) from metallic zero. This gives us the leakage at diminishing electric potentials during the time of observation. We intend to continue these experiments, and to arrange to find the leakage at different constant electric pressures.

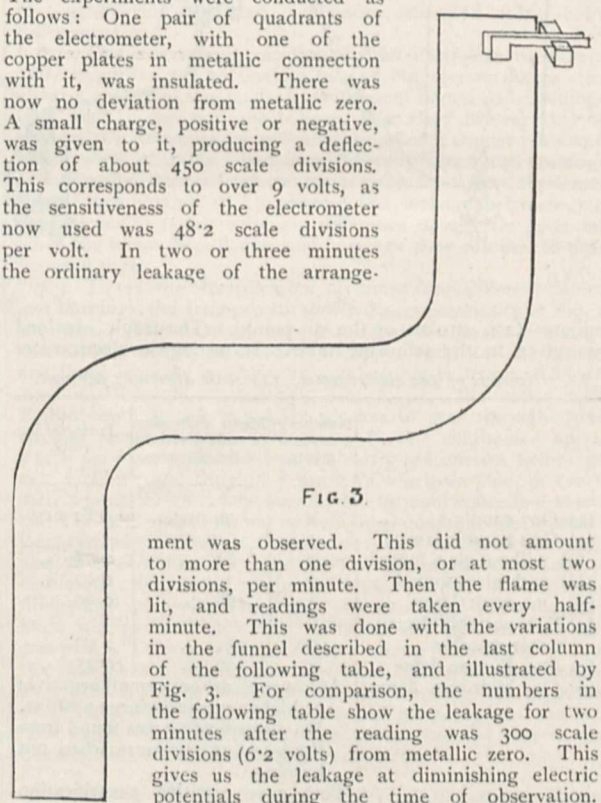

FIG. 3.

§ 12. The marked difference in the leakage obtained when the horizontal tube was of small bore (3·8 cms.) and when it was of larger bore (15·3 cms.), may be contrasted as indicated in the last four results given for spirit flame. We also tried how long the fumes retained this conductive quality, but in every case we found that the leakage stopped in less than a quarter of a minute after the flame was extinguished, or removed from the bottom of the funnel. Closing the top and bottom of the funnel immediately after the flame was removed, we still found that the

± 300 *scale divisions, equivalent to* 6·2 *volts, to begin with in each case.*

Flame.	Length of funnel between burning substance and copper plates.	Leakage in two minutes.	Remarks.
	Centi-metres.	Scale divisions.	
Spirit flame	66	292 pos.	Funnel of 15·3 cm. bore all vertical.
,,	,,	287 neg.	,, ,, ,,
,,	112	253 pos.	,, ,, ,,
,,	,,	254 neg.	,, ,, ,,
,,	343	22 pos.	Funnel 114 cms. vertical of 15·3 cms. bore; and 229 cms. horizontal of 3·8 cms. bore.
,,	,,	20 neg.	
,,	236	24 pos.	Same vertical, and 122 cms. horizontal of 3·8 cms. bore.
,,	,,	20 neg.	
,,	160	40 pos.	Same vertical, and 46 cms. horizontal of 3·8 cms. bore.
,,	,,	46 neg.	
,,	244	165 pos.	Same vertical, and 130 cms. horizontal of 15·3 cms. bore.
,,	,,	187 neg.	
Charcoal	,,	54 pos.	,, ,, ,,
,,	,,	57 neg.	,, ,, ,,

conductive quality of the air and fumes ceased within a quarter of a minute.

§ 13. In connection with these last experiments, attention may be directed to an experiment described by Prof. Schuster, in which he uses an insulated metallic tube bent round at the upper end, to prove that "it is not only the flame itself which conducts, but also the gases rising from the flame."[1] He discovers electric conductance in products of combustion mixed with air quite out of sight from the flame.

SURVEY OF THE TIDES AND CURRENTS IN THE GULF OF ST. LAWRENCE.

WHEN the meeting of the British Association was held at Montreal in 1884, the necessity of establishing stations for tidal observations in Canadian waters was discussed, and the Association adopted a resolution drawing the attention of the Government of the Dominion to the matter. A committee was also appointed to collect information and make representations to the Government respecting it. Two years later a large deputation, representing the British Association, the Royal Society of Canada, and the Board of Trade of Montreal, waited on the Minister of Marine. The matter was favourably received, but, owing to financial reasons, any action was for the time postponed. In 1889, however, exploratory trips were undertaken, by direction of the Government, with the view of ascertaining the best points to establish tide gauges; and in 1890 a practical commencement of the survey of the tides and currents in the Gulf of St. Lawrence was made. The object of this survey is to furnish data for compiling trustworthy tide-tables, and to afford information as to the set of the tidal and other currents in the Gulf. The value of such information is shown by the remarks of Lieut. Gordon in his report to the Minister of Marine, in which he expresses the conviction that until an exhaustive examination of the whole system of tidal movements carried out on similar plans to those which have been made on the United States coasts, and on the coasts of Great Britain, has been made, there will always be the liability to heavy maritime losses due to the lack of information. The average loss, he states, is now over half a million of pounds—a large proportion of which is due to a want of knowledge of the currents.

For the purpose of determining the set and cause of the currents, it was necessary to have a trustworthy record of the time and range of the tides; of the variation in the pressure of the barometer; the force and direction of the wind; and the temperature and density of the water at different depths. The survey is under the charge of the Marine Department, with Colonel Anderson, Chief Engineer, at the head. The tidal survey is in charge of Mr. W. Bell Dawson, C.E. Four reports as to the progress of the work have already been issued. In the first season the two entrances to the Gulf were examined at Belle Isle and Cabot Straits, between Cape Breton and Newfoundland; and the general relation of the Gulf to the ocean as regards tide and currents was examined. Next season the entrance between the Gaspé coast and Anticosti was examined, and the nature of the currents was traced across the south-western side of the Gulf to Cape Breton. This part of the Gulf is a steamship route of constantly increasing importance. More recently, the north-eastern arm of the Gulf, from Anticosti to Belle Isle, through which passes all the Atlantic traffic which takes the Belle Isle route, has been under examination. Seven self-recording tide gauges have also been set up, the establishment of the intended stations on the Atlantic coast having been postponed owing to the want of funds. Although the shortest time for obtaining a correct computation of the tides at any port is the lunar cycle of nineteen years, sufficient data have been collected to enable the Department to issue tide-tables for the use of the pilots of the St. Lawrence, and for Halifax.

