Nature

A WEEKLY

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

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RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

THURSDAY, NOVEMBER 7, 1901.

THE HIND-BRAIN OF THE MONOTREME.

Die Medulla Oblongata und die Vierhügelgegend von Ornithorhynchus und Echidna. Von A. Koelliker. Pp. vi + 100. (Leipzig: Engelmann, 1901.) Price 16*s*.

DETAILED knowledge of the brain of the Monotreme has in recent years been considerably extended by the works of Profs. Elliot Smith, of Cairo, and Ziehen, of Jena. Material suitable for successful prosecution of microscopical research in this field is necessarily rare. It is a matter for congratulation that such material should have reached the hands of a veteran histologist, Prof. v. Kölliker. His monograph deals with the arrangement of nerve-fibre bundles and of nerve-cell groups in the mid-brain and hind-brain of ornithorhynchus and of echidna respectively. The study is based on transverse sections stained with hæmatoxylin by the Weigert method for nerve-fibres. The ornithorhynchus brain furnished for the regions studied a series of 1088 sections. Detailed drawings under defined enlargement are given for sections at eighteen of the levels. Among the points of interest ascertained the following appear the chief.

Both monotremes offer in common certain features in contradistinction to other mammalia. Noteworthy among these are the subjoined.

The fourth ventricle extends very far distally, so far, in fact, that instead of the anterior half of the cell-group of origin of the hypoglossal nerve, the whole length of that cell-group lies practically uncovered in the floor of the ventricle. The hypoglossal cell-group lies, not next the raphe and under the longitudinal bundle, but away at the side of the ventricle.

The root of the cochlear nerve enters the bulb by piercing it ventral to the peduncle of the cerebellum; none of its fibres wind round the peduncle. But the so-called striæ acusticæ exist nevertheless on the dorsal aspect of the bulb.

The facial nerve has, in addition to its regular nucleus, a second widely separate and dorsal to that, near below the genu of the nerve root. The sensory root of the trigeminus is very large, and enters the brain entirely anterior to the pons.

The pons is poor in cell-groups proper to itself. In echidna there are some cell-groups in its lateral portions as well as in the median, but in ornithorhynchus there are no lateral cell-groups at all.

The great system of fibres—the "fillet" or sensory system—ascending toward the brain and fed by secondary relays from the usual recipient afferent cell-groups is well developed, and exhibits the general arrangement obtaining in higher mammals. On the other hand, the system of fibres—the pyramidal—descending from the hemispheres to form connections with the efferent nuclei is so poorly developed that its very existence is not absolutely certain, at least for ornithorhynchus. It is of interest to note that the great efferent cerebral system can coexist in so meagre an extent in forms which possess an afferent spino-cerebral system so extensive. Thus as a permanent condition we have a state of things similar to that which regularly forms a transient stage in the development of the higher type of mammalian nervous system.

Among features of interest offered by the two brains individually, and therefore to be considered more or less apart each from the other, are the following:

In ornithorhynchus, with its small cochlear nerve, there is discoverable only a mere trace of any superior olive. In echidna, with its large cochlear nerve, the superior olive is a structure of considerable extent.

In echidna a large system of fibres passes along the lateral region of the bulb to the outer side of the sensory root of the trigeminus. These fibres in the upper pontine levels bend inward, decussate, and ascend again in the *pes pedunculi cerebri* of the crossed side. They are traceable at least as far as the optic thalamus. Kölliker urges that it is a sensory spino-cerebral system, but the merely anatomical method employed affords no trustworthy guide to the functional direction of the path.

The central nervous system of echidna represents, on the whole, a grade of development distinctly superior to that of ornithorhynchus. Traces of a pyramidal system fairly distinct though very scanty can in echidna be

followed into the proximal end of the spinal cord. In ornithorhynchus, Ziehen could not satisfy himself about the existence of any pyramidal system. Prof. Kölliker believes he can distinguish a pyramidal decussation in ornithorhynchus and that the fibres of it plunge mainly into the dorsal column of the spinal cord (as in the rat and guinea-pig) and not into the lateral column, as in the generality of mammals. But the description he gives is a very unsatisfactory one, and no mention is made of his data for discrimination between the undoubtedly existent fillet decussation and the equivocally existent pyramidal. Moreover, he admits that he finds in ornithorhynchus no trace of longitudinal fibres passing anywhere along the pons. In arguing for the existence of a pyramidal system, he omits mention of what to most minds forms the strongest argument yet adducible, namely, that, as shown by Prof. C. J. Martin, of Melbourne, excitation of a certain region of the cerebral cortex of ornithorhynchus evokes movement of the crossed fore-limb.

