THURSDAY, JULY 28, 1898.

## SUBMARINE TELEGRAPHS.

*Submarine Telegraphs.* By Charles Bright, F.R.S.E. Pp. 744. (London: Crosby Lockwood and Son, 1898.)

IF experience, the possession of records, filial devotion, and many friendships qualify a man to chronicle contemporaneous events, Mr. Charles Bright is eminently prepared to write a history in which his father played an important part. This book is full of information. It gives evidence of great industry. It is well printed, admirably illustrated, thoroughly indexed, and makes a book of reference which should be in every engineer's library. The literature of the subject has been very meagre. Two or three text-books deal with the construction and working of cables. Many valuable papers are scattered in the *Proceedings* of engineering institutions, but there is no complete history of an industry that has not yet attained its jubilee. Mr. Bright has fulfilled his task very well. There is a remarkable free use of the footnote system. Sometimes the footnote, the result of subsequent inquiry, contradicts the text, but more often it gives details useful to the engineer, but uninteresting to the general reader. The book is divided into three parts: history, construction, and working. In the first part the evolution of the system of submarine telegraphy, still in active progress and without any sign of finality ahead, is lightly sketched. The days of secrecy have ceased; and manufacturers, engineers, and commercial managers are equally ready to publish all they know. The rough and tumble rule of thumb method of the speculative pioneer has disappeared, and the results of practical observation and scientific deduction control the progress of the industry. It is very interesting to note that the form of the first effective cable laid from Dover to Calais in 1851 has been but very little departed from, but its details and dimensions have changed with every requirement and for every ocean. Its development has given a knowledge of the sea, of its bottom, of its currents, and of its life, that has enlightened the geographer and the biologist. Science has advanced *pari passu* with engineering. The engineer has succeeded in interring many a foolish assumption in Davy Jones' locker, and in bringing to light and illustrating many a new condition undreamt of by the mathematician. Mr. Bright points out that success was obtained in face of scientific and public opinion. Even the Astronomer Royal of the day (Airy)

> "had very foolishly stated that it would be impossible to deposit the cable at so great a depth; and that in any case it was mathematically out of the question to transmit electrical signals through such a length (p. 51).

Now depth is no impediment; there are twelve cables spanning the North Atlantic. Fifty words a minute can be sent across the ordinary Atlantic in each direction at the same time, and it is pronounced by Mr. Preece even not impossible to speak by telephone between New York and London. The mileage of cable laid about the world is 170,000, and 50,000,000*l.* has been invested in the industry. The author avoids the prevalent mistake of using the term "knot" as a standard of length. It is a velocity, and the proper term for lengths is nautical miles (N.M.) or "nauts."

It should be recorded that the first money subscribed for the construction and laying of a submarine cable to cross the Channel, or indeed any sea, was 500*l.* each from Mr. (afterwards Sir Charles) Fox, Mr. Francis Edwards, Mr. J. W. Brett, and Mr. Charles J. Wollaston—the last-named being still living. These formed "The English Channel Submarine Telegraph Company" in 1850, and were the financial pioneers of the industry.

The construction, laying, and repairing of cables are very fully illustrated, the portion dealing with insulating materials is instructive, and the methods of working, together with the speed of signalling, are gone into very thoroughly. There is a want of agreement among experts in adopting some standard of reference as regards rate of working. Words per minute is very vague. What is the length of a word? Is it five letters, seven letters, or even ten letters per word? Are abbreviations used or not? Are the words ordinary or code? How many elements are there allowed in a letter, and how much is allowed for spacing? What allowance is made for skill? The only true criterion of speed is the number of complete waves that can be automatically and clearly transmitted per unit of time, and even this will depend on the sensitiveness and reliability of the apparatus used at each end.

Mr. Bright has executed his task in an impartial and disinterested way. He has marshalled his facts with much clearness, and the few errors detected are errors of proof-reading, easily remedied in the next edition. The most notable omission is that of the modern improvements in repairing apparatus. There is no description of cutting grapnels, or of the ingenious automatic signalling of the cable caught on the prongs of the grapnel at the bottom of the ocean. Moreover, he has not chronicled events in their chronological order, which becomes occasionally embarrassing in tracing historical sequence.

The history of submarine telegraphy is an excellent example of bold commercial enterprise, combined with blind faith in the prowess of the engineer and determined perseverance in overcoming great difficulties. The names of Cyrus Field and John Pender must always be associated with those of Bright, Canning, Varley, Kelvin, Clark, Siemens, and others, living and dead, who have done so much to establish the industry on a sound practical and commercial basis. Science, too, has benefited largely in numerous ways by this very progress. Physics, geography, biology and astronomy have each gained new facts and new conditions. The accurate determination of the longitudes of distant centres is no mean advantage: that of Madras has recently been measured with great skill. The columns of the *Times* every morning show how completely space has been annihilated, and how the uttermost ends of the earth are now virtually in London.

## A LIFE OF PASTEUR.

*Pasteur.* (The Century Science Series.) By Percy Frankland, F.R.S., and Mrs. Percy Frankland. Pp. vi + 224. (London: Cassell and Co., Ltd., 1898.)

IT is a pleasing task to review a book devoted to the life of a great man, and especially so when that book, like the one before us, does not pretend to be an exhaustive biography, but is intended to tell simple salient facts in a straightforward and scientific manner. This is well accomplished in sixteen chapters; and those who read them will have had amply demonstrated to them a most lovable and simple character, and a series of epoch-making discoveries which the reader can never fail to appreciate, for they were all directed to alleviate suffering and distress. In the first chapter one seems to obtain a clue to the bent of Pasteur's mind, for at the age of twenty-five he had worked out the optical properties of the tartaric acids, and had laid the foundation of our knowledge of the grouping of atoms. In the manner in which he studies the growth of the crystals one sees at this early stage the mind of the biologist, and step by step this becomes more noticeable. In the second chapter, two great events are briefly and sympathetically chronicled by the authors. The first is his marriage, the second emphasises his remarkable observation upon the action of fermentation upon the tartaric acids, showing the delicate selective action of organisms in readily picking out what appear to be chemically identical substances. "His work during this period stands out as one of the most remarkable and artistic monuments in the annals of chemical science."

Chapter iii. is a serviceable and useful one. Pasteur is created Dean of the Faculty of Science at Lille, and at once directs his scientific knowledge to the requirements of the place. The town is a centre for the manufacture of alcohol from beetroot, and Pasteur studies fermentation, and Lille and the world at large has benefited by these studies. It is often stated that the seats of learning are not in touch with the communities in the midst of which they live; it is due, to a great extent, to a lack of the sense of citizenship and patriotism, both of which were developed in a remarkable degree in Pasteur. In the brief sketch of the dawn of fermentation, the very natural opposition of the chemists, and of the others of a less bold frame of mind, is admirably brought out, and Liebig and Helmholtz stand forth in the opposition as men of narrower conception.

In 1857 Pasteur was made Director of the École Normale, an honourable title to which was attached a modest salary but no laboratory, France in no way differing from us in this respect. By this time the biological turn of Pasteur's mind had become much more pronounced. He not only saw the living cell at work and producing the fermentation of beer and vinegar, but he recognised that putrefaction and decay were fermentative processes produced by aerobic and anaerobic organisms. And just as his studies in the fermentation of beer marked a new period in the history of brewing, so at the present time his observations upon putrefaction are being made the basis for the treatment of sewage. Criticism and opposition to his views had by this time largely increased, but the result was excellent and far-reaching; for he laid the ghost of spontaneous generation, and demonstrated to the world that for their foods and infective diseases there could be effective sterilisation.

In Chapters vii.-ix. a still further development of fermentation is developed, and one which was destined to lead directly on to Pasteur's greatest service in the cause of humanity. In these chapters are unfolded his observations upon abnormal fermentation or the diseases of wine, beer, and of silkworms. The authors show how the industries concerned profited by these researches, and how the study of the diseases of the silkworms at once pointed out the necessity in the case of man and animals of intelligent central control in all infectious processes.

In Chapter x. and onwards the final work of Pasteur is described. Henceforth Pasteur is known as the pathologist who was able to bring a vast storehouse of chemical knowledge to his aid. He enters upon a new career, and soon begins to exercise as profound an influence in the medical world as the yeast cells did in the fermentative processes which he was the first to describe. Not only in France, but throughout Europe, medical men were encouraged by Pasteur's successes to come forward and prosecute their own studies into the cause of disease. In this manner it is clearly brought out, Davaine pursued his researches in anthrax, and Lord Lister his investigations in the treatment of wounds, methods which were destined to inaugurate a new epoch in surgery. Pasteur himself led the way in one direction of vast importance and utility, namely immunisation. This is developed in Chapters xii. and xiii., and the reader cannot fail to be filled with enthusiasm when he thinks of the beneficial results which have accrued and are likely to accrue from researches, prompted by a profound conviction in Pasteur's mind that there was a possibility of immunising against disease.

Chapter xiv. treats upon the researches in rabies, and every one will share the feelings of the authors in the stress they lay upon this most marvellously bold step in the cure of disease; it was probably his greatest achievement. The transformation worked in the medical profession had become complete, and laboratories similar to the Pasteur Institute were erected all over the civilised world; researches multiplied, and a new literature sprung into existence. We would wish that those who so hotly criticise Pasteur's work, could pause a little and read this chapter on rabies, and could see with us, something beyond the mere experiments therein recorded, the working of a civilising force which Pasteur has caused to take the form of a study in hydrophobia.

R. B.

## GARDEN-CRAFT.

*Garden-Making.* By L. H. Bailey. Pp. vii + 417. (London: Macmillan and Co., Ltd., 1898.)

*The Pruning-Book.* By L. H. Bailey. Pp. ix + 537. (London: Macmillan and Co., Ltd., 1898.)

THESE two volumes of the Garden-Craft series may, inasmuch as they deal mainly with technical subjects, be here taken together. Products of the pen of Prof. Bailey, originality of treatment may be confidently looked for and as certainly found. Neither principles nor practice in America differ in essentials from those

on this side of the globe; their application necessarily differs according to climatal and economic environment. The American territory, however, is so vast that differences of environment are as great in different parts of the Union as they can be between the old Continent and the new.

Business men are keen in the growth, the purchase, and the sale of plants in both countries. The enormous increase in the cultivation of fruit and flowers for market in the vicinity of London and other great towns is one of the most remarkable features of the last quarter of a century, but one which the economists have not yet fully realised.

The mania for cultivating certain classes of plants—for instance, orchids—has led in certain special cases to an enhancement of value which seems preposterous, though it must not be forgotten that there are hundreds of other plants of equal beauty and interest the price of which may be reckoned in pence.

The extravagant use of flowers for decorative purposes by persons who, for the most part, care little and know less of the plants they utilise, is a phenomenon quite as marked, if not more so, in the States than here. In this country we have, happily, nearly abandoned the floral devices where battleships, mail-carts and other incongruous things are simulated in flowers, and carpet-bedding is gradually becoming less offensive here, though in full blaze in the States.

Withal, gardening for gardening sake is at present less prevalent in the States than in the older countries. The repose, the refinement, the seclusion, the interest attaching to the culture of plants and the maintenance of a garden, are relatively less observable in the new than in the old country. America, moreover, although she has given us botanists of the first rank, has not yet furnished gardeners to rank with a Knight, a Herbert or a Lindley.

That such men may be looked for in the future is, we think, evidenced by the superior quality of the American horticultural hand-books, and by the multiplication of experiment stations. We are not speaking of established text-books, but of the flood of gardening literature which is now being poured out, the quality of which is often in inverse proportion to the bulk.

Prof. Bailey's "Garden-Making" is original and suggestive, and the most mechanical operations are illumined by thoughtful comment and quaint remark. It is as well to say that the book is intended for gardeners who pursue the art on a large scale for commercial purposes. The ordinary gardener would be scarified—the word is appropriate—by the "plows," harrows, and "cultivators" here figured, and the amateur would banish from his "borders" such fearsome weapons and those who used them.

Nematode worms cause much destruction in English gardens, but the American gardener, it seems, sterilises the soil by allowing it to become thoroughly frozen before use, a practice which could not always be followed here. The second section of the book is devoted to the subject of laying-out the garden. The author's guiding principle is that the planting should be done with the definite object of producing a picture, however small. Meaningless planting is very properly deprecated, and numberless suggestions are given for planting which shall be at once pleasant and appropriate. The latter part of the volume is devoted to lists of hardy plants, fruits and vegetables, suitable for cultivation in the Northern States.

The "Pruning-Book" is marked by the same characteristics as "Garden-Making." Artificial pruning serves to regulate the struggle for existence among buds, to favour those which are required for the purposes of the gardener, and to obviate and nullify the competition with others. The operations of the gardener thus differ from natural ones in the circumstance that they are effected with a definite object in view; whilst in nature, that bud survives which is best adapted to the conditions. Wounds and their mode of healing receive much attention, and we note that Prof. Bailey recommends an application of Bordeaux mixture as a dressing for wounds, a practice which, so far as we know, has not been followed in this country. In the matter of pruning and training we have not much to learn from our cousins; indeed it seems, from the quotations in Prof. Bailey's book, as if we were the instructors in this case.

## OUR BOOK SHELF.

*The Diseases of the Lungs.* By James Kingston Fowler, M.A., M.D., F.R.C.P., and Rickman J. Godlee, M.S., F.R.C.S. Pp. xv + 707. Plates v. 1060 Illustrations. (London: Longmans, Green, and Co., 1898.)

THE collaboration of a physician and a surgeon for the purpose of producing a text-book of diseases of the lungs is *à priori* likely to be successful. It has long been quite usual to incorporate into text-books on medicine a chapter by a surgeon upon the surgery of the chest; but the present book, so far as we are aware, is the first of its kind. A perfect knowledge of the capabilities of surgery is essential to the physician, and although a relatively small part of the volume before us is from the pen of Prof. Godlee, his contributions to it lend to the book a very special value to the physician.

The book begins with a chapter on the anatomy of the chest by Prof. Godlee, in which are numerous illustrations; the author's reputation as an anatomist is well maintained, and all the anatomical points of importance in the surgery and medical diagnosis of chest disease are well emphasised. The medical part of the volume is introduced by a chapter on physical diagnosis. Nine chapters are devoted to pulmonary tuberculosis, and together form a very exhaustive monograph upon the subject. So much has been written upon the pathology of tuberculosis by pathologists, that in a work like the present, written by a physician, one naturally turns to the clinical part, and especially to treatment. From this it appears that Dr. Fowler shares the general opinion of the value of the so-called open-air treatment of phthisis, especially when combined with forced feeding, as practised at what may be termed the sub-alpine sanatoria abroad. These sanatoria are now not wanting in England and Wales, and it is to be hoped that all consistent with medical ethics will be done to make them well known. Serum treatment, including under this term the "tuberculines," and the antiseptic treatment, are not spoken of very favourably by the author. Prof. Godlee contributes a chapter upon the surgical treatment of pulmonary cavities, and one upon injuries of the lungs. The subjects of hæmoptysis, pulmonary syphilis, pneumothorax, are exhaustively treated. The volume concludes with a short essay on clubbing of the fingers and toes, containing a photograph and skiagram obtained from a patient suffering from this condition; the latter showing that the ends of the terminal phalangeal bones are not enlarged.

The book is well indexed and written in a clear style; it will doubtless occupy a prominent place amongst the text-books of diseases of the lungs, and well deserves to do so. F. W. T.

*An Elementary Course of Infinitesimal Calculus.* By Horace Lamb, M.A., F.R.S., Professor of Mathematics in the Owens College, formerly Fellow of Trinity College. Pp. xx + 616. (Cambridge: University Press, 1897.)

THE author states that his aim in this book is to teach those portions of the Calculus which are most useful for a student of physics or engineering. We fear that many an engineering student would be disheartened at the start-off by such sections as those in the first chapter on the upper or lower limit of a sequence and of an assemblage. On the other hand, there is surely room to doubt the wisdom of the limitation implied in the statement—"Imaginary quantities are nowhere employed in the book," seeing that this is a book of over 600 pages, and includes chapters on differential equations in which symbols of operation are freely used.

But although we think there is at once too much and too little for the needs of engineering students, and that it is to be regretted that the author has not permitted himself to use illustrations from such subjects as heat or electricity for the benefit of the students of physics he has in view, we are glad to recognise in the work before before us merits of a very high order. Thus immediately after the rules for differentiation are established, we have applications to maxima and minima and to geometrical problems. The rules for integration are then introduced with applications to areas, volumes, moments of inertia, &c. The diagrams are numerous, always large and clear, and often drawn to scale. There are a great many easy, straightforward examples provided; and care has been taken not to admit examples or processes involving difficult analysis or mere ingenious artifice.

Teachers in secondary schools and colleges will be well advised in using this as a text-book for beginners in the Calculus, although it is not in our opinion what is required in technical classes.

*Radiography and the "X" Rays.* By S. R. Bottone. Pp. x + 176. (London: Whittaker and Co., 1898.)

THIS is another of the now considerable series of more or less popular handbooks dealing with the applications of the Röntgen rays. Medical men, amateur experimenters and others who may wish to put Röntgen photography into practice will find it useful, lucid, and trustworthy. Within the compass of 172 pages the book contains many practical hints on the construction and working of induction coils, influence machines, Crookes' tubes, and fluorescent screens, and on general photographic and manipulatory details.

*Ackworth Birds, being a List of Birds in the District of Ackworth, Yorkshire.* By Major Walter B. Arundel. Pp. viii + 105. (London: Gurney and Jackson, 1898.)

IT may be well to remark at once that this is not merely an enumeration of the birds observed in Ackworth and the neighbourhood, but a collection of notes on the habits of the species described. On this account, the volume is not only of interest to local ornithologists, but is also a worthy contribution to the literature of bird-life.

*Angling Days and an Angler's Books.* By Jonathan Dale (I. E. Page). Pp. 160. (London: Elliot Stock, 1898.)

A COLLECTION of stories concerning anglers and angling. A few natural history notes are scattered through the pages; but in the main the book consists of more or less commonplace remarks upon fishing experiences, and the expression of the author's sentiments upon landscapes and rural scenes in general.