It has been settled that the current in the Strait of Belle Isle is fundamentally tidal; and, under normal conditions, runs east and west, with velocities of about two knots in each direction. During heavy winds, especially when westerly, the current which runs with the wind becomes stronger than the current against it; and for a time the current may become continuous in the same direction as the wind.

The tides vary in height from four to five feet in the open Atlantic, to twelve feet in the lower part of the St. Lawrence River, seventeen feet at Quebec, and thirty feet over the Bay of Fundy. To correctly observe these, tide gauges fixed at different parts of the coast are required. Owing to the uninhabited condition of a great part of the coast, the difficulty in selecting suitable places and attending to the gauges has been very great. The self-recording gauges used are of the usual design, but special precautioas have had to be taken to guard against the effect of ice and the oscillation due to wave action. At most stations no wharves or quays were available against which the gauges could be fixed. At some of the stations wells had to be sunk at high-water mark to the level of the lowest tides, and a trench, 270 feet long and 10 feet deep, excavated across the rock shore, to admit the tide to the well. The tide was led to the well by wooden piping, made from fir trees, twelve inches diameter, having a hole three inches in diameter bored through the centre, the joints being made tight with sail-cloth saturated with white lead. To prevent the effect of air entering the pipes, due to the surge of the sea in rough weather, an iron pipe was laid out along the bottom for about 100 feet, into water having a depth of twelve feet at the lowest tides. To prevent freezing in winter, a boiler, three feet in diameter, was placed vertically in the well and kept heated, and in this the tide pipes were fixed. These gauges have been occasionally damaged during gales, and in one case the station could not be reached between January and the opening of the navigation in May. At some of the stations, situated on islands, it was necessary to make a telegraphic exchange of time once a week to regulate the driving clocks. To avoid this expense, meridian instruments, named *dipleidoscopes*, have been employed, which, when once set correctly, give the exact time of the sun's meridian passage. These were obtained from a Paris maker.

The currents in the Gulf are affected both by the tide and the amount of fresh water coming down the river. It was found that the under-currents which exist are frequently displaced and brought nearer the surface, either by the effect of wind or by a variation in the temperature. For the purpose of ascertaining the position and force of these currents observations were taken as to their flow, and also as to the temperature and density of the water. From Quebec to Father Point the tidal current occupies the whole width of the river; when the channel widens, a part of it is occupied by a constant downward current which runs parallel to the south shore all the way to Gaspé. The main tidal current enters the Gulf from the Atlantic by Cabot Strait, between Cape Breton and Newfoundland, and does not lose itself in the great expanse of the Gulf, but continues across

[1] Prof. Schuster, on "Atmospheric Electricity," at Royal Institution, February 22, 1895.

it with an increased range in the passage between Gaspé and Anticosti, and from there pursues its way with ever-increasing height up the St. Lawrence to Quebec. The progress of this tidal wave has been traced to the existence of a deep channel which crosses the whole extent of the Gulf from Cabot Strait to the passage between Gaspé and Anticosti, and thence up the St. Lawrence nearly to Saquenay. This channel extends a distance of 500 miles, with an average width of 35 miles and a continuous depth of 150 fathoms.

For the purpose of ascertaining the nature and velocities of the currents, the steamer used was moored with a wire rope hawser, provided with an accumulator, to prevent sudden jerks and strains. This accumulator consisted of a series of sixty rubber discs, five inches diameter, making a total length of twelve feet, which was reduced to eight feet eight inches under the greatest compression. Two kinds of current meters were used: one having small buckets revolving horizontally, on the same principle as an anemometer; and the other of a fan, similar to a screw propeller, revolving in a vertical plane. The former was found to be best for sea work, as it was least affected by the vertical motion of the vessel due to waves. The latter was found to be liable to head up or down as the vessel rolled, and so give an exaggerated record. Both kinds were worked by electricity. The surface currents were taken at a uniform depth of eighteen feet, which was well clear of the keel of the steamer. The meter was allowed to run for half an hour at this depth, then lowered to the desired depth for an hour, and then again run for half an hour at the eighteen feet. At a depth of ten fathoms the Gaspé current was sometimes found to be stronger than at the surface, but usually the velocity decreased regularly with the depth. At twenty fathoms it was only 50 per cent. of the surface velocity; and at thirty fathoms, 20 per cent. The greatest velocity was 2·81 knots. The current fluctuated with the rise and fall of the tide, decreasing during the rise, and increasing during the fall. The constant outward current from the Gulf was found to have a width of fourteen miles, and a depth of forty fathoms near the Gaspé coast, with a surface velocity of from 1·10 to 2·81 knots. The temperature in July was found to range from 53° at the surface to 33° at thirty fathoms; and 32° at fifty fathoms. In the Gaspé region and in Cabot Strait the coldest water forms a layer between the depth of thirty and fifty fathoms, and, while the surface water rises in temperature during the season, no appreciable variation was found from June to September at a depth of fifty fathoms.

The density of the water was ascertained as affording an indication of the quantity of fresh water coming down the St. Lawrence. In the Strait of Belle Isle and Cabot Strait the density of the surface water ranges from 1·0233 to 1·0245, the same as in the Atlantic. On the western side of Cabot Strait, the outflowing water, which occupies a width of about ten miles, has a density of 1·0220 to 1·0235 at the surface. In the Gaspé region the average density for a width of fourteen miles, and between the surface and ten fathoms, was 1·02195: and to a depth of forty fathoms, was 1·02368. The density of the water is disturbed by currents due to wind. Thus during three days, when the wind from the S.S.W. averaged twenty miles an hour, the density contours were displaced to the northward about nineteen miles at the surface, fifteen miles at ten fathoms, and nine miles at twenty fathoms.