The large extent and specially sentient character of oral-facial surface in ornithorhynchus prepares the observer for a large recipient nucleus in the bulb to subserve the huge sensory root of the trigeminus. This root and its recipient nucleus form a huge projection either side the bulb—the tuberculum quinti, well shown in a figure reproduced from Elliot Smith. Prof. Kölliker finds fibres of this root traceable to the nuclei of the *hypoglossus*, *vago-glossopharyngeus* and *abducens*, as well as to that of the trigeminus itself. From the recipient nucleus of trigeminus he traces fibres to the median fillet, and so to the optic thalamus. C. S. S.

DIVERGENT SERIES.

Leçons sur les Séries Divergentes. Par Émile Borel. Pp. viii+184. (Paris: Gauthier-Villars, 1901.) Price fr. 4.50.

TO make the object of this work intelligible, it is necessary to recall a few facts concerning infinite series in general. Suppose we have a sequence

$$u_1, u_2, u_3, \ldots u_n, \ldots \qquad (U)$$

where u_1, u_2, &c., are analytical expressions constructed by a definite rule. Let $s_n = u_1 + u_2 + \ldots + u_n$; then we have a derived analytical sequence

$$s_1, s_2, s_3, \ldots s_n, \ldots; \qquad (S)$$

this is a definite analytical entity, and its properties are implicitly fixed by those of the former sequence. The expressions u_n, s_n are, of course, functions of n; we may suppose, for simplicity, that, besides this, they involve, in addition to definite numerical constants, a single analytical variable, x. If we assign to x a numerical value, S becomes an arithmetical sequence, and three principal cases arise, according to the behaviour of s_n when n increases indefinitely. If s_n converges to a definite limit s we say that this is the sum of the series $u_1+u_2+u_3+\ldots$, and write $s=\sum_1^\infty u_n$; but the ultimate value of s may be either indeterminate or infinite. In the second case Σu_n has no definite meaning; in the third we may say, if we like, that Σu_n is infinite, but this infinite sum is not a quantity with which we can operate, and presents no special interest.

When the series Σu_n and Σv_n are absolutely convergent we can add and multiply them according to the rules

$$\Sigma u_n + \Sigma v_n = \Sigma(u_n + v_n)$$
$$\Sigma u_n \times \Sigma v_n = u_1v_1 + (u_1v_2 + u_2v_1) + (u_1v_3 + u_2v_2 + u_3v_1) + \ldots = \sum_n \sum_r (u_r v_{n+1-r}):$$

now the sequences

$$u_1+v_1,\ u_2+v_2,\ \ldots\ u_n+v_n,\ \ldots \qquad (A)$$
$$u_1v_1,\ u_1v_2+u_2v_1,\ \ldots\ u_1v_n+u_2v_{n-1}+\ldots+u_nv_1,\ \ldots \qquad (B)$$

can be constructed, whether or not the sequences $(u_1, u_2, \ldots)$ and $(v_1, v_2, \ldots)$ are convergent; the question therefore arises whether it is possible, even when the series Σu_n, Σv_n are divergent, to associate with the sequences $(u_1, u_2 \ldots)$ and $(v_1, v_2, \ldots)$ certain finite and determinate functions U, V in such a way that U+V and UV may be *by the same rule of correspondence* associated with the sequences (A) and (B) above.

Among the various ways in which this can be done, M. Borel's method of exponential summation is particularly interesting. Briefly it is this: let

$$u(a) = u_0 + u_1 a + \frac{u_2 a^2}{2!} + \frac{u_3 a^3}{3!} + \ldots + \frac{u_n a^n}{n!} + \ldots$$

then the function

$$s = \int_0^\infty e^{-a} u(a)\, da$$

is defined to be the *exponential sum* of the series $u_0+u_1+u_2+\ldots$. When Σu_n is convergent, s coincides with the sum in the ordinary sense; the important point is that s may be finite even when Σu_n is divergent; the series is then "exponentially summable"—*absolutely* so, if

$$\bar{s} = \int_0^\infty e^{-a} \mid u(a) \mid da$$

is a convergent integral. M. Borel proves that (in the case of absolute summability) if U, V are the exponential sums of Σu_n and Σv_n, then U+V and UV are the exponential sums of the series whose terms are given under (A) and (B) above; in other words, the formal laws of rational operation are satisfied. In a similar sense, an absolutely summable series may be differentiated any number of times.

As an example of the practical value of these results, suppose we have a differential equation $F(y, y', y'', \ldots)=0$ in which $y, y', y'' \ldots$ enter rationally: then, if this is found to be formally satisfied by a series Σu_n, which, although divergent in the ordinary sense, is exponentially summable, the exponential sum is actually a solution of the differential equation.