## 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.*]

### Liquid Hydrogen.

I SHOULD be inclined to let Prof. Dewar's manner of replying to my statements speak for itself were it not that he makes in his last letter imputations of an unwarrantable kind. He says, "Mr. Hampson got at my assistant behind my back." This expression is quite indefensible. I received an introduction to Mr. Lennox from the senior partner of a large chemical firm in London of the highest standing, who said that he had a familiar acquaintance with Prof. Dewar's assistant. Had he been sufficiently intimate with Prof. Dewar himself to offer me a confident hope of gaining that gentleman's attention directly, I should at that time have been still better pleased with an introduction to him. As it was, I went openly to the Royal Institution, in the busiest part of session, and between the hours of eleven and twelve in the morning. Surely, nothing would have been more natural under these circumstances than a chance meeting with Prof. Dewar himself. Is this the conduct of one who was plotting to "get at" his assistant "behind his back"? Whatever grounds Prof. Dewar may have for thinking his assistant capable of improper action, he has no right to use such abusive terms regarding the very simple and straightforward course that I took in the matter. Prof. Dewar says, "I infer from the public correspondence that he (Mr. Lennox) saw that they (the plans) would not work, and he told Mr. Hampson why they were unworkable." This inference of Prof. Dewar's is altogether false, as is best proved by a study of the correspondence itself. This correspondence took place in *Engineering* last spring. I am myself so satisfied with the conclusions to be drawn from it, that I have had the whole series of letters reprinted, and I will send a copy with pleasure to any one who desires to do me the justice of forming his own opinion on the merits of the case. It is strange that Prof. Dewar, having himself published his belief that his assistant is capable of being "got at" by a complete stranger, should in the very next line attach some importance to that gentleman's account of the transaction as given in those letters. The identity between the "unworkable" plan proposed by me to Mr. Lennox, and that subsequently, or, as Prof. Dewar puts it, "in the meantime," worked out with complete success by Dr. Linde, by myself, and by Messrs. Lennox and Dewar, does not depend on my statement only. All the points of the new combination were put together in the drawings submitted by me to Mr. Lennox, and an exact copy of these drawings was exhibited before the Society of Chemical Industry on May 2 last, when Mr. Lennox was present, as well as Prof. Dewar, and it appears with the published report of my paper. The same combination is found in no earlier drawings except some previous sketches of my own. Prof. Dewar, in his last letter, admits an inventor's property in "the particular combination to which he himself may give concrete form"; and I gave concrete form to this particular combination in the drawings submitted to Mr. Lennox. Prof. Dewar says that it took me "another year to perfect a provisional specification," "which is totally devoid of any plan or drawing of a workable apparatus." It only took five months, of which time half was spent in waiting for Mr. Lennox to fulfil his promise to experiment, and in trying to extract from him some information as to what was being done. It was my failure to obtain any satisfaction on this score that decided me to apply for provisional protection, for which drawings are not required, as Prof. Dewar well knows. My communications to Mr. Lennox were made in November and December 1894, my application for provisional protection in May 1895.

July 22. W. HAMPSON.

### The Distribution of Prepotency.

MR. GALTON has raised under this heading a most important point—or, rather, a series of most important points—in the problem of evolution. Perhaps I may be permitted to say a few words with regard to his views on evolution by sports and by normal variation. Mr. Galton's opinion, I think, is that sports are inherited in a higher degree than improbable normal variations, and that evolution must accordingly take place very largely

by means of the former. To use a term I have introduced elsewhere, the sport connotes a shifting of the focus of regression, but any normal variation, however improbable, does not. In the preface to the 1892 edition of his "Hereditary Genius," Mr. Galton writes: "All true variations are (as I maintain) of this kind [*i.e.* sports], and it is in consequence impossible that the natural qualities of a race may be permanently changed through the action of selection upon mere variations. The selection of the most serviceable variations cannot even produce any great degree of artificial and temporary improvement, because an equilibrium between deviation and regression will soon be reached, whereby the best of the offspring will cease to be better than their own sires and dams." And again: "The case is quite different in respect to what are technically known as 'sports.' In these a new character suddenly makes its appearance in a particular individual, causing him to differ distinctly from his parents and from others of his race. Such new characters are also found to be transmitted to descendants. Here there has been a change of typical centre, a new point of departure has somehow come into existence towards which regression has henceforth to be measured, and consequently a real step forward has been made in the course of evolution. When natural selection favours a particular sport, it works effectively toward the formation of a new species, but the favour that it simultaneously shows to mere variations seems to be thrown away so far as that end is concerned."

I have cited these passages because Mr. Galton's letter seems written with a view to their support, and because they contain principles which I feel to be unproven and even opposed to fairly well-established theory. I will take these principles in order.

(1) *No real step forward can be made by the selection of mere normal variations.*

This principle is stated as if it flowed from the theory of regression; but it is entirely opposed to that theory, and to Mr. Galton's own law of ancestral heredity. According to that law, if the average midparents of the 1st, 2nd, 3rd . . . generations possess on the average quantities $h_1$, $h_2$, $h_3$ . . . of a character in excess of the general population, then the average offspring will possess a quantity $h$ of the character given by

$$h = \tfrac{1}{2} h_1 + \tfrac{1}{4} h_2 + \tfrac{1}{8} h_3 + \ldots$$

Now, if we select parents with deviations H from the general population, these parents being "mere variations," whose ancestry were entirely mediocre, or $h_2 = h_3 = 0$, we have $h = \frac{1}{2}$ H, or the children have half their parents' character. Their offspring, however, have not only exceptional parents but exceptional grandparents; thus, while they lose as to their parents, they are a stage further removed from mediocrity in their grandparents, and for them $h_1 = \frac{1}{2}$ H, $h_2 = $ H, and $h_3 = h_4 = \ldots = 0$. Hence $h = \frac{1}{2}(\frac{1}{2}\text{ H}) + \frac{1}{4}\text{ H} = \frac{1}{2}$ H. For the grandchildren, $h = \frac{1}{2}(\frac{1}{2}\text{ H}) + \frac{1}{4}(\frac{1}{2}\text{ H}) + \frac{1}{8}(\frac{1}{4}\text{ H}) = \frac{1}{2}$ H. Thus by a *single* selection from normal variations and in-and-in breeding a stock has been established which differs by $\frac{1}{2}$ H from the general population. Selection for only two generations leads to a stock with three-quarters of the required character, while selection for three generations from mediocrity gives a stock stable with 87·5 per cent. of the selected character.

I contend therefore, against Mr. Galton, that normal variation really affords material for stable changes, and this without that development "slowly through the accumulation of minute and favourable variations during a long succession of generations" which he considers necessary. Artificial selection in the matter of horse-breeding has, I believe, quite play enough for great changes in the material provided by normal variation. If we take a great thoroughbred sire and put first-class thoroughbred mares to him, we should be utterly wrong in supposing a regression in their offspring measured by $\frac{1}{2}$ (the mean deviation of sire and dam) towards the mediocre race-horse. The sire and dam in this case have, even for thoroughbreds, exceptional pedigrees behind them. I think this goes a long way to explain the phenomenon noted by Mr. Galton, namely, certain sires producing such a preponderance of standard performers. There is another point which, I think, Mr. Galton has under-estimated also, namely the effect of fashion on the breeder. Some years ago I saw a good deal of the inner working of a large thoroughbred stud, of which two at least of the stallions were always very famous horses (costing 6000*l.* to 9000*l.*). I believe from forty to fifty public mares were put to these stallions, besides from ten to twenty mares belonging to the stud itself. Their lists were always full; on the other hand, the less fashionable stallions hardly had their complement of mares, and the mares sent to them were often inferior or past their more intense fecundity. This latter is a very important consideration. I have recently been investigating the fertility of 4000 broodmares. In this case, in one-hundred coverings we find about sixty-three cases in which foals are born and survive to be yearlings, but the standard deviation in this average fecundity is as high as nineteen foals; in other words, there is an immense difference in the capacity of different mares to produce viable offspring. Now a breeder sends not only his best-bred, but his most fecund best-bred mares to the most famous and, therefore, most costly stallions. The result is that comparatively few horses are the sires of the bulk of the best yearlings. It must be remembered that in England we have only some 4000 thoroughbred foals annually, and only a certain fraction of these ever become racers. It would by no means surprise me to find that a quarter of this contribution was due to some six or ten fashionable sires. The American conditions are probably somewhat similar. In other words the second-rate stallions, besides their inferiority in breed, are given far less chance of producing performers.

To complete Mr. Galton's argument it would be necessary to show (1) that the sires who produced only one performer had as much chance of producing performers as those who produced 71 to 154, and (2) that their pedigree was as good as the latters'. Thus it seems to me that Mr. Galton's first principle is opposed to his own law of ancestral heredity, which I look upon as demonstrated to a first approximation by observed facts, and secondly does not, I venture to think, receive support from his data for American horses.

(2) *Sports are more highly inherited than normal variations.*

This seems to me a principle which can only be proven by extensive experiment. In the first place, a "sport" must be carefully distinguished from a normal variation of an improbable degree; and this is not always easy, especially in a case like that of Mr. Galton's American trotters, where high prepotency is asserted to be a sport. In this case it is inheritance in a high degree which leads to the discovery of the sport. But what is the degree of inheritance to be expected when fashion has determined the frequency, it would be hard to say. Further, as I have pointed out under (1), the degree of inheritance depends on the stability of the stock, and the performances of the pedigree of the five leading stallion trotters as compared with the performances of the pedigree of the average stallion trotter are not given by Mr. Galton. The degree of inheritance of the character of the sire by the offspring depends on what I have elsewhere termed the coefficient of stability; and not only is this pedigree often missing in the selection of what is termed a normal variation, but also in the case of what is termed a "sport." It becomes, therefore, difficult to compare the rates of inheritance in the two cases.

There is a well-known case of sheep often cited to show that sports are strongly inherited, but the details of this case are not wholly clear. Polydactyly, which some might term a sport, does not seem to me to indicate any intensity of heredity beyond what may be inferred from an application of the law of ancestral heredity to the pedigree. No direct experiments on sports are known to me. Accordingly I think we must wait until experiment has shown that sports are more highly heritable than normal variations, before we assert that a case of high degree of inheritance is evidence in itself of a sport. Personally I may be bold to set up an opinion against such an authority as Mr. Galton, but the more I learn of race in man, horses and dogs, the less inclined I am to trust sports as a fundamental factor more important than normal variation[1] in the establishment of stable stocks.

But this second principle differs from the first, which I believe to be erroneous, because it ought to be capable of being settled by direct experiment, and is at present only a matter of opinion. Is it absolutely hopeless to wish for the farm which Mr. Galton once dreamed about, where direct experiment might test the laws of heredity on plants and animals?

KARL PEARSON.

[1] I would prefer the term *continuous* variation. I should not necessarily have treated variation according to the normal law of error, as the opposite to a sport.

### Moral Sense and Ethic.

IN the criticism of Mr. Sutherland's book by "F. G." (NATURE, July 14, p. 241), no notice is taken of the distinction between moral sentiments and ethical perceptions. Perhaps this distinction is most evident in cases where a man, or woman, perceives an action to be a bad one, and at the same time prefers to do it, and does it.

At p. 249 Principal Lloyd Morgan quotes Mr. Thorndike as saying, of writings about animals, that "they have all been about animal intelligence, never about animal stupidity." The chapter on "the animal faculties" in my work "On Truth," contains a distinct section (p. 355) devoted to "animal stupidity," which is also referred to (p. 124) in my "Origin of Human Reason." ST. GEORGE MIVART.

77 Inverness Terrace, W., July 15.

### Curious Phenomenon.

ON July 8, at about 8.50 (Mean European time), I noticed what I took at first to be the end of a rainbow. The sky was nearly cloudless towards the north; 30° south of the zenith began a mass of grey clouds, tinged here and there with red till about 15° from the horizon. Below the lowest of the red clouds was an object, about as broad as a rainbow, a degree or two E. of S., and about 12° high. It was red, but in the first few moments I thought I detected a tinge of green on the E. side. It remained in its original brightness about five minutes, then faded very rapidly, and then remained almost stationary again, finally disappearing about eight minutes after I first saw it. The sun had, so far as I could judge, set about five or ten minutes before I noticed the appearance. I am quite sure of the time, as we have a mid-day gun.

9 Gerhard Street, Kiel. N. W. THOMAS.

### The Nature and Habits of Pliny's Solpuga.

ALTHOUGH of great interest in itself, the note by Prof. Cook, in NATURE for July 14, p. 247, becomes more interesting still when considered in connection with Dufour's observation touching the freedom of the Algerian Solpugas from persecution by the solitary wasps. The importance of the fact he records, moreover, would be considerably increased if the reason why the honey-bees of California permit the intrusion of their hives by these Arachnoids was explained. Such an explanation might perhaps furnish a solution to the hitherto unanswered problem why the wasps let the Solpugas alone.

R. I. POCOCK.

## *THE BUILDINGS AT SOUTH KENSINGTON.*

SO far there does not appear to be anything finally settled with regard to the allocation of space to the Science and Art Buildings at South Kensington. While on the one hand Mr. Akers Douglas has declined to give any information to the Chairman of the Select Committee which made the recommendations which have since been strenuously supported by the representatives of Science and Art; on the other, the *Birmingham Daily Post* announces that the matter has been settled on the lines of the recommendations in question.

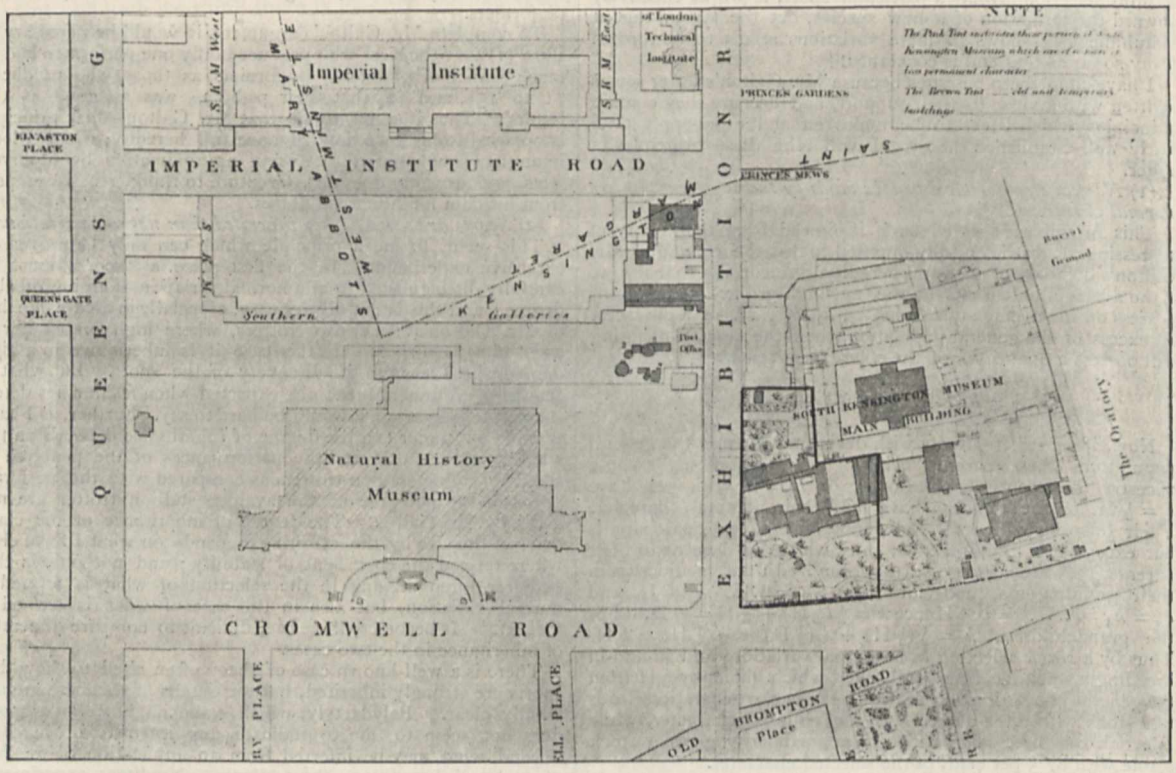



FIG. 1.—The neighbourhood of the South Kensington and Natural History Museums, showing the space (bounded by a black line) available for Science buildings on the east side of Exhibition Road.

In order that the exact nature of the question at issue between the representatives of Science and Art on the one hand, and certain Government officials on the other, may be clearly grasped, it is only necessary to follow up the statistics given by Sir Philip Magnus in his article on Technical High Schools (NATURE, May 19). In this article a comparison was made of the area occupied by the Royal College of Science with that of several German technical schools, one of the results which clearly comes out being that some of the latter are ten times bigger than the College.

It has long been known to the Government that the College is too small. Physics, Astronomical Physics, Geology, Mining, Metallurgy and Mechanics have had

to be accommodated wholly or in part in other buildings; and years ago it was agreed on all hands that the needful accommodation should be provided on the west side of Exhibition Road, on the plot of ground between the Imperial Institute Road and the Natural History Museum.

This ground had been purchased by the Government in 1890, and sold by the Royal Commission for the Exhibition of 1851, at one-third its value, for the purpose of erecting scientific buildings on it.

But quite recently all this has been changed; the perfectly novel suggestion being made that a chemical and physical laboratory should be built on the *east* side of Exhibition Road on a part of the plot of vacant ground where it was proposed some years ago to erect buildings to complete the Art Museum. In fact, Mr. Webb's plans to cover all the vacant space with Art buildings were accepted.

Under the old and accepted arrangement we were to have Art, with power of expansion, on the east side, and Science, with power of expansion, on the west side, of Exhibition Road.

Under the new proposal there would be no possibility of continuous and properly provided expansion of either. Adjacent Art buildings would strangle Science, and adjacent Science buildings would strangle Art. Hence the result would be disastrous for both, and it is on this ground that we now find the Royal Society and the Royal Academy shoulder to shoulder, and sending almost identical memorials to the Prime Minister.

The plan of the neighbourhood of the South Kensington and Natural History Museums (Fig. 1) shows, bounded by a black line, the space we may roughly take as available for the Science buildings on the vacant ground south of the existing Art Museum, on the assumption that this vacant ground is divided equally between Art and Science.

Fig. 2 shows the space thus available contrasted with the areas actually occupied by the buildings of certain continental Chemical and Physical Laboratories, *on the same scale*. It will be seen at once that London will be no better off than Graz!

We next turn to the land available on the west side of Exhibition Road. The plot which the Government has obtained from the '51 Exhibition Commissioners for a nominal sum for the purpose of the erection of Science buildings, is that bounded by the Imperial Institute, Exhibition and Cromwell Roads, and Queen's Gate. It contains 20 acres; of this more than 12 acres are allocated to the Natural History Museum. The remainder has to provide for the Inorganic Sciences, Mechanics, Physics and Chemistry in all their branches, and their teaching and applications to industry. It will be seen that the space is far too small for these needs, if the precedent set by the Natural History Museum is to be followed; and it must not be forgotten that in relation to Natural History there is no provision for teaching in the Museum, and from the nature of the subject no applications.