The completion of the survey is expected to occupy another three or four years.

AGRICULTURAL EXPERIMENTS IN PLOTS AND POTS.

IN a recent number of the *Agricultural Gazette of New South Wales* (vol. vii. p. 663) there is an article by Mr. N. A. Cobb, written at the request of the Minister for Agriculture, upon the methods employed for experiments with crops and manures. It appears that field experiments are being carried out to a considerable extent by the farmers of the country, but that the results are to a large extent untrustworthy and misleading, owing to innumerable sources of error which the experimenters have failed to perceive and guard against. Science is thus brought into ill repute, doubt is thrown on established truths, and progress hindered. The evidence brought forward goes far to show that this is a true indictment. When, however, the author goes a step further, and speaks of field experiments as almost essentially untrustworthy, we cannot agree with him. The sources of error which he mentions may all be avoided by judicious management, if only the experimenter will guard against them at the commencement of his work, and superintend his operations with proper care.

Inequalities of soil are one of the worst evils in field experiments; the investigator frequently remains unconscious of them, the difference in the results being credited to the effect of the manures, &c. It is *very rare* for proper precautions to be taken against this evil, for the simple reason that these precautions imply delay, and the experimenter is generally in a hurry to obtain results. If, for instance, the comparative effect of different manures on barley is to be ascertained, or the comparative yield of different varieties of seed, the only basis for an accurate trial is to divide the field into the required plots, then sow the whole field with a uniform barley seed, without any manure, and weigh separately the produce of each plot. If the crops obtained are equal, within the unavoidable errors of experiment, the field is one suitable for the purpose of the experiment; if the crops are unequal, the field, or that portion of it in which the inequality occurs, is clearly unsuited for the purpose intended. It is not sufficient, as is often supposed, to inspect the field when under ordinary culture, and because of the apparent evenness of the crop, to pronounce it fit for use; for natural inequalities of soil may not appear in a well-manured field, although plainly manifested when the supply of manure ceases.

The errors due to inequalities of the soil in one series of trials may, of course, be neutralised by making many series of trials, and substantial accuracy may be gained by simply regarding the mean results obtained; but if a field is really unequal in fertility, no ordinary arrangement of duplicate plots will suffice to ensure an accurate result. If the same experiment is repeated throughout a wide district, as is often now done in County Council experiments, it may be quite misleading to take the mean of all the results as expressing the truth for the whole district. We must not bring into the mean the results obtained in different soils and climates, unless, indeed, our aim is to procure general statistics which are of no value for any particular place. Basic slag and superphosphate will compare quite differently upon a clay and upon a chalky soil; nitrate of soda and sulphate of ammonia will compare differently on dry and wet soils. To take the mean of experiments made under such different conditions is simply to misinform every farmer in the district; yet public money is continually wasted in this way.

Mr. Cobb points out that the effect of inequality in the soil may be obviated by substituting rows for square plots. This is true, and the point is well worthy of attention; the suggestion is not, however, novel. In a comparison of basic slag and superphosphate for turnips, conducted by the writer at Rothamsted in 1886, the slag and turnip seed were sown by drill on the top of two ridges down the whole length of the field, and on the return of the drill an equal number of ridges by the side of the first were left unsown. When the sowing of the slag was completed, the same drill sowed superphosphate and turnip seed in all the vacant spaces. There were thus throughout the field two rows of turnips with slag, side by side of two rows of turnips with superphosphate, the repetition occurring many times over. This plan was suggested by Sir John Lawes. This is, for many experiments, a good mode of work, but its use is practically limited to those crops and manures which can be sown by drill; unfortunately, drills are not satisfactory machines for evenly distributing given weights of manure over given areas.

Mr. Cobb next passes to the pot system of experiment: he describes the work at the Darmstadt Experiment Station, with its 1000 pots, and suggests that work on this system should be commenced in Australia.

There is no doubt that for solving certain questions the pot system, when carried out with scrupulous accuracy, is far superior to any other. If we wish to know what is the comparative value to any plant of various nitrogenous manures under the most favourable conditions of supply and use, we arrive at this fact only by pot experiments. The produce obtained per unit of nitrogen in the pot will not, however, necessarily be the produce obtained in the field; and the relative value of different manures, as shown in the pot, will only by mere chance appear in the field, where, in fact, it will be found to vary every year. The essential difference between the two systems is due to the fact that the field results are largely influenced by the season, and especially by the amount of rain, and the quantity of water percolating through the soil; while the pot cultures are carefully protected from such vicissitudes. If, then, the farmer

wants to know how nitrate of soda, sulphate of ammonia, and shoddy, compare in his own land and climate, the only way of ascertaining the fact is by field experiments repeated through many years, till the influence of an average season is ascertained.

R. W.

COLLIERY EXPLOSIONS AND COAL-DUST.

AT a meeting of the Physical and Chemical Section of the Bristol Naturalist Society, on January 26, a paper was read, by Mr. Donald M. D. Stuart, upon "The Chemistry of Colliery Explosions due to Gases derived from Coal-dust," in which the researches of Faraday, Verpilleux, Vital, Marreco, Mallard, Le Chatelier, and others were given, and attention was drawn to the points they emphasised. Faraday observed in his report upon the Haswell Colliery explosion: "There is every reason to believe that much coal-gas was made from the coal-dust in the very air itself, by the flame of the fire-damp; . . . and that much of the carbon in this dust remained unburnt only for want of oxygen." M. Vital concluded that—"Very fine coal-dust rich in inflammable constituents, will take fire when raised by an explosion, and that portions are successfully decomposed, yielding explosive mixtures with air, whereby the fire is carried along." Marreco remarked—"The coal-dust is in part submitted to destructive distillation"; and Mallard and Le Chatelier found that gaseous matters were evolved from the coal-dust by the action of the fire-damp explosion. Mr. Stuart observed. These physicists and chemists found that the coal-dust did undergo dry distillation while in atmospheric suspension in a mine passage, after the originating explosion; and the educts added to the explosive effects. He had carefully observed the effects of explosions not only at the point of origin, but throughout the field of the disturbances, and found Faraday's hypothesis of the dry distillation of coal-dust essential to account for the phenomena observed through thousands of yards of mine passages. He observed that the disruptive effects of an explosion of methane and air were necessarily limited to the immediate vicinity of the explosive mixture; but the disruptions beyond and to remote distances required an explosive agent coextensive in distribution, and this agent was coal-dust.