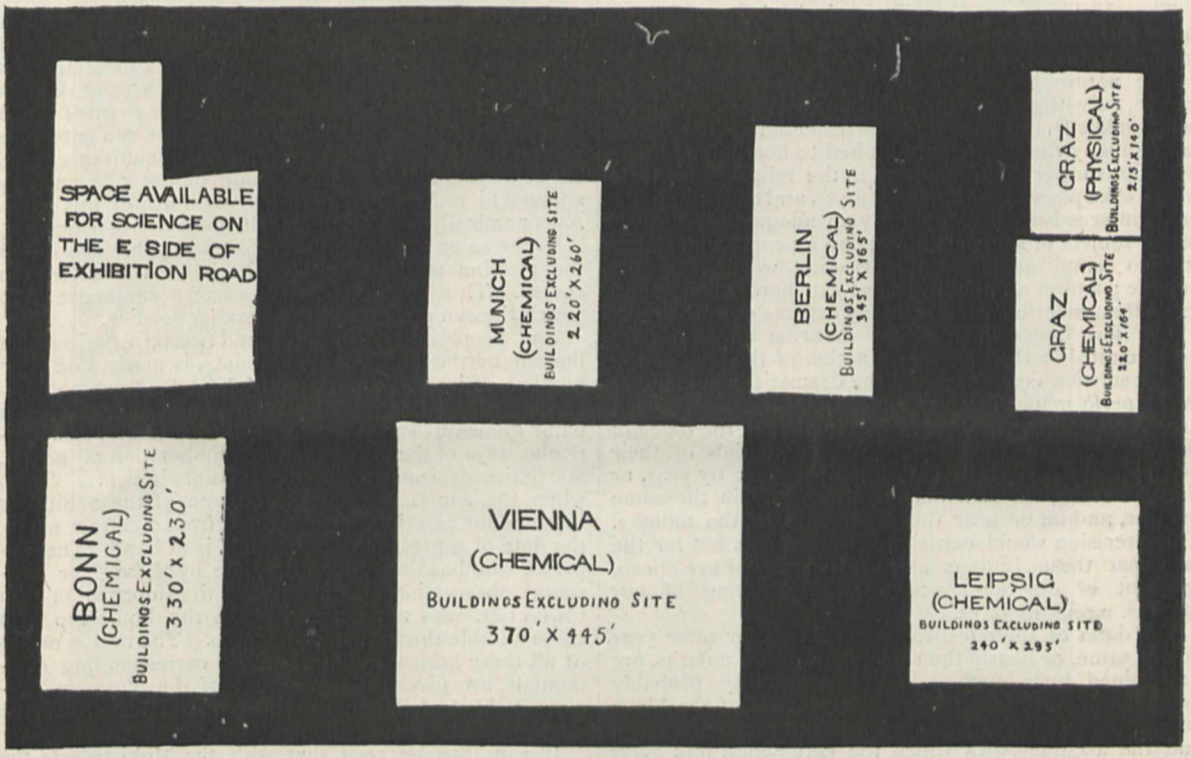



FIG. 2.—Comparison of the space proposed to be devoted to the Chemical and Physical Laboratories at South Kensington, with the space devoted to similar buildings on the Continent.

## *ASPECTS OF SUN WORSHIP AMONG THE MOKI INDIANS.*[1]

THERE probably survives no tribe of Indians in the United States which has preserved its aboriginal worship in a purer form than the so-called Mokis, a group of agricultural people of north-eastern Arizona. These Indians live in seven villages or pueblos, situated on inaccessible mesas, and number a few less than 2000 souls. They inhabit the same territory, and in the case of the denizens of their largest pueblo, Oraibi, live on the

1 "The Winter Solstice Ceremony at Walpi." (*The American Anthropologist*, March–April 1898.)

same site that their ancestors did when visited by the early Spanish explorers, in the middle of the sixteenth century.

For three hundred years after their discovery the Mokis were practically independent, and notwithstanding efforts were made by zealous priests to Christianise them during that time, these heroic attempts signally failed to change the aboriginal character of their religious beliefs and practices. With a pertinacity, born of conservatism, they still cling to their ancient mythology and ritual, which remains practically unmodified, presenting to the ethnologist a most instructive phase of native American religion.

An examination of this ritual shows it to be a most complicated one, as may be seen by a consultation of the extensive literature which has accumulated on this subject. Notwithstanding considerable progress has been made in the interpretation of many details, much still remains to be studied before accurate general ideas of its character are possible.

The Mokis are primarily agriculturists, and their religion is consequently one in which worship of the sun, rain, and growth of maize is pre-eminent.

The nature of their sun-worship is very obscurely known, notwithstanding it is well marked both in all great ceremonials from one end of the calendar to the other, and in many rites, which are limited to family life. Solar worship is especially prominent in the religious festivals which take place at the two equinoxes, and on the summer and winter solstices. Manifestly an adequate treatment of the subject of sun-worship among a people with whom it is so complicated, and all-pervading, would require a volume ; and in a limited space I can hardly hope to do more than mention a few of many aspects of the subject.

The few lines which follow describe an aboriginal astronomical method of determination of the date of the winter solstice ceremony, and the dramatisation adopted in the performance of solar rites at that time. It is well known to students of the Moki ritual that the dates of the months on which the great ceremonials of their calendar are performed vary but little year by year, or that their religious festivals recur annually in the same months, and on or near the same days of the months. This precision would occasion little surprise, but for the fact that these Indians are, and always have been, ignorant of our almanacs, knowing nothing of our months, weeks or days.

The dates of their festivals, recurring year after year on the same, or nearly the same, days of the months, are determined by a method of great antiquity, probably pre-Columbian times. The native calendar of the Maya and kindred peoples of Central America are well known, and the accuracy with which the ceremonial and solar years were adjusted has been commented upon by several well-known Americanists. The Mokis had taken the most important step in the discovery of a similar calendar, for they are able to recognise the same day when it returns, year after year, by a purely astronomical method. To count the intervening days, or to determine the number of days in a ceremonial or solar year, was a secondary step which they never took, nor had they discovered that one festival follows another by a lapse of a certain interval of time.

The student who is interested in the question of the accuracy with which this same date was fixed upon year by year, will find in the *American Anthropologist* a tabular list of ceremonies and dates on which they occur. It will be seen from this list that while there is a variation of a few days in several important festivals, as the snake dance, in the case of those which take place at the winter solstice the method is perfect, and, as a result, the determination accurate to a day.

The dates for the celebration of the great ceremonies in their calendar are determined by the position of the sun on the horizon. The sun-lore, or astronomical knowledge necessary for this purpose, is traditional among men, called sun-priests, who belong to certain clans of the pueblo, and these clans are reputed to have migrated to Moki from ancestral homes in Southern Arizona, bringing this lore with them.

The time of year is determined by the place of the sun at sunrise or sunset, as seen from the roof of a particular house in the pueblo. The points on the horizon of sunrise and sunset, at the summer and winter solstices, are cardinal among these Indians, and they recognise that these directions have no relation to the polar north, or to one west, south and east. The four Moki cardinal points determine the orientation of their sacred rooms or kivas, and are connected with an elaborate world-quarter worship, to discuss which, in detail, would be out of place in this article.

Two of these points are called sun-houses. When the sun sets behind a certain notch in the horizon it descends into a so-called western sun-house which bears 50° south of west from the house of the sun-chief. This notch is made by a depression at the end of the Eldon Mesa, a spur of the San Francisco Mountains, appearing as a slight dent in the horizon silhouetted against the sky. It marks that point on the rim of the horizon south of which the sun never sets. The day on which the sun enters his western house he appears to stop in his southern course, as the word solstice signifies ; and on the following day appears to retrace his steps, and set north of this point. Astronomically speaking, he is at the winter solstice.

In the same way a point on the eastern horizon marks the position of the sun when he halts in his northern course. This point marks the eastern sun-house from which the sun emerges at the summer solstice.

The peoples of the eastern and western horizons, as limited by the Moki cardinal points, is marked off by a number of intervals indicated by hillocks, trees, notches, or pinnacles. Each of these horizontal objects has a name known to sun-priests, who likewise know the particular days of the year which the conjunction of the sun, at sunrise or sunset, with these points indicate. Thus, when the sun rises from behind one of these hillocks the time for planting has come ; or from a certain notch, the date of a great monthly festival is at hand. The sun-priest, who has determined the time by these solar horizontal observations, communicates the information to a town-crier, who announces it from the house-top in a voice audible throughout the pueblo. The native names of all these horizon points, and the corresponding ceremonials, are given in an account of the Tusayan Katcinas, published in the fifteenth Annual Report of the Bureau of American Ethnology.

It will thus be seen that with the Moki priests the position of the sun, rather than phases of the moon, is the primary method of assigning the dates to their great festivals ; but there are certain ceremonials when the appearance of the moon likewise enters into the calculation.

The connection between the diminution of the lengths of the days, the cold winter, and the gradual withdrawal of the sun as each day it sets more and more to the south, has made a profound impression on the observant mind of the Mokis, and the fear naturally arose that the sun is about to desert them. As winter advances his rays become less powerful, and with equal pace a dread grows in the primitive mind that the sun will ultimately wholly abandon the distressed farmers. Special ceremonials arose out of this uncertainty. Means must be adopted to stay the sun's retreat, and rites were inaugurated for that purpose. These were founded on the belief that the sun is an anthropomorphic being who is liable to become feeble ; he must be endowed with new life, and thus it comes about that one object of the winter solstice ceremony among the Mokis,

as among some other races, is to recall the sun, to draw him back and recuperate his strength to fertilise the earth for successful crops.

For some reason, too profound for me to penetrate, these results are sought to be accomplished by an association of the worship of the sun with that of a plumed serpent. As with more cultured races, solar worship and ophiolatry are intimately associated both in the winter solstice ceremony and in similar weird rites which are performed at the vernal equinox immediately before planting time.

Great Serpent worship occurs in the winter solstice ceremony at Walpi, in the chief ceremonial chamber or kiva of that pueblo, on the night of December 20. At the western end of that room there is erected an altar, in the middle of which is an opening in which is placed a painted effigy of the head of the great serpent, made of a gourd. This effigy, which has a plumed head, is surrounded by artificial flowers made of small discs painted in different colours, and set in an upright framework forming a screen, which conceals one of the performers. A stack of maize is piled in front of this altar, and there are various paraphernalia of worship on the floor before it (Fig 1).

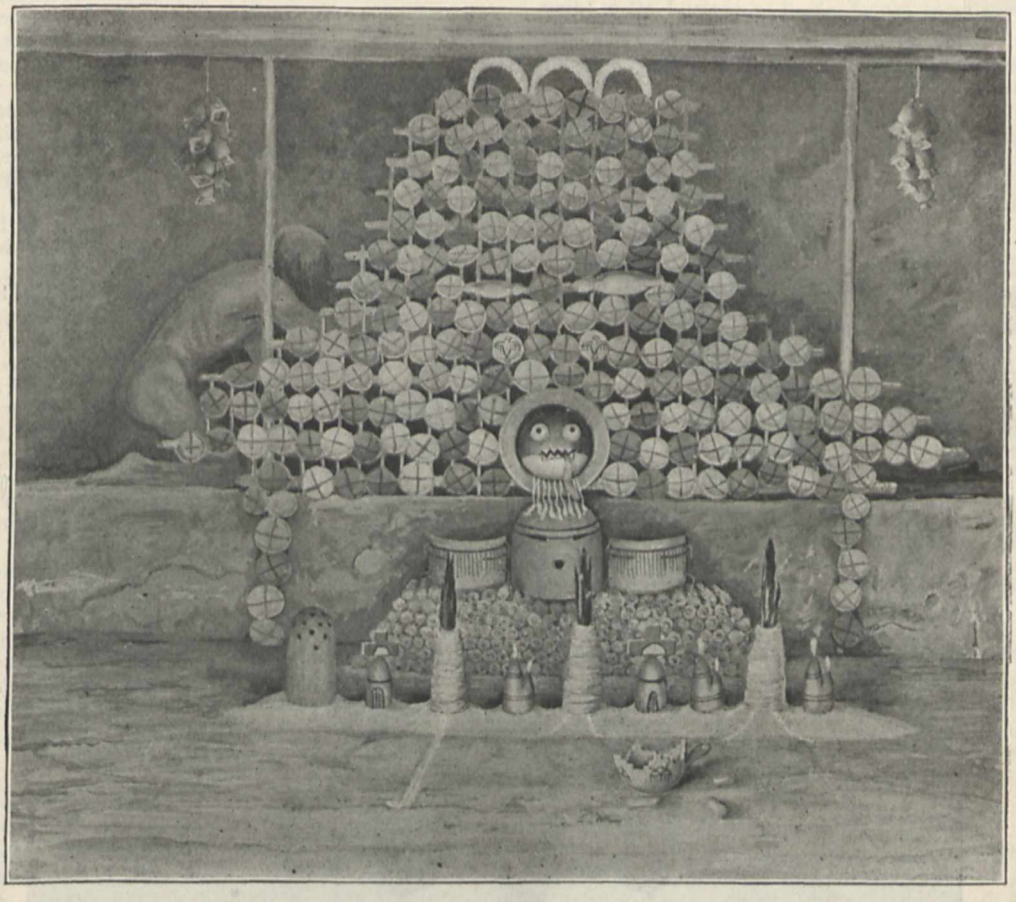


FIG. 1.—The Soyáluña Altar at Walpi.

During the singing of certain songs by the assembled priests, who are warriors, their chief advances to the altar, and sprinkles the snake effigy with sacred meal, at the same time saying a prayer to it.

The man concealed behind the bower or artificial flowers wags the head of the effigy, and blowing through a gourd produces several deep sounds imitating roars or the Great Serpent, in realistic responses to the prayers.

There are several objects sought in these prayers, one of which is that the Great Serpent will fertilise the maize before the altar. It would seem that, in their opinion, the ceremony was efficacious for this purpose, for on the morning following this rite, this maize is distributed among the women of the pueblo, to serve as seed at the next planting.

In a great annual festival at the vernal equinox, we have an even closer connection of sun and serpent worship. At that time a curtain is hung from the rafters of the same room, and this curtain or screen is pierced by a row of six holes, four of which are closed by circular flaps on which sun symbols are painted. These flaps hang by hinges from the upper rim or the orifices, and open towards the spectators. Before this screen, on the floor of the room, there is arranged a miniature field of maize composed of rectangularly arranged hillocks of soil in which sprouted seeds have been inserted. Several men stand behind the screen, and while songs are sung by a chorus, they thrust the heads of effigies of the Great Serpent through the holes in the curtain, raising the flaps decorated with sun emblems. As these monster heads protrude from the screen, a man, personating an earth goddess, passes from one effigy to another holding sacred meat to their mouths for food, and offering their artificially made breasts for nourishment.

Of the several other rites performed before the winter solstice altar, none are more instructive to the student of

Moki sun-worship than the following. Shortly after the ceremonies mentioned above, a number of men, bearing shields with appropriate totems, arrange themselves in two clusters, one on each side of the room, and in their midst stands a performer representing the sun, also bearing a sun-shield (Fig. 2). At a signal the participants, with shields adorned with their totems, engaged in a mimic combat, surging against each other with wild shouting and rhythmic stamping on the floor. This combat is a dramatic representation of the assault of hostile gods on the personator of the sun, who is ultimately victorious over his opponents. It vividly suggests certain Mexican ceremonies performed at the vernal equinox before an idol, Totec (a solar god), save that in the sanguinary Aztec rites men representing hostile gods were sacrificed to recuperate the sun. This episode in the Mexican ceremony is thus referred to by Mr. E. J. Payne in his valuable work on the "History of America." "The victims of the festival, attired like the various deities whom they represented, were conducted to one of those enclosed courts open to the sky, which have been mentioned; here a gladiatorial stone and an altar, elevated on a low platform, stood side by side. Each victim was first placed on the temalacatl and compelled to engage in an imitation of the gladiatorial combat. . . ." On receiving the first wound, he was sacrificed on the solar altar.

In the winter solstice sun-worship among the Mokis there is no such sanguinary outcome to their mimic combat of warriors, for human sacrifice is unknown to them, except in legends. The dramatic combat in the ceremonial room before the altar of the Great Serpent is a bloodless one, but its object is not greatly different from the Mexican variant, viz. to recuperate and draw back the sun by the defeat of hostile powers represented by dramatisation in the sacred room of the pueblo.

J. W. F.

FIG. 2.—Sun Shield of the Horn Society.

## *CLOSING OF THE BEN NEVIS OBSERVATORIES.*

WE have received for publication the following extract from the Report of the Scottish Meteorological Society. It is to be hoped some means will be found of keeping the Observatories going.

"The Directors greatly regret to have to announce that the High and the Low-level Observatories at Ben Nevis will cease to exist in October of this year. This is the necessary outcome of the want of funds. There is no way, so far as the Directors can see, by which these great first-class Meteorological Observatories can be continued, except by aid from the State. In other words, the Directors have no grounds for expecting that further assistance will come from private sources."

"This decision has been come to in consequence of estimates submitted by the Honorary Treasurer, from which it appears that if, in October next, the property belonging to the Directors were realised and all obliga-

tions met, there would probably remain a balance of 250*l*. If, however, the Observatories were carried on till October 1899, there would be a debt of probably 150*l*."

"By the establishment of these Observatories, and the unique observations made at them, a great experiment has been carried out with signal success. In this work the Council of the Society has been strengthened by having on the Board of the Directors of the Observatories representatives of the Royal Society of London, the Royal Society of Edinburgh, and the Philosophical Society of Glasgow. The experiment has been, as anticipated, a costly one. A sum of no less than 18,150*l*. has been expended on the inquiry, and the sum has been obtained by contributions partly from scientific bodies, but mainly from the public."

"The Scottish Meteorological Society cannot fail to experience great satisfaction from its having been found possible to do so much; indeed, when resolving on making the experiment, and founding the Observatories, the most sanguine expectation could not have predicted the ready and liberal response made to the appeal for the necessary funds."

"With much pleasure the Directors are able to report that in a large sense the objects aimed at have been attained. A long series of hourly observations has been obtained by night and by day without a break over a period of fifteen years, though these included eye or other observations outside in the severe climate of the top of Ben Nevis, forming a set of observations quite unique, nothing similar having as yet been done at any other High-level Observatory in the world."

"The Directors would have been extremely glad if the period of simultaneous hourly observations at the High and Low-level Observatories could have been prolonged for other three years, in order to give ten annual instead of seven annual averages running from January to December, and to furnish a better basis for a minute and careful discussion of the mass of observations now in the possession of the Society, and available for the study of meteorological phenomena."