The fields of disturbance exhibited the effects of gas-explosion at separate points of space, with intervals of no explosion but of heat, partial combustion, and dissociation; requiring, for explanation, a chain of chemical changes liberating quantities of heat, and accumulating an explosive mixture at the place of explosion. The question arose whether a given volume of air could hold in suspension, as dust, a sufficient weight of coal to give, by its resolution into gas, more gas than the given volume of air was capable of burning or exploding; and investigation showed that the coal yielded a quantity of combustible gases, not less than one half the volume of the air in which it was suspended. In these conditions there could be only partial combustion, until a place was reached where the mine passage emerged into a capacious chamber in which the unconsumed gas found sufficient atmospheric oxygen, and was exploded by the flame in the partial combustion referred to. The disruptive effects were located in places of large air capacity in the paths of coal-dust.

At the point of origin, the coal-dust was reduced to coke, the residue of dry distillation; and this phenomenon was of frequent recurrence in the paths of the propagated explosions. Amorphous carbon was found universally deposited in the field of explosions, chiefly upon the vertical side-walls; it was also in copious suspension in the stagnant atmosphere in the passages, and the effluent gases at the shafts. Combustible bodies, as timber, cotton fabrics, and candles, forming obstructions in the paths of coal-dust and between the explosions, were not consumed or burned. The bodies of the victims in these intervals were blistered to various degrees; the cotton fabrics retained their external form, but had been deprived of their volatile matter, the candles had melted and run together, and the adjacent coal-dust and lumps of coal had undergone dry distillation. These effects upon the coal, men, calico, and candles disclose the fact that the atmospheric oxygen in the mine passages was not more than adequate to supply a portion of the educts of the coal undergoing distillation; consequently there was no oxygen available for the chemical requirements of other combustible bodies, as timber, clothes, cotton fabrics, and candles.

The chemical changes in the intervals from explosion to explosion caused considerable diminution in the atmospheric pressure, indicating a very small production of permanent gases, and the employment of the atmospheric oxygen to form readily condensible gas.

The explosions at the non-gaseous Camerton and Timsbury Collieries were originated by the heat in the products of the exploded blasting powder. The temperature of fired powder of a similar composition was determined by Abel and Noble at 1800° to 2000° C.; the products, therefore, struck the coal-dust in the immediate vicinity while at an exalted temperature, certainly higher than that of the gas retort, which is below 1000° C. The educts of the coal-dust would consequently be similar to ordinary illuminating gas. The composition of London gas is given (by Frankland) at 51·24 per cent. free hydrogen, 38·84 per cent. gaseous hydrocarbons, and some other bodies.

Upon the foregoing and other data, Mr. Stuart advanced the following rationale of a colliery explosion:—The educts of the coal are in excess of the relative combination volumes of atmospheric oxygen present; therefore the large proportion of nascent free hydrogen present, seizes the principal part of the oxygen, liberating heat in the combination. Some of the hydrocarbons obtain the remaining oxygen, causing a limited combustion, as in the preparation of diamond black, disengaging more heat, and placing amorphous carbon in suspension. At the temperature of burning hydrogen, the hydrocarbons that have not undergone change, for want of oxygen, are dissociated, placing more amorphous carbon in suspension, and yielding free hydrogen for disruptive effects.

The heat in the products of the exploded powder, therefore, instituted a series of chemical actions in the coal-dust, in which large quantities of heat were disengaged, and free hydrogen placed at disposal for disruptive action. This series is regenerative by virtue of the heat liberated, which instituted a similar series in the adjacent coal-dust; and these activities are of constant and similar reproduction along the paths of coal-dust until a place is reached, which supplies a large quantity of atmospheric oxygen, in which the accumulated hydrogen diffuses, and the mixture is ignited by the flame in the partial combustion, causing an explosion. This explosion liberates more heat, and re-establishes a similar chain of chemical changes in the coal-dust beyond, closing in a second explosion at the next abnormal supply of air, and propagation proceeds along each path of coal-dust so long as adequate oxygen is available, and wet surfaces do not intervene to reduce the temperature below the point at which the coal undergoing distillation yields sufficient free hydrogen to supply by its oxidation enough heat to make the actions continuous. The paper was illustrated with limelight slides, and was followed by an interesting discussion. Upon the motion of the President, Mr. Stuart was cordially thanked for his paper.

A NEW DIPHTHERIA ANTITOXIN.

A RECENT number of the *Archives des Sciences Biologiques*, issued by the Imperial Institute of Experimental Medicine in St. Petersburg, contains a highly important communication from Dr. Smirnow, on a new method of obtaining a diphtheria antitoxin of great therapeutic value. For the last three years Dr. Smirnow has been working on this subject, and the present memoir places experiments, which before were only in a tentative stage, on what now appears to be a sound and practical basis.

As is well known, the preparation of curative diphtheria serum involves not only great expense, but also a great deal of time; the raising of a horse's serum to the requisite pitch of immunising properties requiring many weeks. Dr. Smirnow has been endeavouring to produce an antitoxin, the preparation of which is less costly and less cumbersome. The method adopted was that of electrolysis, and in the first instance ordinary serum was electrolysed; but as this led to nothing, virulent diphtheria broth cultures were substituted for serum, and the results obtained were highly encouraging. These electrolysed cultures were found to contain an antitoxin of great efficacy, and, even when employed in smaller quantities than the therapeutic serum, it entirely protected animals from the effects of diphtheria poison. "Le traitement par cette antitoxine marche d'une manière remarquablement satisfaisante: malgré les périodes les plus avancées de la maladie, il suffit d'un demi

ou d'un centimètre cube pour que l'animal supporte sa maladie même sans grande élévation de température et presque sans aucune réaction à l'endroit de l'infection." So writes Dr. Smirnow; and, indeed, the experiments which he cites with this antitoxin fully justify this favourable verdict. Still more recently it has been employed on dogs, which of all animals are perhaps the most susceptible to diphtheria poison; this being proved by the difficulty which is experienced in immunising them for the production of curative serum. Dr. Smirnow states that a dog weighing from eighteen to twenty pounds, inoculated subcutaneously with 0·5 c.c. of virulent diphtheria broth cultures, usually dies in two or two and a half days after it has been infected. The protective treatment of a purposely infected dog was commenced one day after inoculation, and from 3 to 5 c.c. of the electrolytic antitoxin sufficed to save the animal's life. This quantity Dr. Smirnow thinks might probably be lessened, and yet not interfere with its remedial action. For the technical details of the methods recommended by Dr. Smirnow for the production of this artificial antitoxin, we must refer the reader to the original memoir, to be found in vol. iv. No. 5, 1896, of the Petersburg *Archives* already mentioned. It would appear that in itself the antitoxin is quite harmless, for ordinary guinea-pigs can stand with impunity a dose ten times and more as strong as that required for remedial purposes. As regards the effective quantity for injection, it appears that in the initial stages of the disease there is no difference in the amount required of the serum and Smirnow-antitoxin respectively; but as the disease progresses, whilst yielding to reduced doses of the artificial antitoxin, it will not to similarly reduced doses of antitoxic serum. Its preparation is incomparably simpler, and with a good supply of toxic diphtheria broth in hand, the antitoxin can be produced in a day, whilst, involving far less expense, it can be supplied at a much more reasonable rate. Dr. Smirnow has at least shown that the preparation of a specific remedy against diphtheria is not the exclusive monopoly of the animal organism, but can be elaborated artificially without the assistance of living mechanism. The author is to be congratulated upon the highly successful results which he has so far achieved; and if the therapeutic value of this electrolytic antitoxin is shown to be as great for man as it has undoubtedly proved itself to be for animals, then indeed Dr. Smirnow has made a distinct and important step forward in the domain of preventive medicine.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE following are among recent appointments:—Dr. Vélain to occupy the chair of physical geography recently founded in the Paris University; Mr. H. M. Paul and Mr. G. A. Hill to be professors of mathematics in the U.S. Navy.

THE Spanish Universities and other educational institutions under State control have just been thrown open to foreigners by Royal decree. By the new ordinance foreigners are admitted to the right of matriculation, study, and examination in all educational establishments under the Spanish Government, and are entitled to take degrees in the Universities.

IT is reported (says *Science*) that the subsidy given by the state to the University of California will be doubled, being hereafter 240,000 dols. annually. Mr. Levi Strauss, of San Francisco, has endowed twenty-eight undergraduate scholarships in the University, and seven graduate scholarships, of the value of 250 dols., have been endowed by other donors. The number of students in the University has increased from 918 in 1891-2 to 2250 in the present year. It is again stated that the University will receive gifts amounting to 5,000,000 dols. for buildings, of which sum 1,200,000 dols. is promised by Mrs. Hearst, of San Francisco. Chicago University has received a gift of 225,000 dols. from Mrs. Mary Esther Reynolds, in fulfilment of a pledge made nearly five years ago.

SCIENTIFIC SERIALS.

Symons's Monthly Meteorological Magazine, April.—The first daily weather map. In September 1895, Mr. Symons issued a photographic reproduction of the first daily weather map ever published, and promised to give its history, after making further inquiries. In 1849 the proprietors of the *Daily News* decided upon publishing reports of wind and weather. The organisation was entrusted to Mr. Glaisher, who travelled over the country, and, with the co-operation of the railway and electric telegraph companies, erected instruments and instructed the clerks in their use. The issue of the above journal for June 14, 1849, contained the earliest known telegraphic weather report. During the Exhibition of 1851, the Secretary of the Society of Arts decided upon issuing the information collected by the Electric Telegraph Company in the form of a daily weather map, the first of which appeared on August 8, 1851.—Scientific kite work in the Arctic regions. In a foot-note to Dr. Harvey's article on meteorology, in the *Encyclopedia Metropolitana*, there is a description of an experiment made by the Rev. G. Fisher and Captain Sir E. Parry, at the island of Igloolik, in lat. 69° 21′ N. and long. 81° 42′ W. during the winter 1822-23. The height observed was 379 feet, and the temperature recorded was −24°, there being no variation in the temperature between that altitude and the surface of the earth, although the thermometer was capable of indicating the smallest change.

SOCIETIES AND ACADEMIES.

LONDON.