"In conclusion, the Directors cannot contemplate without sadness the giving up of these two Observatories, both well-equipped and in full working order, especially as they are strongly of opinion that two such Observatories should continue to be carried on as essentials in the observing system of the country."

## NOTES.

SEVERAL congresses and meetings of scientific interest are being held as we go to press. The International Congress on Navigation was opened at Brussels on Monday last; there were more than 1000 delegates present. The opening session of the sixty-sixth annual meeting of the British Medical Association was held, under the presidency of Sir T. Grainger Stewart, in Edinburgh on Tuesday, and on the same day the summer meeting of the Institution of Mechanical Engineers began at Derby, under the chairmanship of Mr. S. W. Johnson.

THE Secretaries to the Reception Committee of the International Congress of Zoology are preparing a list of the Cambridge addresses of the members of the Congress who have definitely announced their intention of attending the approaching meeting. They will be glad to receive any information which will help them to make this list as complete as possible. It would be a convenience if those subscribers who are unable to attend the meeting will inform the Secretaries of the fact. Communications should be addressed to Mr. S. F. Harmer or Mr. A. E. Shipley, The Museums, Cambridge.

THE following grants have recently been made by the Physico-Mathematical Section of the Berlin Academy of Sciences:—2000 marks to Prof. Engler, of Berlin, for the continuation of his monograph on East African plants; 1500 marks to Prof. Schultze, of Berlin, for the publication of a work on American Hektinellidæ; 1000 marks to Prof. Brandt, of Kiel, to enable him to accompany the Prince of Monaco in the Prince's investigations in the Atlantic Ocean; 1000 marks to Prof. Burckhardt, of Basle, for investigations on the comparative anatomy of the brain; 1000 marks to Prof. Kohen, of Greifswald, for the continuation of his investigations on meteoric iron; 600 marks to Prof. Graebner, of Berlin, for the continuation of his investigations of the formation of the German heaths; 500 marks to Dr. Kruger, of Charlottenburg, for investigations on urine; 500 marks to Dr. Küster, of Tübingen, for his investigations on the colouring matter of the blood and bile; 500 marks to Dr. Loesner, of Berlin, for the completion of a monograph on the Aquifoliaceæ; 5000 marks to Dr. F. Ristenpart, of Kiel, for preliminary studies for a "Thesaurus positionum stellarum fixarum"; 1000 marks to Dr. Adolph Sauer, of Heidelberg, for the geological investigation of the Aar region; 1000 marks to Dr. Schellwien, of Königsberg, for an investigation of the Palæozoic Eastern Alps.

PROF. VON LEYDEN has been elected a corresponding member of the Paris Académie des Sciences, in the place of Prof. R. Virchow, who has been made an associate.

PROF. FOUQUÉ, of the Collège de France, has been elected a foreign member of the Vienna Academy of Sciences.

THE death is announced of Prof. Suringar, who succeeded Miquel as director of the Leyden Garden and Herbarium in 1857.

WE regret to learn that Mr. van Voorst, for many years a publisher of scientific works, particularly relating to natural history, died on Sunday last, at Clapham, at the ripe age of ninety-four. He retired from business in 1886.

THE monument to Prof. Charcot is to be formally unveiled at the Salpêtrière in Paris on October 23.

A REUTER telegram from Valparaiso states that a violent shock of earthquake, lasting a minute, was experienced on the night of July 23 at Concepcion and Talcahuano, Chile. Many houses fell in consequence, and others were damaged. Telegraphic communication was interrupted, and the electric light wires were broken. A further shock is reported to have taken place at 1.55 p.m. on July 24.

IT is announced in the July issue of the Johns Hopkins University *Circular*, that during the coming year Prof. Simon Newcomb, F.R.S., until lately director of the U.S. *Nautical Almanac*, will resume his superintendence of the work in mathematics and astronomy in the Johns Hopkins University. He will, it is stated, be especially interested in promoting the work of any student who desires to pursue an advanced course of study in celestial mechanics. Near the beginning of the year, Prof. Newcomb hopes to give a short course of lectures on the Encyclopædia of Mathematical Sciences. The *Circular* also reports that the delivery of the second course of lectures, in connection with the George Huntington Williams Memorial Lectureship, upon the principles of geology may be expected during the coming session. The first course of lectures was given, as will be remembered, by Sir Archibald Geikie, F.R.S., during the session of 1896-97.

THE steps recently taken by the Secretary of State for the Colonies, for instituting a system of instruction for medical officers of the Colonial Service in the treatment of tropical diseases, have

already been noticed in the press. In further pursuance of this policy, Mr. Chamberlain has invited the Royal Society to co-operate with the Colonial Office in undertaking a thorough investigation into the origin, transmission, and possible prevention of such diseases, and especially of the malarial fevers which are responsible for such a high rate of mortality and disablement among European officers serving in tropical Africa. The Royal Society has accordingly appointed a Committee to deal with the subject, and has voted a money grant, which will be supplemented by a contribution from the Colonial Office funds, for the purposes of the inquiry. Expert investigators will probably be sent out to Africa to study the diseases on the spot, and the Committee will, at the same time, no doubt take note of the work which has been carried out by Surgeon-Major Ross in Calcutta, in reference to the supposed activity of the mosquito in relation to malaria.

A CONGRESS of the Royal Institute of Public Health will be held in Dublin from August 18 to 23, under the presidency of Sir Charles Cameron. The presidential address will be delivered on the opening day, and during the meeting there will be conferences of naval and army medical officers, of medical officers of health, of sanitary inspectors, and of veterinarians. The Section of Preventive Medicine and Vital Statistics will be presided over by Dr. Grimshaw; that of Chemistry and Meteorology by Prof. Moore; and that of Engineering and Building Construction by Mr. Cotton, of the Local Government Board. There will also be an exhibition of sanitary appliances.

AMONG the subjects proposed for discussion at the forthcoming Congress of the Sanitary Institute, to be held at Birmingham, are: Antiseptics in food; prevention of tuberculosis in relation to meat and milk supply; central cooking stations; bacteriological and clinical diagnosis in relation to the notifiable infectious diseases; prevention of measles in reference to school attendance; the soil in relation to typhoid; vital statistics; dwellings of the working classes; Birmingham water scheme; water supply for rural districts, and the means of protecting it from contamination; the qualities of sewage as affecting the method of disposal; recent advances in sewage treatment: (*a*) towns, (*b*) country houses; the natural purification of sewage; the flora of sewage; purification of trade effluents and utilisation of factory waste products; ventilation of sewers and drains; construction and ventilation of house drainage; the drainage of buildings possessing no open space; the geology of the Midlands in relation to water supply; female occupations in relation to health; the hygiene of infancy; the waste of infant life; village nursing of infectious disease; influence of women in regard to household sanitation; woman's share in sanitary administration; hygiene of dress; teaching of sanitation in elementary schools.

THE Yorkshire Naturalists' Union announce a three days' excursion to Easington, for Spurn and Kilnsea, from July 30 to August 1.

IT is expected that the German Tiefsee Expedition will start from Hamburg at the beginning of August. The steamer *Valdivia* is being fitted out with all the necessary appliances.

A DEPARTMENT for the treatment of hydrophobia by Pasteur's method, and for scientific research on the subject of hydrophobia, has, says the *British Medical Journal*, just been opened in the Berlin Institute for Infectious Diseases (Koch Institute). This establishment is the first of its kind in Germany. Apparently, rabies is becoming more frequent in that country. In spite of the stringent legislation on muzzling, five persons died of hydrophobia in Prussia during the year 1897.

MR. ALEXANDER WHYTE has been appointed, by the Secretary of State for Foreign Affairs, curator of the Botanic Garden, Uganda, which is about to be established for the better examination and development of the agricultural resources of the Protectorate. It will be remembered that Mr. Whyte started a similar enterprise in British Central Africa, in which he was, from 1891–97, head of the Scientific Department.

THE Göttingen Academy of Sciences is reported to have received from the Emperor of Germany's special fund 5000*l.* for gravity determinations in East Africa.

IN a lecture recently delivered at Copenhagen, Prof. la Cour communicated some of the results of the numerous State-aided experiments and tests in connection with the utilisation of the wind's power, which have been carried on by himself over a number of years. After speaking on the historical side of the question, the lecturer referred to the construction of a windmill, and pointed out the fallacy of the opinion that the greatest effect was obtained by horizontally moving wings. Reference was made to the various ways in which the problem of turning the mill according to the wind had been solved, and the lecturer then dealt with the construction of the wings. The question of the effect of the wind's pressure upon a flat surface is a complicated one, but it has been demonstrated that the suction on the lee side is a very important factor. Prof. la Cour had in his experiments measured the effect of an artificial wind upon various models at different speeds, and these experiments pointed to the correctness of some of the ordinarily accepted rules in the construction of windmills; as, for instance, the number of wings. A mill with sixteen wings had only 1⅛ times as much power as one with four wings. In measuring the percentage of the power of the wind striking the wings, he had arrived at the somewhat startling result of 143·7 per cent. This unlooked-for conclusion was owing to the above-mentioned suction on the lee side of the wind passing between the wings. That the wings should not be plane, but have a bent or a concave shape, was an old-established truism; and the shape of the wings has in reality much influence upon the suction caused more especially by the wind, which just passes the edges of the wing. In measuring the percentage of the wind-power utilised, the wind passing between the wings was taken into account, and instead of 143·7 per cent. the result was 21 per cent. The absolutely best shape for wings has, however, not yet been ascertained. The most important practical point in connection with windmills is the solution of the problem, how best to neutralise the inconveniences caused by the irregularity of the wind. Prof. la Cour has for this purpose constructed an original regulator, called the Kratostate, by means of which a windmill can be used for working a dynamo.

THE St. Petersburg Society of Naturalists has lately opened a fresh-water biological station at Lake Bologoye, on the Valdai plateau, near to a railway junction of the same name. The station was opened after only the sum of 120*l.* had been subscribed, chiefly by M. Voronin, "who made also the gift of three microscopes, a rich algologic library, and a flag." A house on the shores of the lake, and surrounded by a garden, was rented, and the station was well provided with scientific instruments, boats, &c. No fees for housing and work at the station are paid, while the boarding, which is excellent, having been organised on co-operative principles, costs, washing included, only 17 roubles (1*l.* 14*s.*) per month to each visitor. The lake is very shallow, having a uniform depth of 5 metres, A narrow isthmus separates it from Lake Glubokoye, 14 metres deep. The aquatic vegetation of the two lakes is very rich, and two interesting plants have already been discovered: the *Najas minor* (*Caulinia fragilis*), characteristic of the Steppe region, and *Najas flexilis* (*Caulina flexilis*), characteristic of Scandinavia and Finland. The neighbourhood of the station has a rich flora—such rarities as *Viola umbrosa*, *Luzula albida*,

*Botrychium virginianum*, &c, growing at the doors of the house. Four persons, all botanists, worked at the station last summer. The lake was carefully mapped, its depth was measured in its wide part, and the phyto-plankton was studied by L. A. Ivanoff, who discovered several interesting forms, including the diatoms *Attheya Zachariasi* and *Rhizolenia longiseta*, akin to marine forms.

AN interesting article is contributed to the June part of the *American Anthropologist* by Mr. J. W. Fewkes, on "An Ancient Human Effigy Vase from Arizona." The ancient people of southern Arizona manufactured human effigies in clay, the typical forms of which, so far as the author is aware, have not been described. The vase in question was obtained by Mr. Fewkes in the summer of 1897, on behalf of the U.S. National Museum, from a cave at Pima, a settlement in the Pueblo Viejo valley. In his opinion the vase was manufactured by the ancient people of Arizona, probably by a people whose ruined houses are found in the neighbourhood from whence the specimen was obtained. The accompanying illustration, copied from a figure appearing in the *American Anthropologist*, shows the general form of the vase. It is made of coarse material, and

has a rough exterior, with patches of calcareous secretions on the surface. The form of the head is shown by a constriction forming the neck, and the eyes, nose, mouth, chin and ears are well represented. No attempt is made to represent the legs, and the arms, it will be noticed, are simply irregular ridges, one on each side of the body. It is supposed that the vase was filled with votive offerings when it was placed in the cave, and that in course of time the contents were washed out. The nature of these offerings may be conjectured from the fragments of shells, turquoises, and other objects strewn about the floor of the cavern.

THE *Lancet* prints the following note on Egyptian native remedies for hydrophobia:—"Though there are no medical accounts of rabies in times past, there are plenty of supposed cures which make it appear as if the disease were well known. Papyri contain mention of the dangers of a bite from serpent, crocodile, or dog. Charms were sold in old days to protect from these three, and there is a folk-lore story where the wicked fairy condemned the heir at his birth to be killed by one of these three biting creatures. He destroyed a serpent who attacked him, and he and his favourite hound killed a crocodile, but the master died in consequence of an accidental bite from the dog during the fight. The modern treatment for a person bitten by a presumably mad dog in Upper Egypt is to kill the dog, extract the spinal cord, bruise the cord with pestle and mortar until a paste is made, and then rub the patient's body all over with paste. Sometimes, too, they burn the dog's hair, and apply the ashes to the bite. The Bedouin make the patient eat the raw liver of the dog, and this is done, too, in the Haussa State of the Western Soudan. In Lower Egypt the favourite remedy has been acquired from the Syrians of Mount Lebanon. It is the *Mylabris punctata*, a dark-blue beetle used instead of cantharides, and well known in the south of France and Spain."

IT is reported that a drainage scheme for Cairo, based on plans by Sir B. Baker, F.R.S., has been submitted to the Ministry of Public Works on behalf of the Cairo Water Company. The estimated cost is £E.600,000, but this does not include anything for maintenance.

AN agricultural department, having for its object the increase, if possible, of the number of the staple products of Zanzibar, has been established in that State. It is under the superintendence of an English horticulturist whose duties are not only to try to improve the methods by which the old-established crops are reared and harvested, but to introduce and cultivate experimentally any other plants which may be likely to thrive in a tropical soil, and which, if successful, would add to the commercial prosperity of the country. Experiments, which already give some promise of good results, have been made with cocoa, kola, vanilla, anatto, and several varieties of rubber, and trials are still being carried on with coffee, candle nut, eucalyptus, and other plants of economic value. Camphor, olives, safflower, and sarsaparilla are said to have failed.

THE Rev. M. Dechevrens, S.J., Director of the St. Louis Observatory, Jersey, and formerly Director of the Observatory at Zikawei, China, has communicated to the Academy of the *Nuovi Lincei* an interesting discussion of the variations of air temperature in cyclones, and their principal cause. The investigation is based upon an examination of the weather charts published in the daily *Bulletin International* issued by the Meteorological Office of Paris, and particularly those for January to March 1895. The author finds that the extremes of heat and cold, which are observed respectively in areas of low and high barometric pressure, do not occur at the centres of these systems, but are met with in the neighbourhood of the mean isobars. Also that the descending current of air in an area of high pressure escapes along divergent lines, and that it is principally due to this divergence that the cold usual in anticyclones is observed. Similarly, that the relatively high temperature in areas of low pressure is due to the convergence of the ascending air currents. The paper is accompanied by a number of examples, and is illustrated by diagrams, which materially add to its value.

THE twelfth volume (for the year 1896) of the *Analele* of the Meteorological Institute of Roumania, a work of 800 quarto pages, has recently been issued. In addition to the usual meteorological tables it contains ten memoirs, several of which are printed in parallel columns in French and Roumanian. The painstaking director, Dr. S. C. Hepites, writes, among other subjects, on the drought in the Dobrudscha in 1896, on the Roumanian rainfall in 1896, and on the results of twelve years of meteorological observations at Bucharest (1885–1896). He also continues his valuable register of Roumanian earthquakes, from which we learn that, during 1896, eleven shocks were recorded. The majority were of slight intensity, only one (that of March 12) being felt over a large part of the country, and causing small landslips within a limited district.

A RECENT number of the *Aberdeen Journal* prints a communication, received from a correspondent, on the pollution of the river Lossie, by which, it is said, thousands of trout have been poisoned. At the place where the poisoning has occurred the Lossie is at its broadest and deepest, and has been one of the favourite haunts of Elgin anglers. It is fully a mile further up the river from the place where the town's sewage enters, and the water here had continually been used by the cottagers at Scroggiemill and Sheriffmill for domestic uses. In the opinion of many people the pollution is due to the influx of distillery refuse. The same issue of the *Journal* states that a number of distilleries have combined together to offer a premium of 2000*l* to any person devising and handing over to them for their sole use a scheme for the purification of the residual products of distilleries.

PROF. KÜTTNER, of Tübingen, has, says the *Lancet*, been making some interesting experiments with the Röntgen rays at the Constantinople Hospital. In his report, just issued, he says that while the apparatus proved of service when applied with the screen, it was rarely possible to take a satisfactory photograph on account of the difficulty of bringing the patients into the proper position. The former method proved often the only way to ascertain the site of a projectile which had entered the body and had remained there. This was applicable to all parts of the body except the stomach and head. A bullet in the brain, for instance, showed very indistinctly. Prof. Küttner says it is noteworthy that splinters of bullets and of bone which had penetrated into the soft parts of the body could not be distinguished from each other. Also, he says, it was proved that the opinion that deep-lying masses of pus could be located was erroneous. Injuries to the central nervous system, the spinal cord, and the peripheral nerves were solely ascertainable by the aid of the Röntgen rays. It was impossible to do this before. Furthermore, it could be seen whether a bone was totally or only partially severed—a matter of great importance as far as therapeutics are concerned. For shot wounds in the extremities he recommends that a photograph be taken. His conclusion is that the Röntgen rays are of great importance for medical aid in war, but only for fixed hospitals, such as reserve hospitals and those installed in fortresses, while for moving field hospitals their application is very limited.

THE Paris correspondent of the *British Medical Journal* states that the French State engineers have succeeded in giving a formula for making lucifer matches which does not include either white phosphorus or any substance injurious to health. Machinery has also been invented which will contribute to the health and safety of those engaged in match manufacture. The machinery has been tested, and, after a few improvements have been made, it will be generally adopted in the Government match factories.

THE July issue of the Kew *Bulletin* states that, in response to an inquiry from the Kew Gardens for specimens of all the plants yielding a milky juice, samples of Fiji rubber have been received and examined. The first samples received proved entirely valueless; but the second, received in March last, were more promising. *Alstonia plumosa* is described as abounding in the forests, and if carefully treated might prove a useful rubber-producing plant; but, judging from the specimen of rubber received, the preparation of the article has almost become a lost art, for the specimen was soft and viscid on the outside, with little or no elasticity, and practically without value. A later specimen, received in June, was not so viscid, but it gradually became hard and inelastic. A sample of rubber from a tree known as "Baka" (*Ficus obliqua*, Forst. f.) was also received, and although not sufficiently coagulated, was regarded as suitable for mixing purposes, and to be worth today from 1*s*. to 1*s*. 3*d*. per pound. A substance obtained from the "Ban" tree, possibly a member of the *Sapotaceæ*, but, in the absence of flowers, otherwise indeterminable, was slightly elastic, and might command a sale at 10*d*. to 1*s*. per pound. Other specimens, obtained from the "Wasalili" (*Carruthersia scandens*, Seem.) and the "Malawaci" (*Trophis anthropophagorum*, Seem.), were entirely deficient of elastic properties, and reported to be of no commercial value.