Linnean Society, April 1.—Dr. A. Günther, F.R.S., President, in the chair.—Mr. Miller Christy exhibited three royal state cloaks formerly worn by the kings of the Hawaiian Islands, and made of the feathers of four species of birds, of which the exhibitor gave an account, referring to the coloured figures of them given in Mr. Scott Wilson's "Birds of Hawaii," namely, *Vestiaria coccinea* (red), *Psittacirostra psittacea* (green), *Acrulocercus nobilis*, and *Drepanis pacifica* (black and yellow). The last-named, of which no specimen is to be found in the National Collection, was believed to be now extinct.—Mr. W. T. Thiselton-Dyer exhibited: (1) A series of drawings (on the screen) to illustrate the "Cultural Evolution of *Cyclamen latifolium*, Sibth." The species is a native of Greece and the Levant, and is believed to have been first introduced into European cultivation in 1731. In 1768 Miller described a form modified by cultivation, under the name of *Cyclamen persicum*. This was erroneous, as, according to Boissier, neither the wild nor the garden form occur in Persia. The latter persisted in cultivation for about 150 years, and about 1860 became the starting-point of the modern races which were illustrated. *Cyclamen latifolium* has never been hybridised, and it was shown that the striking forms now in cultivation were the result of the patient accumulation of gradual variations. Drawings of the remarkable forms, "Papilio," obtained by de Langhe-Vervaene, and of the "Bush-Hill Pioneer," by Messrs. Hugh Low and Co., were shown. It was pointed out that the tendency of the species under cultivation was to lose its distinctive generic characters, and to approximate to a more generalised type. The reflexion of the corolla-segments was often lost, as in *Lysimachia*; the segments were sometimes multiplied, as in *Trientalis*; and the margins were fringed, as in *Soldanella* and cultivated forms of *Primula sinensis*. The "Bush-Hill Pioneer" possessed, in the cresting of the petals, a remarkable character, without parallel in any primulaceous plant occurring in a wild state. (2) A series of plants was exhibited to illustrate the origin of the garden "Cineraria." It was generally agreed that this had sprung from one or more species native of the Canaries. An extreme cultivated form was shown, and compared with *Senecio cruentus*, which all internal evidence indicated as the sole original stock. *S. Heritieri*, another reputed parent, was exhibited. But it was pointed out that this has a shrubby habit and stems markedly zigzag between the internodes, while the leaves are clothed beneath with a dense white tomentum. These characters it transmits, more or less, to its hybrid offspring. In illustration of this point, Mr. Poë's hybrid (*S. super-Heritieri* × *cruentus*) was exhibited (a similar one has occurred at Edinburgh); also the Cambridge hybrid (*S. super-cruentus* × *Heritieri*. *S. cruentus* crosses very freely with the garden Cineraria, and as the latter never exhibits any trace of the characters of *S. Heritieri*, it was concluded that that species had no part in its origin, and that, as in the case of the Cyclamen, the striking development of *S. cruentus* in cultivation was due to the continued accumulation of gradual variations.—Mr. A. W. Bennett exhibited a series of drawings, by Mr. E. B. Green, of root-hairs of plants with various parasitic growths, and showed

preparations of several under the microscope.—Mr. G. R. Murray exhibited several lantern-slides of coccospheres and rhabdospheres, prepared from specimens collected by Captain Milner, of the ss. *Para*, while on a voyage to Barbados, including all the forms figured in the *Challenger* Report (see p. 510).—Mr. H. Groves exhibited a large number of *Characeæ*, collected by Mr. T. B. Blow in various parts of Australasia and Asia, views of the localities referred to being shown on the screen by the collector.—Mr. George Massee, on behalf of Miss Helen B. Potter, communicated the substance of a paper on the germination of spores of *Agaricineæ*.—A paper by Dr. A. J. Ewart, on the evolution of oxygen from coloured bacteria, was deferred for reading until May 6 next.

Entomological Society, April 7.—Mr. Roland Trimen, F.R.S., President, in the chair.—A memorandum of an association for the protection of insects in danger of extermination, which had been drawn up by a Committee appointed for the purpose and approved by the Council, was laid before the Society and signed generally by those present (see p. 588).—The draft of alterations and additions to the Society's bye-laws, recommended for adoption by the Council, was read for the first time.—Mr. McLachlan showed, on behalf of Mr. Gerald Strickland, a magnified photograph of *Brachycerus apterus*, obtained by direct enlargement in the camera, and extremely clear in definition and detail.—Mr. Tutt exhibited some of the silk used by *Tephrosia bistorta* to cover its ova, and discovered by Dr. Riding. It was contained in a pouch at the extremity of the abdomen in the form of dense bundles about 2 mm. long, and resembling in miniature locks of wavy flaxen hair. Hitherto all such coverings were supposed to consist of scales from the anal segment.—Papers were communicated by Prof. Miall, F.R.S., on the structure and life-history of *Limnobia replicata*, and by Messrs. Godman, F.R.S., and Salvin, F.R.S., on new species of Central and South American Rhopalocera.

Mathematical Society, April 8.—Prof. Elliott, F.R.S., President, in the chair.—The President made some appreciative remarks upon the late Prof. Sylvester, dwelling more especially upon the loss to the Society and to the mathematical world generally sustained by his death. He mentioned that he had been authorised by the Council to write a message of sympathy to the deceased Professor's nearest relative.—The Rev. F. H. Jackson read a paper on the extension of a certain theorem (connected with Gauss's hypergeometric series).—Mr. Macaulay gave a sketch of a note on the deformation of a closed polygon, so that a certain function remains constant.—Mr. Love communicated an abstract of a paper, by Prof. Sampson, entitled "A Continuation of Gauss's Dioptrische Untersuchungen."—The President communicated from the chair a paper, by Herr Sommerfeld, "Ueber verzweigte Potentiale im Raum." (The method of the paper is a generalisation of Lord Kelvin's theory of images, and there are in it some interesting applications to diffraction problems. The paper was presented at the instance of Prof. Klein, who would like to bring about a somewhat livelier connection between English and German mathematicians.)—Mr. S. Roberts, a past President of the Society, having taken the chair, Prof. Elliott communicated papers, by Mr. A. L. Dixon, on the potentials of rings, and by Mr. J. W. Russell, on certain concomitant determinants.—Mr. R. Hargreaves and Lieut.-Colonel Cunningham, R.E., made impromptu communications, the latter writing on the board the following high primes:—305, 175, 781; 466, 344, 409; 550, 554, 229; 632, 133, 361.

EDINBURGH.