THE *Engineer* gives particulars of two forms of artificial india-rubber—one emanating from France, the other from Germany. Textiloid is the name of the French form. It consists of resinoline and admixtures. The resinoline is said to be obtained by treating oil with three or four times its bulk of metallic carbonates, and then with nitric acid. Then follow saponification, precipitation by means of an acid, and dissolution in alcohol or ether. A hundred parts of resinoline are mixed with twenty of zinc, oxide of manganese, &c., and sixty parts of methylated spirit; after several hours the mass is kneaded for one hour or more, and finally compressed. The German process consists in the oxidation of linseed oil, with the addition of prepared jute refuse, or similar hitherto worthless textile refuse, by which means a substance is produced which possesses many of the qualifications of genuine india-rubber. It is capable of being utilised in many ways, and of being manufactured into various articles hitherto made of india-rubber.

THE Council of the Anthropological Institute has decided to alter the size of the quarterly journal of the Institute. The journal in its present form compares unfavourably in size with several Continental publications, and does not allow sufficient scope for extensive illustrations. At the present time there is no anthropological publication in England capable of meeting these requirements, and it has occasionally happened that papers of much interest, accompanied by valuable photographs and drawings, have been published abroad for want of a suitable medium in London. With the desire of obviating this unsatisfactory state of affairs, the Council of the Institute has resolved to sanction additional expenditure on printing in the hope that the proportionate increase in the interest and utility of the journal will secure for it the sympathy and support of all those interested in anthropological studies throughout the Empire. The attempt will be made in the new series to apportion the available space as evenly as possible between the different branches of study included in the general science of man. Folk-lore is provided for elsewhere, but physical anthropology, prehistory, and ethnology have all claims to a more liberal treatment than they have hitherto been able to obtain. In view of the temporary dislocation of existing arrangements which the proposed change will entail, it has been decided that there shall be no issue of the present series in August, and that the new series shall commence in November with a combined August and November part.

IN a note in the *Rendiconto* of the Naples Academy, Signor A. Costa briefly summarises the various problems opened out by the recently discovered reciprocal action of animal toxins. In November 1892, this writer observed when in Algiers that when the sting of a Tunis scorpion was followed by that of *Scolia interstincta* Kl. in the same finger seventeen hours later, the result was a complete removal of all the symptoms of poisoning, the finger regaining its normal state. The recent discovery by M. C. Phisalix, that the poison of hornets confers immunity against viper bites, now suggests the following questions: (1) Have the poisons of all hymenoptera the power of sterilising? (2) Of what animals are the poisons capable of sterilisation? (3) Does any specific or generic relation exist between the

sterilising and sterilisable poisons in virtue of which (*e.g.*) the sting of one particular family of hymenoptera confers immunity against the sting or bite of one particular group of animals?

ALTHOUGH volcanic flames have been seen and described by many writers, their existence has been doubted by others. Special interest thus attaches to the outbursts of flame which occurred on Vesuvius in April last, and which are dealt with in two papers—one by Prof. E. Semmola in the *Rendiconto* of the Naples Academy, the other by Prof. V. Matteucci in the *Atti dei Lincei*. From the former paper it would appear that this rare phenomenon may have been caused by the falling in of a part of the crater wall, and consequent blockage of the orifice, the pent-up gases becoming heated until a chimney was formed through which they escaped in flames. Prof. Matteucci's paper concludes with the following summary of the principal points: (1) The greater part of the aeriform substances evolved from volcanic magma has the power of producing flames. (2) The small flames in the crater of Vesuvius were of longer duration than the large ones; these latter did not last without intermission for more than 19 or less than 15 days, and ultimately became small and quiescent like the others. (3) The complex phenomenon, of which the flames were one of the most interesting features, seems only comparable with that described by Sir Humphry Davy. It has not been reproduced, or, at any rate, has not been noticed on Vesuvius for eighty-four years. (4) The spectrum produced by these flames is continuous, like that observed by Libbey in the incandescent lavas, also with flames, of Kilauea.

PROF. VILLARI, writing in the *Atti dei Lincei*, shows how the shadows of Röntgen rays, produced by different vacuum tubes, can be compared by photography. The shadows in question were produced by a circular leaden disc fixed some little distance in front of the plate, a cross of lead being placed in contact with the plate in order to facilitate comparison of the darknesses of different parts of the shadow. Prof. Villari found, and his illustrations show, that the shadow of a body intercepting the radiations from a focus tube is surrounded by a kind of penumbra several millimetres wide, ending abruptly at the outside and darkening rapidly towards the centre of the umbra. When a Crookes' tube is used, the umbra terminates in a clearly defined edge; near the edge, within the umbra, there is seen a black line or fringe; outside the umbra there is a pale penumbra several millimetres wide, fading away outwards, and followed by a bright ring indicating increased radiation. These two fringes, the dark and the light, resemble those of diffraction. The central umbra seems to gradually darken from the periphery to the centre, probably owing to deflection of the rays into the shadow produced by the opaque intercepting body.

A BRIEF memoir on the geology of the country around Bournemouth, by Mr. Clement Reid, has just been issued by the Geological Survey, in explanation of the new series map, Sheet 329. The main points of geological interest are described, including the pipe-clays of Poole, the plant-beds in the Bournemouth cliffs, and the richly fossiliferous clays and sands of Barton. The price of this little memoir is 4*d.*, and it is illustrated by figures of some of the characteristic fossils found in the neighbourhood of Bournemouth.

IT is announced that the Trustees of the British Museum are about to issue a facsimile of the famous Rhind mathematical papyrus, which deals with such subjects as the elements of geometry and the theory of fractions. The work was prepared for publication several years ago by the late Dr. Samuel Birch, but has since been revised, and a special introduction to it has been written by Dr. Budge.

A FLORA of the Ardennes, by M. A. Callay, is about to be brought out under the auspices of the Society of Natural History of the Ardennes. It will be published at Charleville by the Society.

THE fossil and recent genera of Eurasian *Dreissensidæ* have been figured by M. N. Andrusov in a series of twenty phototype plates ("Travaux de la Soc. des Naturalistes de St. Petersbourg," vol. xxv.). The genera include *Congeria Dreissensia* and *Dreissensiomya*.

THE U.S. Department of Agriculture has issued a *Bulletin* (No. 16) on American ginseng, its commercial history, production, and cultivation, by Mr. Geo. V. Nash. The plant so called is *Panax quinquefolium*, belonging to the Araliaceæ. At one time in great repute as a sovereign remedy for constitutional weakness, &c., the medicinal use of ginseng is now abandoned except as a demulcent.

A NEW edition of Mr. H. G. Wells's "Text-book of Zoology" has been published by the University Correspondence College Press. The work is more particularly intended for students preparing for examinations of the University of London, and as such it has met with success. The new edition follows the plan and method of the original volume, which appeared about five years ago, but a large part of the text has been rewritten by Mr. A. M. Davies, whose name now appears on the title-page as joint author with Mr. Wells. The preface states: "Only one chapter in the book remains practically unaltered from the first edition, so that while the credit for the general plan of the work belongs to Mr. H. G. Wells, no responsibility attaches to him for any part of the present book." New diagrams have been inserted, and they are remarkably clear and instructive.

IN vol. iii. No. 4 of the *Records of the Australian Museum*, illustrated descriptions appear, by Mr. W. J. Rainbow and Mr. C. Hedley respectively, of a new Araneiad, from Cooktown, and a new Bivalve, *Lima alata*, from Santa Cruz.

A SPECIAL number of the Middlesex Hospital *Journal*, which has just come to hand, contains, in addition to the usual notes, information respecting the various institutions in connection with the hospital, &c., the beginning of a very interesting account, by Dr. A. Coupland, of "The Story of the Middlesex Hospital." The article is illustrated by several figures of the hospital at different stages of its existence, and a reproduction of a photograph of seventeen members of the staff in 1865. Among the number is to be found Prof. Burdon Sanderson, F.R.S., at that time an assistant physician.

THE additions to the Zoological Society's Gardens during the past week include a Naked-footed Owlet (*Athene noctua*), European, presented by the Hon. Walter Rothschild; a Bridled Wallaby (*Onychogale frenata*) from Australia, two Coquerel's Lemurs (*Cheirogaleus coquereli*) from Madagascar, a Glass Snake (*Ophiosaurus apus*), a Back-marked Snake (*Coluber scalaris*), a —— Snake (*Tropidonotus*, sp. inc.), European, ten Algerian Tortoises (*Testudo ibera*) from the Caucasus, nineteen Saddle-backed Tortoises (*Testudo ephippium*) from the Duncan Islands, Galapagos Group; thirty-three South Albemarle Tortoises (*Testudo vicina*) from the Albemarle Islands, Galapagos Group; four Speckled Terrapins (*Clemmys guttata*), thirty-seven Painted Terrapins (*Chrysemys picta*), two American Box Tortoises (*Cistudo carolina*), a Stink-pot Terrapin (*Cinosternon odoratum*), two Alligator Terrapins (*Chelydra serpentina*) from North America, deposited; a Graceful Ground Dove (*Geopelia cuneata*), two Peaceful Ground Doves (*Geopelia tranquilla*) from Australia, purchased.

## OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN AUGUST:—

August 8. 10h. 7m. to 10h. 44m. Occultation of $\mu$ Arietis (mag. 5·8) by the moon.
8. Saturn. Outer minor axis of outer ring, 17″·37.
8. 15h. Mercury at greatest elongation (27° 22′ E.).
10. Meteoric shower from Perseus (radiant 45° + 57°).
11. 14h. 49m. to 15h. 38m. Occultation of 118 Tauri (mag. 5·4) by the moon.
12. 12h. 31m. to 13h. 19m. Occultation of 8 Geminorum (mag. 6·5) by the moon.
15. Venus. Illuminated portion = 0·655, diameter = 17″·4.
15. Mars. Illuminated portion = 0·889, diameter = 6″·0.
15. Jupiter. Polar diameter = 29″·8.
15. Saturn. ,, ,, = 15″·8.
19. 6h. Venus in conjunction with Jupiter (Venus 1° 51′ S.).
23. 9h. 32m. Minimum of Algol ($\beta$ Persei).
25. 10h. Mars in conjunction with Neptune (Mars 1° 13′ N.).
28. 12h. 53m. to 13h. 43m. Occultation of $\sigma$ Capricorni (mag. 5·6) by the moon.

THE MINOR PLANETS.—Mr. John K. Rees, in a lecture before the New York Academy of Sciences (*School of Mines Quarterly*, vol. xix. No. 3), delivered a very interesting discourse on the history of the discovery of the minor planets, a reprint of which has been sent to us. Mr. Rees describes from the beginning how, after the discovery of Uranus by Herschel, Prof. Titius, of Wittenberg, pointed out the existence of a remarkable symmetry in the disposition of the bodies constituting the solar system. It was he who suggested the relationship now known as "Bode's law," Prof. Bode putting into the place of the missing body a hypothetical planet. It is not generally known, perhaps, that Von Zach in 1785 actually calculated elements for this "unseen and unfelt body," and for fifteen years kept in his mind the need for a careful search. At the beginning of this century he organised, what was termed jocularly by him the "Celestial Police" to track and intercept this fugitive object, a force for the express purpose of systematically scanning the heavens; but it was left for the astronomer, Piazzi, who found the first of what eventually proved a series of small bodies, although he was carefully observing the heavens for quite another purpose, namely the formation of a star catalogue. This discovery of the minor planet Ceres was the first of many which followed, and the introduction of photography in this branch of observation has brought to light many small bodies which are now numbered in hundreds, besides rendering the task, which was beset with great difficulties, one that is now simplicity itself.

THE MOON AND AURORÆ.—From the earliest times the presence of auroræ was in some way connected with the influence of the moon, and there may be some, even to-day, who are inclined to hold to this opinion. Prof. H. A. Hazen, in the *Monthly Weather Review* (vol. xxvi. No. 161), discusses the evidence of such supposed influence, using as his data the observations made by the regular observers in the United States Signal Service. We need not, however, refer to the curves and tables which are brought together by Prof. Hazen, but simply quote the words which he uses in summing up the whole of the investigation in question. He says: "It will be seen readily that the whole theory of a lunar influence upon auroras breaks down from first to last under this analysis." That the appearances of auroræ may be connected with the periodicity of sun-spots is another matter, and it is here that probably a close connection exists.

*Apropos* of auroræ, we notice that Prof. Cleveland Abbe is publishing a very detailed and important historical account of the altitude of auroræ above the earth's surface as determined by observers all over the world. The first of these articles appears in *Terrestrial Magnetism* (vol. iii. No. 2), and is well worth reading by those who are interested in this important question.

MARS IN 1896-7.—Prof. V. Cerulli has just published, in the *Pubblicazioni dell' Osservatorio privato di Collurania* (Teramo) (No. 1), a most important memoir of the planet Mars, as observed by him during the period 1896-7. The volume covers no less than 126 pages, and is accompanied by numerous plates, forming a valuable addition to our knowledge of this interesting planet. Perhaps a special feature of this publication is the determination of the latitudes and longitudes of sixty of the most prominent markings on the surface; and this will, without doubt, be found most valuable to those who wish to locate accurately any surface features which they may from time to time observe. In the remaining portion of the work Prof. Cerulli discusses these and other surface markings which were seen during this period of observation, and a comparison of these with the observations of others should be found of great interest.

## RECENT WORK IN THERMOMETRY.

THERMOMETRY is one of those departments of physics which are left almost exclusively to specialists, and writings on the subject are apt to assume an amount of preliminary knowledge not possessed by physicists in general. There thus appears room for a brief account in popular language of recent progress. The space at my disposal being limited, I am obliged to confine my remarks to a comparatively small number of researches, and I can hardly hope that my choice of matter will meet with unmixed approval.

Thermometry possesses two main branches, which, though intimately connected, are yet more or less distinct. One branch deals with the detection of extremely minute differences of temperature, or the subdivision of small temperature intervals; the other aims at assigning a definite numerical value to temperatures on an exact scale. A worker in the first department may employ apparatus showing differences of one-millionth of a degree Centigrade, and he may even believe that he is measuring temperature to this degree of nicety. A worker in the second department, unless endowed with an exceptionally optimistic temperament, will probably not profess to measure temperature to nearer than the one-thousandth of a degree, and that only between the freezing and boiling points of water. Here I shall consider almost exclusively the question of the determination of temperature in absolute measure.

The first requisite is a normal scale to which all measurements can be referred. An ideal scale should be perfect in theory, and easily and exactly realisable in practice. From the former point of view, Lord Kelvin's absolute thermodynamic scale is generally regarded as *facile princeps*. In the meantime, however, it fails to satisfy the second condition. The International Committee of Weights and Measures, representing all the leading Powers, including Great Britain, accordingly selected in 1887 for the normal scale that of the hydrogen constant-volume thermometer, the gas when at 0° C. to be under the pressure of 1 metre of mercury under standard conditions; on this scale equal increments of temperature answer to equal increments of pressure. Apparently the choice was due mainly to two considerations, viz. the very low freezing point of hydrogen, and the existence of theoretical and experimental grounds for believing its scale to approach Lord Kelvin's absolute scale more nearly than that of any other common gas. Whether hydrogen will prove a manageable substance at high temperatures seems open to some doubt. Failure in this respect would be a serious drawback, in view of the rapidly increasing importance of high temperature measurements.

After the choice of a normal scale, we are next concerned with its relationships to other scales that are, or have been previously, in use. Here, however, one difficulty is conspicuously present. Nothing is commoner than such a statement as that a certain temperature was observed on the scale of the air thermometer; but there are air thermometers and air thermometers. Quite apart from the distinction between constant volume and constant pressure instruments, there are questions as to the pressure at 0° C., the purity of the air, the sufficiency or insufficiency of the corrections applied to the observed readings, and a host of others. In most investigations thermometry is but a means to an end, and observers are apt to treat somewhat lightly of preliminaries which are not of general interest. On the other hand, an observer is very apt to attach undue significance to the agreement between the several observations he makes, overlooking the fact that in thermometry such agreement need imply no

more than uniformity in the conditions and in the method of experiment. For these several reasons, in translating old temperature observations into the normal hydrogen scale, it would in general be a waste of labour to aim at the degree of accuracy possible in the best thermometric work.

Whilst the exact determination of other scales in terms of the hydrogen scale is from a historical standpoint less important than might appear at first sight, it is still rendered essential by the fact that for many practical purposes the hydrogen thermometer is inconvenient, and is unlikely to supersede other forms.

The most exact scale comparisons are doubtless those made at Sèvres, under the auspices of the international committee of weights and measures. These are described, with the exception of the most recent, in Dr. Guillaume's "Thermométrie de Précision," a work which all really interested in exact thermometry should study for themselves. Air being a composite medium, and so presumably less suitable for the basis of an exact scale than the elementary gases, has apparently not been dealt with at Sèvres; but the work there has included the comparison of the hydrogen, nitrogen and carbonic acid scales, especially of the first two. The investigation covered, in the first instance, the range $-25°$ C. to $+100°$ C., and was executed with great care by Dr. Chappuis. In point of time it preceded and, in fact, led up to the adoption of the hydrogen scale. The comparison of the gas scales was not direct, but through the intermediary of mercury thermometers. From the data on p. 258 of Guillaume's "Thermométrie," one learns that within the range 0° to 100° C. the difference between the hydrogen and nitrogen scales does not exceed 0°·011 C., but at $-25°$ C. it amounts to about 0°·016. The differences between the hydrogen and carbonic acid scales are five or six times as large as these. The hydrogen temperature is algebraically less than the nitrogen or carbonic acid temperatures between 0° and 70° C., but algebraically greater at temperatures below 0° C. In Guillaume's opinion it is probable that ordinary (constant volume) air thermometers give a scale near that of nitrogen, but lying somewhat on the side of the carbonic acid scale, *i.e.* more remote from hydrogen. The probable error in Dr. Chappuis' comparisons is given as $\pm 0°{\cdot}001$ between 0° and 50° C., and twice or thrice as great at either $+75°$ C. or $-25°$ C.

The differences between the several gas scales presumably increase as the temperature falls, but probably never become large. At all events, in 1896 Holborn and Wien (*Wied. Ann.*, vol. lix., 1896, p. 213), using constant volume thermometers (with, however, an initial pressure of only one atmosphere at 0° C.), found the hydrogen thermometer to read only about 0°·6 C. higher than the air thermometer at $-190°$ C., a temperature close to the freezing point of air. Ten years earlier Olszewski found a difference of about 1° between the hydrogen and nitrogen scales at $-150°$ C.; but his thermometry was probably less exact. With only Olszewski's results before him, Guillaume infers that the hydrogen scale is almost certain to agree closely with the absolute scale, even at $-220°$ C.; and Holborn and Wien's observations lead them to a somewhat similar conclusion. Recent comparisons by Olszewski of hydrogen and helium thermometers (NATURE, vol. liv. pp. 378 and 544) are strongly confirmatory.

For every-day use, unfortunately, gas thermometers are somewhat cumbrous. The international committee accordingly assigned an important place in their programme to the determination of the relations between the hydrogen scale and that of the glass-mercury thermometers which they have selected as working standards. The thermal expansion of glass, though small, is not negligible compared to that of mercury, and varies in different kinds of glass. The international committee accordingly selected one special kind of glass, French *verre dur*, as standard. The selection of the glass does not alone suffice to fix the scale. No glass has yet been discovered whose behaviour is decided wholly by the existing conditions. When a thermometer after exposure to a temperature of 50° C. is placed in ice, it reads lower than it would have done prior to the exposure, and this *depression of zero*, as it is called, increases to a certain extent with the duration of the previous heating. It is thus necessary for high accuracy to decide on a uniform plan of dealing with this source of uncertainty. The plan adopted by the international committee is to refer every reading of a thermometer to a zero determined immediately *after* the reading. Under certain circumstances enough is known of the behaviour of *verre dur* to permit of the substitution for the actual zero observation of results extracted from a table of zero depressions. After a reading is taken with a *verre dur* thermometer, a variety of corrections have to be applied. These are necessitated by inequalities in the bore or errors in graduation, by the influence of the external pressure exerted by the atmosphere and the internal pressure exerted by the mercury. Verification at Sèvres consists in evaluating and tabulating all the necessary corrections. After these corrections are applied, the result represents the temperature on the natural *verre dur*—mercury scale.[1] This scale has been compared with that of the hydrogen thermometer at Sèvres from about $-38°$ C. to $+200°$ C. Below $-10°$ C. and above 100° C. the comparison is probably less exact than between these limits.

In considering the probable accuracy of temperature measurements made with *verre dur* thermometers, we have to take into account the consistency of readings taken with the same thermometer, the closeness of readings taken under the same conditions with different thermometers, and, from certain points of view, the degree of accuracy with which readings can be reduced to the hydrogen scale.

The consistency of readings taken with a single *verre dur* thermometer depends in the first instance to some extent on the success with which the correction tables have been constructed at Sèvres; it varies to a large extent with the skill of the observer, the conditions of the experiment, and the temperature to be measured. The ordinary *verre dur* standard thermometer is divided to 0°·1 C. and read by estimation, with the aid of a lens magnifying from ten to twenty times, to 0°·001 C. This involves subdivision of a space into hundredths by eye, a feat which the skilled observers at Sèvres accomplish with marvellous accuracy, but which is far beyond the powers of the ordinary experimenter. In some instances use can be made of a micrometer, but this can hardly be employed unless temperature is practically stationary; and, when this is the case, troubles are apt to arise from capillary action in the mercury. The more remote the temperature to be measured from that of the surrounding air, the greater, as a rule, is the probable error of an observation. Thus, speaking generally, observations between 0° and 40° C. are those capable of the highest accuracy; and here it would appear that the mean results obtained on different occasions by skilled observers for a fixed temperature with a *verre dur* thermometer may be expected to agree to within about $\pm$ 0°·001 C.

At temperatures below 100°C. the corrected readings of different *verre dur* thermometers on the same occasion show apparently about as good agreement as is to be expected from the readings of a single *verre dur* thermometer exposed on different occasions to the same fixed temperature. At temperatures, however, approaching 200° C. Dr. Chappuis found that the corrected readings of different *verre dur* thermometers might differ by as much as 0°·05 C.

The accuracy with which the relation of the *verre dur* to the hydrogen scale is known is hard to say. Until the Sèvres comparisons have been repeated at other places, under equally favourable conditions, there will always remain a certain amount of doubt as to the existence of possible local or temporary influences. In the meantime, it is not altogether reassuring that a recent partial comparison of the hydrogen and *verre dur* scales at 10°, 20°, 30° and 40° C., by Dr. Chappuis, gives results differing from those of the original comparison at Sèvres by from 0°·001 to 0°·007 C.

From the above data two considerations naturally arise. At temperatures between $-20°$ C. and 100° C. the natural *verre dur* scale is probably that most easily and exactly realised in practice; and it is, perhaps, fully as correct to regard the present normal hydrogen scale as one deducible in a prescribed arbitrary way from the *verre dur* scale as to accept it as having any real physical existence. On the other hand, there is no such thing as a *verre dur* scale, unless we agree to neglect differences of temperature which are of the same order as differences actually found between different *verre dur* thermometers. At the present moment, for instance, we must apparently treat 0°·05 C. as a negligible quantity in temperature measurements at 200° C. if we are to extend the *verre dur* scale to that point. It has to be borne in mind that identity in the chemical constitution of thermometer glass may not necessarily imply identity in temperature scale.

[1] For any *natural* glass-liquid scale, thermometer degree divisions include equal volumes of the bore.

Age or prolonged annealing may introduce an appreciable change in physical properties.

In addition to the work already referred to, a comparison has been made at Sèvres of the hydrogen scale with the natural scales of low range glass-alcohol and glass-toluene thermometers. At − 70° C. on the hydrogen scale the toluene temperature is − 56°·63 C., as against about − 63° C. on the alcohol scale. Notwithstanding its greater contraction of scale at low temperatures, toluene is preferred by Dr. Chappuis to alcohol, on the ground that the latter is much more difficult to get of uniform purity. At − 70° C. differences of as much as 1° were observed in thermometers filled with alcohol supplied as pure by different first-rate chemists. Even with toluene thermometers, 0°·01 C. appears the limit of accuracy to be hoped for. English alcohol thermometers, I should explain, are not, as a rule, constructed to give temperatures on the glass-alcohol scale. The degree divisions are shortened as we go down the scale, in such a way as to make the thermometer, when exposed to freezing mercury, read − 37°·9 F. ; this being the air thermometer temperature for freezing mercury according to Balfour Stewart's determination.

The thermometric work at the German Reichsanstalt[1] has included the comparison of the *verre dur* scale with that of several German glasses, notably the Jena glasses 16$^{III}$ and 59$^{III}$. The former glass is fairly similar in character to *verre dur ;* the latter is a boro-silicate glass capable of resisting very high temperatures, and showing exceptionally small depression of zero. Thermometers made of it, with compressed gas above the mercury to prevent boiling, supply a convenient means of measuring temperatures up to 500° C. or even 550° C. In such high temperature measurements it is often difficult to avoid having a long mercury column emergent above the bath or other source of heat whose temperature is in question. The consequent error can be found apparently with great accuracy by means of a special form of long bulb thermometer ("Faden-thermometer"). Dr. Guillaume, who apparently anticipated the Reichsanstalt observers in the idea, has curiously enough found it foreshadowed in the *Phil. Trans.* for 1777. Using the "Faden-thermometer," the Reichsanstalt observers apparently claim an accuracy of 0°·1 C. in comparisons made in a well-stirred bath at 500° C. They claim, however, an accuracy of 0°·02 C. in comparisons of Jena glass thermometers with the air thermometer between 100° and 300° C. Until these results are confirmed or similar accuracy is claimed by the Sèvres observers, a chronicler may perhaps be pardoned an attitude of reserve.

Even with the aid of compressed gas, the range that can be covered by a mercury thermometer is somewhat limited, in view of modern requirements ; and within that range there are many cases in which other means of measuring temperature are preferable. Nearly every property of every natural substance is modified by heat, so that the possible ways of measuring temperature are practically innumerable. Several of the ways that have been proposed for measuring high temperatures are very ingenious and may have a great future before them ; but the methods that have actually been utilised to an appreciable extent are but few. Of these the two that have been most to the front of late years have depended on the measurement of electric resistance and electromotive force respectively. The former method we may regard as embodied in the platinum-resistance thermometer. Its introduction and the improvements it has undergone are due mainly to Prof. Callendar and Mr. E. H. Griffiths, while its application to the determination of melting points of metals and alloys is largely due to Mr. C. T. Heycock and Mr. F. H. Neville. A clear description of the necessary apparatus and the mode of graduating platinum thermometers was given by Mr. Griffiths in NATURE, November 1895, p. 39. The essential fact is that a piece of platinum wire, *suitably protected*, is exposed to the temperature it is desired to measure, and its electrical resistance is found by a Wheatstone's bridge method. If $R_1$ be the resistance in steam, $R_0$ in ice, R at any other temperature, then

$$pt \equiv 100(R - R_0) \div (R_1 - R_0)$$

is termed the "platinum temperature." In common use $pt$ is employed only to deduce a quantity $t$, connected with it through the relation

$$t - pt = \delta\{(t/100)^2 - (t/100)\},$$

where $\delta$ is a constant, so chosen that $t$ equals 444·53 when the platinum wire is at the temperature of the vapour of sulphur boiling under standard pressure.

The investigations of Callendar, Griffiths, Heycock and Neville show that the values obtained in this way for $t$, over a range of at least 1000° C., are very close in different samples of platinum wire, so that $t$ represents temperature on what is at least very approximately a definite fixed scale. Further, Prof. Callendar found that the scale so arrived at approximates very closely to that of the air thermometer (at constant pressure) over at least the range 0° to 600° C. ; whilst the values of $t$ obtained by Messrs. Heycock and Neville for the melting points of silver, gold and copper, lie pretty close to the corresponding air temperature results obtained by Holborn and Wien at the Reichsanstalt.

If the wire of all platinum thermometers possessed the same value of $\delta$, then every platinum thermometer would give the same $pt$ when exposed to the same temperature $t$. We should then have a definite independent platinum scale, precisely as we now have a definite *verre dur* mercury scale between 0° and 100° C.

In reality, however, $\delta$ varies considerably—over at least 25 per cent.—in existing platinum thermometers, so that the present use of the term "platinum temperature" is open to criticism.

The question as to what is the best formula for use in platinum thermometry has been discussed by Mr. Hamilton Dickson recently in the *Phil. Mag.* (December 1897, p. 445, and June 1898). After considering Prof. Callendar's principal formulæ, and others suggested at one time or another by him and Mr. Griffiths, Mr. Dickson decides in favour of the species

$$(R + a)^2 = p(t + b),$$

where $a$, $b$, $p$ are constants, and $t$ is the temperature answering to a resistance R in the platinum wire. Mr. Dickson applies this formula to Prof. Callendar's original comparison with the air thermometer, to certain melting point determinations by Prof. Callendar and Mr. Griffiths, and to low temperature comparisons by Profs. Dewar and Fleming and by Messrs. Holborn and Wien.

Determining the constants in the several cases by the method of least squares, he finds the probable divergence of observed and calculated values to be of the order 0°·25 C.

The formula approved by Mr. Dickson is really of the type

$$t = a + bR + cR^2,$$

employed previously by Holborn and Wien in discussing observations made by them at the German Reichsanstalt. These gentlemen, perhaps owing to their less exact method of determining the constants, claim for their formula accuracy only of the order 1° C. Their comparison with the air thermometer extended down to − 190° C., so that it seems in any case a valuable tribute to the suitability of platinum thermometers for the measurement of low temperatures.

At high temperatures Holborn and Wien's experience of the platinum thermometer was not very favourable, the wire showing appreciable permanent changes. As Mr. Griffiths, however, points out, these changes occurred at temperatures to which platinum thermometers of the type he approves have frequently been exposed without any apparent ill effect. The preference expressed by Holborn and Wien for thermo-electric methods thus perhaps carries less weight than it might seem to deserve at first sight. It would certainly appear, as pointed out by Mr. Griffiths in NATURE, vol. liii. p. 390, that the determinations of the melting point of copper, about 1080° C., by Heycock and Neville, with a variety of different platinum thermometers, agree considerably better amongst themselves than the corresponding results obtained by Holborn and Wien with thermo-couples.

Be this as it may, there can be no doubt that thermo-couples are very convenient instruments for high temperature measurements, and they have had hitherto a considerably wider use than platinum thermometers.

The physical quantity whose variations in the thermo-couple give temperature variations, is the total electromotive force in a circuit. The mainly active part of the circuit consists of two metals, one of whose common junctions is usually kept at a known fixed temperature, the other being exposed to the temperature it is desired to measure. The most widely used couple of late years has been Le Chatelier's, in which one metal is platinum, the other an alloy of platinum with rhodium (10 per cent. rhodium). The substitution of iridium for rhodium is not

[1] Described in various memoirs in the Reichsanstalt's *Wissens. Abhandl.* and in the *Zeitschrift für Instrumentenkunde.*

uncommon. Holborn and Wien have compared the Le Chatelier couple with the air thermometer at the Reichsanstalt up to 1450° C. In *Wied. Ann.* vol. lvi. p. 364, they say that the readings of different thermo-elements may be expected to agree within ± 5° at 1000° C., while different observations with the same instrument agree better than this. They also say that properly prepared thermo-elements have remained unaltered for years, whether unemployed or subjected to frequent temperature changes, always provided they are not exposed to certain sources of contamination.

In their more recent low temperature work, already referred to, Holborn and Wien made further use of thermo-couples, but the metals chiefly employed were apparently iron and constantan.

In translating measurements of E.M.F., E, into air temperature, $t$, Holborn and Wien employ an ordinary algebraic formula

$$t = aE - bE^2 + cE^3.$$

Here, as usual, $a$, $b$, $c$ denote constants, which may be determined by observations at three fixed temperatures.

The question of the most suitable type of formula to be applied to thermo-electric data is discussed very fully by Prof. S. W. Holman in the *Phil. Mag.* for June 1896. The three types he advances as most deserving of notice are

$$E = (\tau - \tau_0)\{a + b(\tau + \tau_0)\},$$
$$E = m(\tau^n - \tau_0{}^n),$$
$$E = mt^n.$$

In all E represents E.M.F, $m$ and $n$ constants to be determined by reference to fixed points, $\tau$ and $\tau_0$ temperatures of hot and cold junctions measured from absolute zero, $t$ ordinary Centigrade temperature of hot junction (the cold junction being supposed in ice). The first or algebraic type, in a special form, is usually associated in this country with the name of Prof. Tait. The second type is called by Prof. Holman the *exponential*, and the third the *logarithmic* (as lending itself readily to logarithmic calculation). The three types are applied by Prof. Holman to what he regards as the most notable series of recent observations. In addition to the high temperature observations of Holborn and Wien, already referred to, he considers a number of comparisons of platinum and platinum-iridium couples with constant-pressure air thermometers made by Barus in America, and less extensive series by other observers in France and Germany. Of the three types of formulæ, the algebraic proved the least suitable for application to a wide temperature range.

In a later paper in the *Phil. Mag.* (vol. xlii., 1896, p. 37), Prof. Holman, with Messrs. Lawrence and Barr, apply the three above specified formulæ to observations of their own with couples of platinum and platinum-rhodium at the melting points of aluminium, silver, gold, copper and platinum. The constants in the formulæ were determined from the same three fixed points, viz. the ice point, the boiling point of sulphur at standard pressure, and the melting point of gold. For the second point Callendar and Griffiths' value 444°·53 C. was accepted, and for the third point Holborn and Wien's mean result 1072° C.

Observations were taken at the boiling points of water and naphthalin, as well as at the melting points of the several metals. The temperatures calculated from the three formulæ agree closely for the copper point—which lies near the gold point—and fairly closely for the silver point. For the naphthalin point the calculated values differed from the true air scale temperatures by from 4° to 12°, and the errors in the calculated values for the steam point were fully as large. If the authors are correct in their opinion, "so far . . . as constant or variable instrumental errors are concerned, it is believed that no error beyond 0°·5 to 1° C. exists in the results," we must conclude that further inquiry into thermo-electric methods is highly desirable.

Thermo-electric methods lend themselves fairly readily to the study of gradual temperature changes, the spot of light reflected by the mirror of the galvanometer measuring the E.M.F. being thrown either on a screen or on a photographic plate actuated by clockwork. Prof. Roberts-Austen (*Roy. Soc. Proc.*, vol. xlix., 1891, p. 347) has inaugurated investigations by this method[1] into the phenomena accompanying solidification of metals. Prof. Callendar, on the other hand (*Trans. Roy. Soc. of Canada*, 1897, p. 34), has recently applied the platinum thermometer in the continuous registration of the changes of earth, water and air temperatures; and, unless my memory deceives me, bare wire resistances have been used previously for the last-mentioned purpose

Thermo-electric and electrical resistance methods are also specially applicable to the measurement of minute temperature differences. As examples of this application, we may take the bolometer of Langley and the radio-micrometer of Boys (*Phil. Trans.*, 1889, p. 159). The former instrument in its most approved shape—as in use at the Astrophysical Observatory at Washington—has been described very recently by Prof. Langley himself (*The Smithsonian Institution*, 1846–96, pp. 419–442, Washington, 1897). Its main use at Washington is in mapping out the infra-red spectrum and determining the intensity of the solar radiation at different wave-lengths. It is simply an electrical resistance thermometer, the resistance being that of a "metallic tape usually about $\frac{1}{3}$-inch long, but narrower and far thinner than a human hair . . . this, at present, may be arranged to record changes of temperature as small as one-millionth of a degree." Prof. Langley has devised the means of producing a uniform relative motion of the bolometer and solar spectrum, and obtaining an exact photographic record of the varying heating effect; and in this way he has apparently enormously reduced the labour of mapping the spectrum.

The radio-micrometer, on the other hand, consists essentially of a thermo-electric circuit—the principally effective junction being that of bismuth and antimony—which is suspended by a quartz fibre and is capable of rotation in an intense magnetic field. It is especially suitable for measuring the radiation from a distant or feeble source of heat, the radiation being received on a metal surface in immediate connection with the bismuth antimony junction. The delicacy of the instrument varies greatly with the shape of the circuit and the fineness of the quartz fibre suspension. According to Mr. Boys, it would be possible with the most approved pattern to detect with certainty "a temperature difference of less than one two-millionth of a degree Centigrade." Whether this has been realised in practice, I do not know.