Royal Society, April 5.—Prof. McKendrick, in the chair.—A paper by Lord Kelvin and Dr. Maclean, on the electric properties of fumes proceeding from flames and burning charcoal (p. 592).—The automorphic linear transformation of a quadric, by Dr. Muir.—On ethene prepared from ethyl-iodide, and on the properties of some mixtures of ethene and butene, by Prof. Kuenen.—Continuation of experiments on electric properties of uranium, by Lord Kelvin and others.—Prof. Tait, in a short communication on the relations among the quantities p, v, t, in a substance, discussed certain of Amagat's recent results in their bearing upon Van der Waal's theory. What at first sight seemed to be a remarkable concordance between this theory and the facts of experiment, proved on closer inquiry to be quite the reverse.—Dr. D. Fraser Harris gave a demonstration of the reducing power of the living animal tissues (cat and rabbit), made by injecting into left external jugular the gelatine and Berlin-blue mixture used for blood-vascular injections. Injection commenced as soon as the animal ceased to breathe, and it was found that the liver most vigorously, and kidney next, reduced the ferric ferrocyanide in the blood-vessels to the pale-green or almost colourless ferrous ferrocyanide, which, on the organs being cut up and exposed to air, was reoxidised to the deep blue ferric salt. This reduction is the expression of the inspiratory phase of the internal respiration, and is a measure of the metabolic power of the living tissues.—In a second paper on hæmatoporphyrinuria and its relations to the source of urobilin, Dr. Harris showed that urobilin—for which urochrome would be a better term, as connoting no particular source of the urinary pigment—cannot now be held to be derived from absorption of altered bile pigment in the intestines. It has a *hepatic*, but not a biliary origin, and in health is formed in the liver probably thus: Hæmatin is there decomposed with deposit of iron and a precursor of urobilin produced, probably the chromogen, which, on traversing the lungs, is oxidised to urobilin, and in the kidneys again partly reduced to chromogen, so that we find both urobilin and its chromogen in the urine. In hæmatoporphyrinuria the urine is orange-coloured, and contains a less deoxidised pigment than urobilin, probably from depraved metabolism in muscular, cutaneous, and connective-tissue systems.—Dr. Albert A. Gray, Glasgow, in a paper on the perception of the direction and distance of sound, dealt, first, with some experiments on the degree of accuracy with which the direction of sound may be estimated. The question of how far the difference of phase with which a sound affects the two ears simultaneously may aid in judging its direction was considered, and Prof. Sylvanus Thompson's discoveries in this connection commented upon. The author described some experiments of his own upon the tympanic membrane, which showed that pressure of the chain of ossicles of one ear inwards caused the opposite ear to hear a sound more loudly. This peculiar fact was shown to be due, in all probability, to a reflex starting from the labyrinth of the first ear, and passing to the *tensor tympani* or *stapedius*, or (more probably) both these muscles of the opposite ear near which the sound was produced. Thus the muscular system of one ear is in connection with the opposite ear, and *vice versa*. As the positive phase of a sound-wave will relax the *tensor tympani*, and render the *stapedius* tense, and the negative phase will produce the reverse effect, it is evident that by means of the muscular sense we may be able to estimate the phase of a sound-wave in each ear, and by comparing both, be able to localise roughly the direction of the source of a sound.—Mr. A. Rankin read a note on the number of gales observed at Ben Nevis Observatory.

PARIS.

Academy of Sciences, April 12.—M. A. Chatin in the chair.—The election of M. Radau as a member in the Section of Astronomy, in the place of the late M. Tisserand, was approved by the President of the Republic.—On the observatory of Mount Etna, after observations of M. Riccò, by M. H. Faye. The observatory is situated about a kilometre from the central crater, at a height of 9650 feet. The chief difficulties have not been due to the eruptions of the volcano, but to the heavy snowfalls, which frequently attain a depth of from seven to sixteen feet at the observatory. The mean temperature for the year is 0°·4 C.—On the law of the discharge in air of electrified uranium, by M. Henri Becquerel. The loss of electricity by uranium appears to be solely effected by the gas in contact with the metal, since the losses sustained by a uranium ball in a vacuum are extremely small, and are of the order of the amounts which would leak through the supports. Reserving the effects of varying the gas for a future communication, the present paper contains the relations experimentally found to exist between the loss of potential and the time.—Further remarks on the classification of the Inseminæ, by M. Ph. van Tieghem.—Morphology of the sternum and clavicles, by M. Armand Sabatier. By a study of the sternum of the crocodile, new light is thrown upon the vexed question of the morphological signification of the sternal apparatus of vertebrates.—Interpretation of the parts of the anther, with special reference to the ovule in the genus *Lepidoceras*, by M. D. Clos.—Some remarks on two recent papers of M. van Tieghem.—Committees were nominated to act as judges for the prizes bearing the names of Philipeaux (experimental physiology), Montyon (unhealthy trades), Cuvier, Trémont, Gegner, Petit-d'Ormoy (mathematical sciences and natural sciences), Tchihatchef, Gaston Planté

Cahours, and Saintour.—Discussion of the barometric heights in the zone 10°—30° N. during 1883, by M A. Poincaré.—An internal governor for an aerial boat, by M. F. Lacerer.—Photography of Kœnig's flames, by M. Marage.—Experiments made on a new kathodic apparatus, by MM. Foveau de Courmelles and G. Seguy. The apparatus consists of two vacuum tubes joined to a spherical reservoir. The observations with this form show that the interior pressure in a vacuum tube is not equal at all points, this unequal distribution of the gas being produced during the passage of the current.—On the local attractions observed in Fergana, by M. Venukoff.—Heat of formation of formaldehyde, gaseous and dissolved, by M. Marcel Delépine.—On the formation of ammonium cyanide and its manufacture, by M. Denis Lance. Ammonia gas passed over carbon at a temperature of about 1000° C. always gives ammonium cyanide, the yield being greatest when the ammonia is mixed with a considerable proportion of nitrogen and hydrogen, and when the temperature is 1100° C.—Classification of the Orthoptera according to the characters drawn from their digestive apparatus, by M. L. Bordas.—Researches on the histology of the nerve cell, with some physiological considerations, by M. G. Marinesco.—On the physiological and pathological action of the X-rays, by M. Sorel. An account of the serious resnlts following the application of the X-rays to the stomach. It is regarded as inadvisable, at least in certain subjects, to apply the X-rays in the neighbourhood of important organs, such as the stomach, heart, or lungs. It has been remarked that the body of an animal which has been dead for some time is always more opaque to the Röntgen rays than one just dead and still warm.—Remarks on the preceding note, by M. Lannelongue.—On the toxicity of the alcohols, by M. Picaud. A study of the action of the alcohols upon fishes (*Carassius auratus*), batrachians (*Triton vulgaris*), and birds (*Carduelis elegans*). The toxic effect, as with the mammalia, was found to increase with the molecular weight.—Animal evolution, a function of the cooling of the globe, by M. R. Quinton.—Method of vaccination against poisoning by ricin, by M. Ch. Cornevin.—The destination of the megalithic monuments, by M. Ch. Godey.—A hydro-pneumatic motor, by M. G. Housset.—A horizontal barometer with rarefied air without the use of ice, by M. Victor Ducla.