A *differential* radio-micrometer was employed some years ago by Mr. W. E. Wilson and Mr. P. L. Gray (*Phil. Trans.* A, 1894, p. 361) in experiments in which solar radiation was balanced against the radiation from a strip of platinum heated to various known temperatures. The object of the research was to determine the mean effective temperature of the sun. The method is one which would seem capable of numerous useful applications.

As already stated, thermo-electric and electrical resistance methods are by no means the only ones, in addition to gas thermometry, for which high accuracy is claimed in high temperature measurements. There is, however, only one other method to which I shall refer here, viz. the expansion of solids. This is, of course, a very old method, and is generally employed only for commercial purposes for which high accuracy is not aimed at. In 1891, however, Dr. Joly applied the principle in a new special form of instrument, the meldometer, for which high accuracy is apparently claimed as a means of determining melting points. The essential part of the instrument is a thin strip of platinum, kept stretched by a spring and heated as required by an electric current. A minute quantity of the substance under examination is placed on the strip, whose temperature is raised until the substance melts. There is delicate means of measuring the lengthening of the strip, and the corresponding temperature is deduced with the aid of a preliminary calibration, based on observations at two or three known melting points. The meldometer has been used by Prof. Ramsay and Mr. Eumorfopoulos (*Phil. Mag.*, vol. xli., 1896, p. 360) in determining the melting points of a large number of salts, and these observers seem to think highly of it. A meldometer strip was also the source of heat, whose radiation was compared with that of the sun in the experiments of Messrs. Wilson and Gray already referred to. Having had no personal experience of the meldometer, I can only say that I should hardly expect it to rival in accuracy either the thermo-couple or the electrical resistance thermometer; but the smallness of the quantity of material required, is unquestionably a recommendation to its use in determining the melting points of rare or precious substances.

C. CHREE.

[1] Since this article was written there has appeared in the *Phil. Mag.* for July 1898, an interesting paper by Mr. A. Stansfield, describing improvements in Prof. Roberts-Austen's recording pyrometer, and discussing thermo-electric results. Mr. Stansfield obtains $E = a\tau + b \log \tau + c$, for the relation between E.M.F. and temperature, measured from the absolute zero. His melting points agree well, on the whole, with the determinations of Heycock and Neville.

## THE DESTRUCTION OF THE BIRDS AND MAMMALS OF THE UNITED STATES.[1]

IN the course of the correspondence of the New York Zoological Society with hunters and collectors regarding a future supply of American mammals and birds with which to stock the Zoological Park, the extent of the disappearance of our vertebrate fauna, as a whole, has become painfully evident. It seems that the war of annihilation, now going on with great activity against all our wild creatures, indiscriminately, is far more universal and far more fatal in its effects than people are aware.

In order either to verify or disprove what appeared to be the existing facts, and to discover possible remedies for existing evils, the Society resolved to make a brief but pointed inquiry into conditions affecting bird life as they exist to-day throughout the United States.

The prime object of this inquiry, and the report on its results, is to call universal attention to the fact that the whole volume of bird and mammal life in the United States is decreasing at an alarming rate.

In seeking a method by which the extent of bird destruction —or preservation—might be reduced to figures and averages, it seemed entirely possible for any person who is specially interested in birds, and who has lived for several years in a given locality, to make and furnish a general estimate as to the abundance of bird life about him to-day in comparison with what it was ten or fifteen years ago. Accordingly the following questions were prepared, and addressed to persons competent to answer them :

(1) Are birds decreasing in number in your locality?

(2) About how many are there now in comparison with the number fifteen years ago? (one-half as many? one-third? one-fourth?)

(3) What agency (or class of men) has been most destructive to the birds of your locality?

(4) What important species of birds or quadrupeds are becoming extinct in your state?

In each state and territory several observers were addressed, and an effort was made to cover the various sections of each large state. Had every addressee responded with a report the results would have been more voluminous, but it is doubtful if the figures given herein would have been greatly changed. While the majority of the persons addressed were ornithologists, and associate members of the American Ornithologists' Union, the list of observers was purposely made to include many well-known sportsmen, guides, collectors of animals, and taxidermists.

The fact that the inquiry was intended as a step in the direction of preservation awakened keen interest, and brought forth reports from nearly two hundred observers, representing all states and territories in the United States, except three. Fully 90 per cent. of the reports bear unmistakable evidence of having been prepared with conscientious thought and care. Many are very full, and particularly valuable by reason of their wealth of detail. The closeness with which the estimates of different observers in a given state or region agree with each other is quite surprising, and this may justly be regarded as evidence of their scientific value.

### DESTRUCTIVE AGENCIES NOW IN OPERATION.

If the reports before us are true, the boys of America are the chief destroyers of our passerine birds, and other small non-edible birds generally. The majority of them shoot the birds, a great many devote their energies to gathering eggs, and some do both. Wherever there are herons who bear the fatal gift of "plumes," there will the plume-hunter be found, hard at work. Every now and then the newspapers and sportsmen's magazines record sickening details of the slaughter of gulls, terns, doves, or ducks; of brutal "side" hunts; of enormous catches of trout, bass, or other game fishes. It is estimated that during last autumn's hunting season, three thousand hunters entered the Maine forests in quest of deer, moose and caribou. Not taking into account what they killed and ate while in camp, they brought out 2640 deer, 102 moose. and 53 caribou; and concerning the ability of those three species to survive the attacks of the army of riflemen that annually sweeps through the forests of Maine, Mr. Caton, State Game Warden of Maine, has expressed the opinion that it is only a question of a very short time when the moose and caribou will all have disappeared from the hunting grounds of Maine. It has been estimated that during the past season 7500 deer were killed in that state.

Of the series of one hundred and ninety reports now before us, about 80 per cent. declare a decrease in bird life, and state the causes therefor. The list of destructive agencies now operating against our birds is a long one, and it is interesting to note the number of observers who complain of each. The figures given below show the number of observers who have reported each of these various causes in answer to the third question in the list.

### CAUSES OF DECREASE IN BIRD LIFE.

| | Reports. |
|---|---|
| 1. Sportsmen, and "so-called sportsmen" ... | 54 |
| 2. Boys who shoot ... ... ... ... ... | 42 |
| 3. Market-hunters and "pot-hunters" ... ... | 26 |
| 4. Plume hunters, and milliners' hunters... ... | 32 |
| 5. "Shooters, generally" ... ... ... ... | 21 |
| 6. Egg-collecting, chiefly by small boys ... ... | 20 |
| 7. English sparrow ... ... ... ... ... | 18 |
| 8. Clearing off timber, development of towns and cities ... ... ... ... ... ... | 31 |
| 9. Italians, and others, who devour song birds ... | 12 |
| 10. Cheap firearms ... ... ... ... ... | 5 |
| 11. Drainage of marshes ... ... ... ... | 5 |
| 12. Non-enforcement of laws ... ... ... | 5 |
| 13. Gun clubs and hunting contests ... ... | 5 |
| 14. Trapping birds for sale alive ... ... ... | 2 |
| 15. Prospectors, miners and range-riders ... ... | 2 |
| 16. Collectors (ornithologists and taxidermists) ... | 5 |
| 17. Coloured population ... ... ... ... | 4 |
| 18. Indians (for decrease of game quadrupeds) ... | 4 |

### SLAUGHTER OF ALL EDIBLE BIRDS.

In the absence of deer, elk, bear and other large mammals, the well-nigh universal desire to range afield and "kill something," expends itself upon the so-called "game" birds. Thousands of usually conscientious sportsmen and farmers find an excuse for killing the last grouse, duck or snipe in their locality in the fact that the bird is a "game bird," *i.e.* fit for food, and therefore deserving of death before the gun.

The list of North American birds universally classified by gunners and others under the general head of "game birds" is not only very large, but is constantly being increased. To-day it stands about as follows, for the United States alone :—

| | Species. |
|---|---|
| Gallinaceous birds—pheasants, grouse, partridges, quail, &c. ... .. ... ... | about 33 |
| Pigeons and doves ... ... .. ... | ,, 12 |
| Shore birds—snipes, sandpipers, curlews, &c. | ,, 47 |
| Anseres—ducks, geese, swans ... ... | ,, 43 |
| Rails ... ... ... ... ... | ,, 9 |
| Cranes, herons, egrets, ibises and other large birds always shot on sight, for their plumage or for other reasons ... ... ... | ,, 10 |
| | 154 |

### DESTRUCTION OF BIRDS FOR MILLINERY PURPOSES.

One of the strangest anomalies of modern civilisation is the spectacle of modern woman—the refined and the tender-hearted, the merciful and compassionate—suddenly transformed into a creature heedlessly destructive of bird life, and in practice as bloodthirsty as the most sanguinary birds of prey.

After having stripped our Atlantic coast, the whole of Florida and the Gulf coast of egrets, terns, and hundreds of thousands of other birds acceptable to the milliners for hat trimmings, the "plume hunters" are now at work along the coast of Mexico and Central America, Lower California, and even upon the headwaters of the Orinoco and Amazon. Quite recently, two of them risked their lives with the Indians on Tiburon Island, Gulf of California, and lost their stake!

### THE SCOURGE OF EGG-COLLECTORS.

Throughout the north-eastern quarter of the United States, extending as far westward as the Mississippi River and as far south as Virginia, bird life generally is persecuted by a perfect scourge of egg-collectors, largely in the name of science, but really for purposes of mere curiosity or trade. In the reports

[1] Abridged from a report on the results of an inquiry, contained in the Second Annual Report of the New York Zoological Society, by William T. Hornaday.

now before us, the outcry against the havoc thus wrought is very general and bitter. During the breeding season of the birds that nest in the region indicated, an army of boys and men takes the field, and sweeps through the thickets, the woods and the meadows, searching out the home of every nesting bird, gathering in or destroying all the eggs that are found, and very often shooting great numbers of the nesting birds.

The outcry against the irresponsible, unscientific egg-and-birdskin collectors is almost as great as that against the English sparrow. They are the special enemies of the birds most useful to agriculture—those which seek the privilege of making their homes with us during at least one-half the year, and fighting the noxious insects all through their summer campaign. The amount of actual damage inflicted upon the farmers by those who collect the eggs of insectivorous birds, and useful birds of prey, is undoubtedly great. Is it not time for egg-collecting to be brought to a full stop, at least for five years?

### HUNTING CONTESTS, OR "SIDE" HUNTS.

Of all the influences now operating for the destruction of our birds and mammals, the most outrageous is the so-called "side hunt." A side hunt may properly be defined as a game of murder, in which a body of particularly brutal (or thoughtless) men, sometimes *more than a hundred* in number, and usually known as a "gun club," choose sides, arm themselves with guns and an unlimited quantity of ammunition, go forth on a given day, and for a fixed number of days shoot many kinds of wild creatures, "for points." At the close of the slaughter, the victims are collected, counted according to the "points" agreed upon for each species, and the side which has accomplished the greatest amount of butchery is declared the winner.

### SPECIES REPORTED AS "EXTINCT," OR "BECOMING EXTINCT."

*Mammals.*

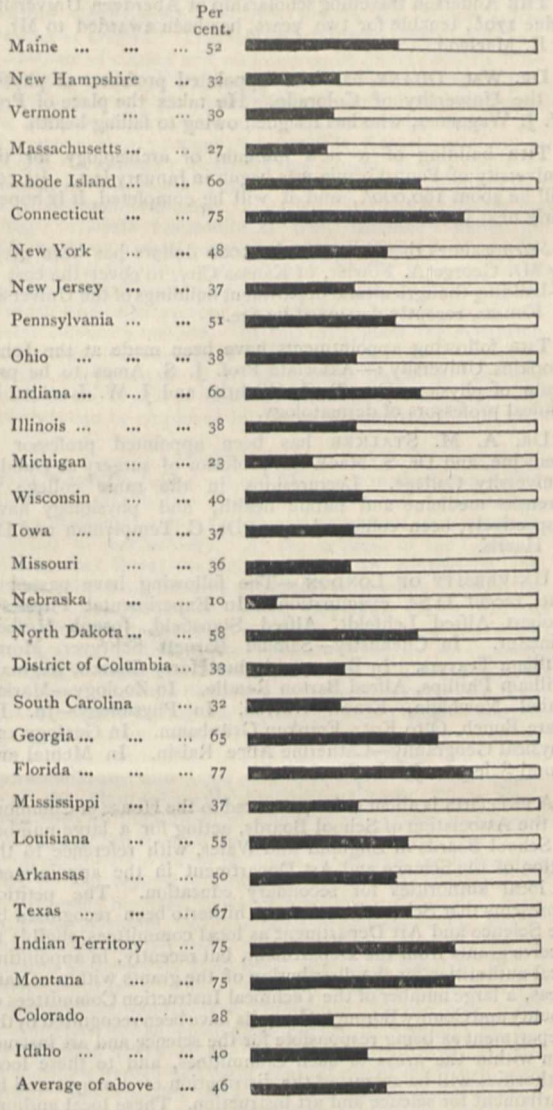
| | Reports. |
|---|---|
| "The larger quadrupeds, generally" | 6 |
| Bison; Buffalo (*Bos americanus*) | 15 |
| Elk; Wapiti (*Cervus canadensis*) | 22 |
| Moose (*Alces americana*) | 7 |
| Virginia or White-tailed Deer (*Cariacus virginianus*) | 32 |
| Mule Deer (*Cariacus macrotis*) | 3 |
| Black-tailed Deer (*Cariacus columbianus*) | 1 |
| Woodland Caribou (*Rangifer caribou*) | 2 |
| Prong-horned Antelope (*Antilocapra americana*) | 15 |
| Mountain Sheep (*Ovis montana*) | 10 |
| Mountain Goat (*Haploceros montanus*) | 2 |
| "Bears, generally" | 1 |
| California Grizzly Bear (*Ursus horribilis horriaeus*) | 2 |
| Black Bear (*Ursus americanus*) | 15 |
| Jaguar (*Felis onca*) | 1 |
| Puma; Mountain Lion (*Felis concolor*) | 6 |
| Red Lynx (*Lynx rufus*) | 5 |
| Otter (*Lutra canadensis*) | 11 |
| Beaver (*Castor canadensis*) | 22 |

*Birds.*

| | |
|---|---|
| "All birds, generally" | 3 |
| "Game birds, generally" (meaning gallinaceous species) | 5 |
| "Shore birds, generally" | 5 |
| "Geese and ducks, generally" | 20 |
| "Herons and egrets, generally"; "plume birds" | 12 |
| "Hawks, generally" | 3 |
| "Owls, generally" | 4 |
| Wild Turkey (*Meleagris gallopavo*) | 30 |
| Ruffed Grouse (*Bonasa umbellus*) | 20 |
| Pinnated Grouse; Prairie Hen (*Tympanuchus americanus*) | 13 |
| Heath Hen (*Tympanuchus cupido*) | 1 |
| Passenger Pigeon (*Ectopistes migratorius*) | 35 |
| Blue Bird (*Sialia sialis*) | 15 |
| Carolina Paroquet (*Conurus carolinensis*) | 5 |
| Wood Duck (*Aix sponsa*) | 5 |
| Flamingo (*Phœnicopterus ruber*) | 1 |
| Roseate Spoonbill (*Ajaja ajaja*) | 3 |
| White Heron (*Ardea candidissima*) | 10 |
| Ivory-billed Woodpecker (*Campephilus principalis*) | 4 |
| Pileated Woodpecker (*Ceophlœus pileatus*) | 4 |
| California Vulture (*Pseudogryphus californianus*) | 1 |

### DECREASE IN BIRD LIFE IN THIRTY STATES.

(The shaded portions show the percentages of decrease throughout the States named during the last fifteen years, according to the reports.)




## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE.*

CAMBRIDGE.—Sir David Salomons, who founded in 1895 at Gonville and Caius College a scholarship to be called the Salomons Engineering Scholarship, has, on the occasion of the celebration of the 550th anniversary of the foundation of the college, increased the annual value of the scholarship from 40*l.* to about 70*l.* The scholarship is open to persons not yet in residence, and is tenable for three years. The person elected is to make a declaration that he *bona fide* intends to enter the engineering profession as a civil and electrical engineer, and will, if required by the governing body of the college, become a candidate for the Mechanical Sciences Tripos. The next examination will be held on Tuesday, November 1, 1898. Candidates must not be more than nineteen years of age on October 1, 1898. The successful candidate will be required to commence residence in October 1899. The subjects of examination will be Euclid, Algebra, Plane Trigonometry, Geometrical and Analytical Conic Sections, Elementary Statics and Dynamics, and Differential Calculus Physics, including

Dynamics and Hydrostatics, with practical work. Candidates must send their names, with testimonials of good conduct and certificate of birth, on or before Tuesday, October 25, to one of the tutors, the Rev. E. S. Roberts or Dr. J. S. Reid.

THE Anderson travelling scholarship at Aberdeen University, value 170*l.*, tenable for two years, has been awarded to Mr. J. J. R. Macleod.

DR. WM. DUANE has been appointed professor of physics in the University of Colorado. He takes the place of Prof. W. J. Waggener, who has resigned owing to failing health.

THE building of a new museum of archæology for the University of Pennsylvania was begun in January last. Its cost will be about 100,000*l.*, and it will be completed, it is hoped, early next year.

*Science* states that the sum of 21,000 dollars has been given by Mr. George A. Fowler, of Kansas City, to cover the cost of re-building the agricultural department buildings of the University of Kansas, recently destroyed by fire.

THE following appointments have been made at the Johns Hopkins University:—Associate Prof. J. S. Ames to be professor of physics; Drs. T. C. Gilchrist and J. W. Lord to be clinical professors of dermatology.

DR. A. M. STALKER has been appointed professor of medicine, and Dr. S. MacEwan professor of surgery at Dundee University College. Lectureships in the same college in forensic medicine and public health, and physiology have, respectively, been conferred upon Dr. C. Templeman and Dr. F. Harris.

UNIVERSITY OF LONDON.—The following have passed in the recent D.Sc. examination:—In Experimental Physics—Robert Alfred Lehfeldt, Alfred Stansfield, Joseph Herbert Vincent. In Chemistry—Samuel Barnett Schryver, Morris William Travers. In Botany—Arthur Harry Church, Reginald William Phillips, Alfred Barton Rendle. In Zoology—Marion Isabel Newbigin, Ernest Warren. In Physiology—Jn. Le Mare Bunch, Otto Fritz Frankau Grünbaum. In Geology and Physical Geography—Catherine Alice Raisin. In Mental and Moral Science—Jessie Charles.