DIARY OF SOCIETIES.

THURSDAY, APRIL 22.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Recent Developments in Electric Traction Appliances: A. K. Baylor. (Continuation of Discussion.)

CAMERA CLUB, at 8.15.—Peeps into Nature's Secrets: R. Kearton.

SATURDAY, APRIL 24.

ROYAL BOTANIC SOCIETY, at 4.

TUESDAY, APRIL 27.

ROYAL INSTITUTION, at 3.—Volcanoes: Dr. Tempest Anderson.

SOCIETY OF ARTS, at 8.—Delft Ware: Dr. J. W. L. Glaisher, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Annual General Meeting.

ROYAL STATISTICAL SOCIETY, at 5.30.

ROYAL HORTICULTURAL SOCIETY, at 1.—Winter and Spring Bedding.

ROYAL PHOTOGRAPHIC SOCIETY.—Technical Meeting, at 8.—A Practical Demonstration of Glass-blowing at the Lamp: T. Bolas.

ROYAL VICTORIA HALL, at 8.30.—The Life of an Egg: Dr. W. B. Benham.

WEDNESDAY, APRIL 28.

SOCIETY OF ARTS, at 8.—Asbestos and Asbestic: with some Account of the Recent Discovery of the latter at Danville, in Lower Canada: Robert H. Jones.

GEOLOGICAL SOCIETY, at 8.—On the Origin of some of the Gneisses of Anglesey: Dr. Charles Callaway.—Note on a Portion of the Nubian Desert South-east of Korosko: Captain H. G. Lyons, R.E., Miss C. A. Raisin, and Miss E. Aston

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, APRIL 29.

ZOOLOGICAL SOCIETY, at 4.—Annual Meeting.

CHEMICAL SOCIETY, at 8.—Monochlordiparaconic Acid and some Condensations: Dr. H. C. Myers.—On the Decomposition of Iron Pyrites: W. A. Caldecott.

CAMERA CLUB, at 8.15.—The Automatic Telephone: S. B. Apostoloft.

FRIDAY, APRIL 30.

ROYAL INSTITUTION, at 9.—Kathode Rays: Prof. J. J. Thomson, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.—Some Observations on the Infectivity of Diphtheria, and its Relation to School Closure: Dr. Louis Parkes.

SATURDAY, MAY 1.

ROYAL INSTITUTION, at 5.—Annual Meeting.

GEOLOGISTS' ASSOCIATION.—Excursion to Cookham. Leave Paddington 1.40 p.m.; arrive Cookham 2.30 p.m. Director: Ll. Treacher.

LONDON GEOLOGICAL FIELD CLASS.—Excursion to Leith Hill. Lower Greensand. Leave London Bridge, 2; arrive Holmwood, 3.17.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Le Four Électrique: H. Moissan (Paris, Steinheil).—Meteorology in Mysore, 1895: J. Cook (Bangalore).—A System of Medicine: edited by Dr. T. C. Allbutt, Vol. 2 (Macmillan).—Farm and Garden Insects: Dr. W. Somerville (Macmillan).—Collected Contributions on Digestion and Diet: Sir W. Roberts, 2nd edition (Smith).—Das Studium der Technischen Chemie: Dr. P. Fischer (Braunschweig, Vieweg).—L'Ottica delle Oscillazioni Elettriche: Prof. A. Righi (Bologna, N. Zanichelli).—Some Unrecognised Laws of Nature: I. Singer and L. H. Berens (Murray).—The Ancient Volcanoes of Great Britain: Sir. A. Geikie (Macmillan).—Aids to the Study of Bacteriology: T. H. Pearmain and C. G. Moor (Baillière).—Geology of North-East Durham: D. Woolacott (Sunderland, Hills).—Proceedings of the London Mathematical Society, Vol. xxvii. (Hodgson).—Contributions to the Science of Mythology: Prof. F. Max Müller, 2 Vols. (Longmans).—A Guide to the Fossil Invertebrates and Plants in the Department of Geology and Palæontology in the British Museum (Natural History), S.W. (London).—The Law and Practice of Letters Patent for Inventors: Dr. L. Edmunds and Dr. T. M. Stevens, 2nd edition (Stevens).—With the Dutch in the East: Captain W. Cool, translated by E. J. Taylor (Luzac).—The Forcing Book: L. H. Bailey (Macmillan).—The Story of the Mine: C. H. Shinn (Gay).—Problems and Questions in Physics: C. P. Matthews and J. Shearer (Macmillan).—Experimental Morphology: Dr. C. B. Davenport, Part 1 (Macmillan).—Cytologische studien aus dem Bonner Botanischen Institut: E. Strasburger and others (Berlin, Borntraeger).—Recherches sur les Origines de l'Égypte: J. De Morgan (Paris, Leroux).

PAMPHLETS.—Comité International des Poids et Mesures. Procès-Verbaux des Séances de 1895 (Paris, Gauthier-Villars).—Comptes rendus des Séances de la Deux Conférence Générale des Poids et Mesures, 1895 (Paris, Gauthier-Villars).—A Protest against the Modern Development of Unmusical Tone: T. C. Lewis (Chiswick Press).—Criticisms on Darwin's, Wallace's, and Häckel's Evolution Theories (Hodgson).—First Annual Report of the New York Zoological Society (New York).

SERIALS.—Bulletin of the American Mathematical Society, March (New York).—Physical Review, Vol. iv. No. 5 (Macmillan). Geographical Journal, April (Stanford).—Mind, April (Williams).—American Journal of Science, April (New Haven).—Notes from the Leyden Museum, October 1896 (Leiden, Brill).—Journal of the Royal Statistical Society, March (Stanford).—Engineering Magazine, April (Tucker).—Proceedings of the American Philosophical Society, November 1896 (Philadelphia).—Annals of the Astronomical Observatory of Harvard College, Vol. xl. Part 5; ditto, Vol. xxx. Part 4 (Cambridge, Mass.).—Journal of the Royal Horticultural Society, March (117 Victoria Street).

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