A PETITION is about to be presented to the House of Commons by the Association of School Boards, acting for a large number of School Boards in England and Wales, with reference to the action of the Science and Art Department in the appointment of local authorities for secondary education. The petition represents that School Boards have hitherto been recognised by the Science and Art Department as local committees eligible to receive grants from the Department, but recently, in appointing local authorities for the distribution of the grants within certain areas, a large number of the Technical Instruction Committees of County and County Borough Councils have been recognised by the Department as being responsible for the science and art instruction within the areas of such Committees, and to these local authorities will be entrusted the distribution of money voted by Parliament for science and art instruction. These local authorities are thus being invested with many of the important administrative powers of local authorities for secondary education, and the Science and Art Department, it is urged, are carrying into effect without legislation an arrangement that was proposed in the case of the Education Department and of the Science and Art Department by the Education Bill of 1896, which was successfully opposed and withdrawn. In the opinion of the Association the action of the Science and Art Department is a serious interference with the powers of School Boards and of managers of voluntary schools; it forestalls imminent legislation, since a Government measure for secondary education is shortly to be introduced into Parliament; and it disregards the absolute necessity which is universally felt for correlating all educational machinery, and is in direct opposition to the recommendations of the recent Royal Commission on Secondary Education. The petitioners request that steps be taken to secure that the Science and Art Department in making the appointment of local authorities dealing with science and art grants under Clause 7 of the Science and Art Directory, if permitted at all, shall act in accordance with the Association's recommendations, which are stated to be almost identical with those of the Royal Commission.

## SCIENTIFIC SERIALS.

*Bulletin of the American Mathematical Society*, June 1898.—The regular meeting, held on April 30, was largely attended. In addition to the presentation of some thirteen papers, a slight amendment was made in the by-laws to provide for life-membership.—The following five papers were read at the meeting:—Example of a single-valued function with a natural boundary, whose inverse is also single-valued, by Prof. Osgood. It is first shown that functions exist which are analytic within the unit circle, which have the unit circle as a natural boundary, and which take on no value more than once. Then an explicit example is taken, viz. the series

$$f(z) = z + \frac{z^{a+2}}{(a+1)(a+2)} + \frac{z^{a^2+2}}{(a^2+1)(a^2+2)} + \dots$$

where $a$ denotes an integer greater than unity. This example is discussed and illustrated.—Note on Poisson's integral, by Prof. Bôcher. A non-artificial proof is given, and the theorem generalised by inversion, whence results the theorem, If $(x, y)$ is any point within the circle C,

$$V(x, y) = \frac{1}{2\pi}\int_0^{2\pi} V_c d\psi,$$

(A) where $\psi$ is the angle measured from a fixed circle through $(x, y)$ which cuts C orthogonally to a variable circle of the same sort. Hence is derived the further theorem, given a continuous function $V_c$ upon the circumference of the circle C, the function $V(x, y)$ defined by (A) throughout the interior of C is harmonic throughout C, and joins on continuously to the values $V_c$ on the circumference. [From a theorem of Gauss the value of V at the centre $(x_0, y_0)$ of C is the arithmetic mean of its values on the circumference. If $V_c$ denotes the values of V on the circumference, and $\phi$ is the angle at the centre, we have

$$V(x_0, y_0) = \frac{1}{2\pi}\int_0^{2\pi} V_c d\phi].$$

—On the polynomials of Stieltjes, by Prof. van Vleck. Such a polynomial is defined to be one which satisfies the regular differential equation of the second order.

$$\frac{d^2y}{dx^2} + \left(\frac{1-\lambda_1}{x-e_1} + \dots + \frac{1-\lambda_r}{x-e_r}\right)\frac{dy}{dx} + \frac{\phi(x)[= A_0x^{r-2} + A_1x^{r-3} + \dots + A_{r-2}]}{(x-e_1)\dots(x-e_r)} = 0.$$

—Note on Stokes's theorem in curvilinear coordinates, by Prof. A. G. Webster.—Is continuity of space necessary to Euclid's geometry, by W. M. Strong. The space is thus defined: Let a real number which can be obtained from the integers by a finite number of rational operations and extractions of square roots be called a *quadratic number*. A, B, C are any three points not in a straight line. Such that AC and BC are quadratic in terms of AB. The points whose distances from each of the three points A, B, C, are quadratic in AB, constitute the space (*i.e.* quadratic space). In such a space it is shown that figures may be moved about without change of size or shape. Two other striking peculiarities are—two circumferences may intersect in a single point, and a circumference may have no centre.—A short note on the Steiner points of Pascal's hexagon, by Dr. Snyder, gives a short and simple proof of the conjugate nature of M, N with regard to the conic for which M, N are associated Steiner points (*cf.* Von Staudt, "Ueber die Steiner'schen Gegenpunkte," Crelle, vol. lxii.). In this proof the author claims that it is clearly shown which of Steiner's points are associated as "Gegenpunkte."—There are two reviews, viz. of the "Cours de Géométrie Analytique of Niewenglowski," by Prof. Bôcher, and of Goursat's "Partial Differential Equations," by Prof. E. O. Lovett (thirty-five pages).—The notes give the mathematical courses for the summer semester at the Universities of Berlin, Göttingen, Leipsig, Munich, Columbia, Chicago, and Harvard.—At the end is given the usual list of new publications.

*Symons's Monthly Meteorological Magazine*, July.—The principal article contains some account, by Mr. Rotch, of the recent International Aeronautical Conference at Strassburg, which was well attended. The methods discussed for obtaining observations were manned and unmanned balloons, the captive kite-balloon, and kites.—M. Cailletet described his apparatus for photographing automatically at fixed invervals a barometer in the balloon and the ground vertically below, so that the

height and route of the balloon may be determined. He also exhibited a very sensitive thermometer having a spiral silver tube for its bulb soldered to a glass tube, both being filled with the liquid toluene.—M. Teisserenc also showed a very sensitive self-recording thermometer which is, at the same time, almost insensible to shocks.—Mr. Rotch read a paper on the use of kites, based on the experiments carried on at Blue Hill Observatory. The Conference recommended their use as being of great value to meteorology. Trials were made with the kite-balloon, a captive balloon which, unlike the ordinary spherical one, is not driven down or carried away by strong winds. It is a German invention, and is used in the army for reconnoitring. The Strassburg balloon, which is of smaller construction, is the first adapted for lifting self-recording meteorological instruments.—Results of meteorological observations for June at Camden Square (London) for forty years, 1858-97. The mean of all the maximum temperatures is 71°·3, and of the minimum, 50°·9. The mean rainfall is 2·23 inches; in June of the present year the total fall was 1·11 inches only.

## SOCIETIES AND ACADEMIES.

### LONDON.

**Royal Microscopical Society**, June 15.—Mr. E. M. Nelson, President, in the chair.—The President referred to the loss the Society had experienced in the death of Mr. Henry Perigal, who died at the advanced age of ninety-eight. He then exhibited and described two old microscopes, one of which, made by Benjamin Martin, probably dated from about 1770. It had two concave mirrors, one of 4″ and the other of 9″ focus. The optical part was curious, having a fixed back lens in the tube which was common to all the objectives, each of which was fitted with a lieberkuhn. The other was an antique instrument with simple lenses fitting into one another to increase the power. It seemed to be a copy of one made by Mann and Ashcroft somewhere about 1740, and was made by Cary. He next called attention to an excellent lithographic portrait of Prof. John Quekett, the work of Wm. Lens Aldous, whose son had presented it to the Society.—Mr. Frederick Ives exhibited a camera lucida which he had devised. It was one he had obtained from Messrs. Swift, and he had slightly modified it by depositing on one of the inside faces of the compound prism a very thin specular film of silver, through which it was possible to see the pencil without having to centre the eye, as was the case where the film was opaque with a small hole in it to look through. After some remarks by Mr. Beck, Mr. Swift said there was a difficulty in centring the eye in the old form which did not exist in the one before them, the pencil being seen with ease while delineating the object under observation. The President thought the device a valuable one, and preferable to that of a thick film of silver with a hole in it.—Mr. Ives also exhibited a monochromatic green screen, consisting of dyed films between two plates of glass, which he thought possessed advantages over liquid screens. The one now shown would cut off all beyond the F line on the blue side, including the ultra-violet, and also all red and yellow. In reply to an inquiry, Mr. Ives said that of course the light was not strictly monochromatic; it was a mixture of pure green in the spectrum at the E line, with some yellow-green on one side and blue-green on the other.—Mr. B. W. Priest exhibited a large number of slides of sponges. He said he had brought a selection which would be found to be characteristic of the order Calcarea and the three sub-orders of Silicea, viz. the Monaxonidæ, Tetractinellidæ and Hexactinellidæ, to the last of which he directed attention on account of their great beauty. There were also some slides of fresh-water sponges.—The Secretary said there was a paper of great interest, namely, the continuation of Mr. Millett's report on the Foraminifera of the Malay Archipelago, which being of a very technical character he proposed should be taken as read.—The President reminded the Fellows present that the next meeting of the Society would not take place until October 19.

**Mineralogical Society**, June 21.—Prof. A. H. Church, F.R.S., Vice-President, in the chair.—Prof. Miers communicated an account of some minute cubic crystals of lead developed by the action of acid upon the surface of cast lead. These, although too small to be isolated and measured individually, were successfully measured by means of the new double-circle or "theodolite"-goniometer, by which all the faces of a complicated crystal may be determined in a single operation.—Mr. E. G. J. Hartley read an account of an analysis of Cornish Chalcophyllite, carried out in the Mineralogical Laboratory at Oxford. This mineral, hitherto supposed to be a basic arsenate of copper and aluminium, he found to contain no less than 7 per cent. of $SO_3$, which has been overlooked by previous analysts, so that Chalcophyllite must now be classed among the double arsenates and sulphates.—Mr. G. F. H. Smith gave a short account of a possible dimorphous form of Laurionite. In general appearance this mineral is very similar to Laurionite, but on crystallographic and optical examination was found to be monosymmetric, imitating rhombic symmetry by twinning; whereas Laurionite is truly rhombic. From an analysis, made on a small quantity of selected material, Mr. G. T. Prior found the chemical composition to be the same as that of Laurionite.—Mr. Tutton exhibited a new dilatometer designed for the purpose of measuring the thermal dilatation of crystals by Fizeau's delicate method. In this instrument the expansion of the platinum-iridium screws which carry part of the apparatus is exactly compensated by an aluminium block, so that the dilatation of the crystal is measured directly, and comparatively thin crystals can be employed for the experiments.

### EDINBURGH.

**Royal Society**, July 4.—Lord McLaren in the chair.—The Gunning Victoria Jubilee Prize for 1893-6 was presented to Mr. John Aitken, for his varied and important researches in the physics of meteorology. At the request of the Council, the Astronomer Royal for Scotland gave an address on the total solar eclipse of January 21, 1898, with some account of solar observation generally. Prof. Copeland began with a brief statement of what is now known concerning the sun's constitution, and indicated the lines along which an increase of knowledge might fairly be expected from observations of total eclipses. He then described the work his party had been able to accomplish during the recent eclipse. The photographs shown in illustration were chiefly from among those taken by himself and his assistants, and included several of the corona and protuberances and some fine spectrograms of the upper parts of the photosphere of the eclipsed sun. These were obtained with an instrument in which quartz prisms and lenses were used, and the spectral lines could be traced as far as Q. A careful examination would no doubt throw light on the heights reached by the various glowing vapours. The Astronomer Royal expressed his deep sense of gratitude to all who, both officially and privately, had facilitated his labours.—Dr. R. H. Traquair communicated three papers (1) on a new species of *Cephalaspis* found by the Geological Survey of Scotland in the Old Red Sandstone of Oban; (2) on *Thelodus Pagei* (Powrie) from the Old Red Sandstone of Forfarshire; (3) report on fossil fishes collected by the Geological Survey of Scotland on the Upper Silurian rocks of the Lesmahagow district. In this report four new genera and eight new species of fossil fish were described. The remains were in a remarkably good state of preservation, and threw a new light on several important biological problems. Thus certain scales, which had been previously described as sharks' teeth, were proved incontestably to belong to forms of *Thelodus*; and these forms also showed that Powrie's *Cephalopteris* was a *Thelodus* (subject of second paper). The characteristics of the new genera *Lanartia* and *Birkenia* were described at length, one peculiarity of the latter being the direction of the scales, which was from above downwards and forwards, instead of from above downwards and backwards, as in *Ganoids*.—Dr. W. Aitchison Robertson read a paper on the effect of mixed diet as regards salivary digestion. Among the results obtained may be mentioned the following: Porridge, especially if diluted with water or milk, was rapidly digested. Potatoes in a powdered state were also easily digested. Newly-baked bread was not so rapidly acted upon by saliva as stale bread, but the ultimate degree of starch conversion was greater in the former than in the latter. Alcohol retarded salivary digestion of starch, but not so much as infusion of tea. Wines had a marked inhibitory action; but beer aided digestion.

### PARIS.

**Academy of Sciences**, July 18.—M. Wolf in the chair.—Researches on the relations which exist between luminous and chemical energy, by M. Berthelot. An experimental study of the action of sunlight upon concentrated nitric acid, iodic

anhydride, hydrogen iodide, and hydrogen bromide, the tubes containing the substances under examination being placed in baths of different substances. Mixtures of hydrogen with carbon dioxide and sulphur were also submitted to sunlight, but with negative results.—On the *Terfezia Leonis* from the department of Landes, by M. Ad. Chatin. The host of this fungus in France, as abroad, is *Helianthemuum guttatum*.—Results of recent borings for coal in the north of France, by M. J. Gosselet. An account of a series of borings made in the north of France with the view of finding a prolongation of the great Franco-Belgian coal basin. The borings were not successful.—Remarks by M. Albert Gaudry on the scientific work of M. Victor Lemoine.—M. Mosso was elected a Correspondant in the Section of Medicine and Surgery in the place of the late M. Tholozan.—On a theorem of M. Casserat, by M. Tzitzéica.—On the elastic equilibrium of a pneumatic tyre, by M. L. Lecornu.—Telegraphy without wires and collisions at sea, by M. Edouard Branly. Although it is quite possible for a transmitter on one ship to send signals to another furnished with a sensitive receiver, great difficulties arise when an attempt is made to render the action reciprocal, since the same ship must be furnished with a powerful transmitter and sensitive receivers, and it is scarcely possible to completely shield the latter from the action of the former. The arrangement tentatively suggested is that the current working the transmitter should automatically enclose the neighbouring receivers in a metallic screen.—On the kathode rays, by M. P. Villard.—On a new radio-active substance contained in pitchblende, by M. P. Curie and Mme. S. Curie. Previous researches have shown that the activity of the Becquerel rays emitted by uranium compounds is proportional to the amount of the metal present. This, however, is not the case for pitchblende, in which the activity is much greater than that calculated from its percentage of uranium. Hence arose the possibility of the presence of a new substance, to account for the increased activity. In the separation of the metals as sulphides the active material was thrown down along with bismuth sulphide; a partial separation could be effected by heating in vacuo at 700° C., the sublimate thus obtained possessing 400 times the activity of uranium. Since no chemical substance out of a large number examined behaves in a similar manner, the authors believe the metal to be a new one, and suggest the name of *polonium*, from the country in which the pitchblende was found. The spectrum exhibits no characteristic ray.—Decomposition of calcium and barium phosphates by boiling water, by M. Georges Viard.—On anhydrous-crystallised magnesium sulphide, by M. A. Mourlot. The amorphous sulphide, prepared by the methods of Reichel or Parkinson, is heated in a carbon boat in the electric furnace; the fused mass thus obtained is crystalline, showing rectangular cleavages clearly. The crystallised sulphide can also be readily produced by the action of tin sulphide upon magnesium chloride in the electric furnace.—Exchange of the halogens in the aromatic series, by M. V. Thomas.—Action of bromine upon para-isobutyl phenol in presence of aluminium bromide. Remarks on the bromination of phenols, by M. F. Bodroux.—On the diketones of tetrahydro-β-oxazol, derived from the phenylurethanes of some oxy-acids, by M. E. Lambling.—On the estimation of phosphoric acid, by M. Leo Vignon. Some remarks on the criticisms of M. Lasne.—On the existence, in germinated barley, of a soluble ferment capable of acting upon pectin, by MM. Em. Bourquelot and H. Hérissey.—On the deep-sea Gephyridia collected from great depths, by the *Travailleur* and *Talisman*, by M. Louis Roule.—On the attack of the seeds of *Phaseolus* by *Colletotrichum Lindemuthianum*, by M. Edmond Gain.—On the displacement towards the east of the water running from the plateau of Lannemezan, by M. L. A. Fabre.—On the clinical applications of radiography, by M. Garrigou.

### NEW SOUTH WALES.

**Royal Society**, June 1.—Mr. G. H. Knibbs, President, in the chair.—Aeronautics, by Lawrence Hargrave. The author described at length, with scale drawing and photographs, a kite that under favourable circumstances soars horizontally and at various acute angles to the direction of the wind. The kite is of the well-known cellular form, but in addition has a bent piece of vulcanite nearly midway between the cells. This is called the propeller, and its effect is to create a vortex that acts on its under and concave side. The vortex pushes against the propeller in the same manner that the ball of a water nozzle draws against the orifice from which the water is issuing. The kite is heavily ballasted with lead, and weighs 1·9 lbs. for every square foot of area. Three methods of soaring were described, and eight points that require investigation were indicated for the guidance of any one who has the leisure and sufficient interest in the subject to assist in the work. The paper also contained a short description of a pipe boiler and screw engine that is intended to drive a flying machine, and also the proposed arrangement of aeroplanes for supporting it, with the method of ensuring a safe trial.—Australian divisional systems, by R. H. Mathews. The author pointed out that all tribes of Australian aborigines are divided into two exogamous intermarrying groups—the men of one group marrying the women of the other group. These tribal divisions have been designated organisations or systems. The names of the groups may change with the languages of the people in different districts, but the same system prevails in them all. Besides this segregation into groups, there is a further subdivision of the latter into smaller segments, bearing the names of animals, such as kangaroo, iguana, emu, cod-fish, frog, &c. These animal names have been called *totems*, a word in use for the same purpose among the North American Indians. Mr. Mathews then proceeded to give an exhaustive description of the rules of marriage and descent established in relation to the divisions referred to, selecting examples from various native tribes located in districts widely separated from each other in different parts of Australia.—Artesian waters in New South Wales, by J. W. Boultbee. The paper described briefly the initial efforts at artesian boring in New South Wales, and led up to the utilisation of the water for irrigation purposes; it described the work in that direction undertaken by the Government at the Native Dog and Pera Bores. It pointed out how the Government was guided by American experience, and referred to the areas, soil, water, results, and the revolution effected in some of the States, and the rapid growth of settlement by means of the artesian water supply; it referred to the gradual awakening of the western pastoralists to the benefits conferred. The progress of the work in New South Wales, cost, yield of water, &c., was tabulated.

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