In Chapter iv. M. Borel applies the idea of exponential summation to an interesting problem in function-theory. Suppose we have a power-series

$$u_0 + u_1 x + u_2 x^2 + \ldots$$

which is convergent within a circle of finite radius, but divergent outside of it. Within the circle, this series defines a function of x, say $f(x)$; within the same region the series is exponentially summable, and its sum is $f(x)$. But the exponential sum may exist and be finite in a region *larger* than the circle of convergence of the power-series; in this case the exponential sum is an analytical continuation of $f(x)$ outside the circle, and the new region

of summability is shown to comprise an area bounded by a (finite or infinite) number of straight lines, each of which goes through a critical point. This new region M. Borel calls the *polygon of summability*. An obvious question arises here; does the continuation of $f(x)$ obtained by exponential summation necessarily coincide with one obtained by other methods, for example Weierstrass's? In some cases it certainly does; for instance, when $f(x)$ is a rational function of x, or one branch of an algebraic function.

So far it has been supposed that the object of inquiry is in the first instance a series given by the law of construction of its terms; and the main result has been to show how, in certain cases where the series is divergent in the ordinary sense, it may be associated with a finite function, called its sum (in an extended sense), which the series so far represents that relations satisfied formally by the series are actually and arithmetically satisfied by its sum. But there is another side of the question which is of equal importance, especially from the practical point of view. We may have a function explicitly or implicitly defined by certain properties, and try to obtain a series which for purposes of computation or otherwise may be regarded as its equivalent. A typical illustration is afforded by the ordinary process of solving differential equations by series; here we have a uniform method which, if it does not fail altogether, leads us to a power-series, formally satisfying the equation, but not necessarily convergent. Exponential summation, when it is applicable, enables us to obtain a solution from the merely formal equivalent. In this connection we have Poincaré's theory of asymptotic series, which is expounded by M. Borel in Chapter i. Independently of its convergence, the expansion

$$c_0 + \frac{c_1}{x} + \frac{c_2}{x^2} + \ldots + \frac{c_n}{x^n} + \ldots$$

is said to represent $f(x)$ asymptotically if

$$x^n \left[f(x) - c_0 - \frac{c_1}{x} - \frac{c_2}{x^2} - \ldots - \frac{c_n}{x^n} \right]$$

vanishes when x is infinite. Asymptotic expansions may be combined by the ordinary formal rules of rational operations, and the result is asymptotically equivalent to the corresponding combination of the functions represented. These considerations justify the use of semi-convergent series in computation; the classical example occurs in the theory of the gamma function. It must be carefully observed, however, that although the asymptotic expansion (if it exist) of a definite function is itself definite, we *cannot* infer the existence of a definite function corresponding to a given expansion $\Sigma c_n x^{-n}$: the reason of this rather paradoxical result is that innumerable functions (for instance e^{-x}) lead to an asymptotic expansion with zero coefficients throughout.

In Chapter ii. M. Borel discusses the results contained in Stieltjes's memoir (*Annales de la Faculté des Sciences de Toulouse*, tt. viii. ix.), and in Chapter v. deals with the polynomial expansions due to Mittag-Leffler. Interesting as they are, it seems hopeless to try to analyse these chapters within the compass of a review; they are, indeed, themselves of the nature of summaries, and will be best appreciated by those readers who accept M. Borel's invitation to consult the original memoirs. Attention may, however, be called to the author's estimation of these researches. It is, in effect, that the memoir of Stieltjes, though of great originality and suggestiveness, is of restricted application and not likely to lead to a general theory; and that, on the other hand, while Mittag-Leffler's theory does not immediately afford a calculus of divergent series, in the proper sense of the term, it may very probably lead to one. It should be added that M. Borel himself has made substantial contributions to this theory of polynomial expansions; some of them appear for the first time in the present volume.

The fact is that most of the field traversed in this very attractive course is of recent discovery, and we cannot expect to be presented with a complete and symmetrical doctrine all at once. Let us be thankful that M. Borel, himself one of the pioneers on this novel route, has so clearly and impartially indicated the progress that has hitherto been made. G. B. M.

OUR BOOK SHELF.

The Chemical Essays of Charles-William Scheele. Pp. xxx + 294. (London: Scott, Greenwood and Co., 1901.) Price 5*s.* net.

THIS is a reprint of Dr. Beddoes' translation of Scheele's essays, which was published in 1786 by John Murray and may still be picked up occasionally in second-hand book shops. The reproduction is faithful even to the mis-spelling of Priestley's name in Beddoes' preface. Between this preface and the essays, however, there now appears a memoir of the life and work of Scheele, written for the reissue by Mr. John Geddes McIntosh. Mr. McIntosh presumably has inspired the reissue of the essays, and if this will be the means of getting them more generally read by students of chemistry, he may so far prove a benefactor.

Of the essays themselves it is hardly necessary to say anything. The facts they establish belong for the most part to what is now very elementary chemistry and the phlogistic hypothesis with which the explanations are involved did not long outlive Scheele; but the spirit which breathes in these essays and the method they inculcate can never grow commonplace or antiquated.

The strict fidelity to experiment, the rare sagacity, the scrupulous and minute observation and the extraordinary experimental skill combine to make Scheele a model for all time. When we add to this the pathos of his early struggles, the simplicity of his blameless life and the nobility of his untimely death, there can be no wonder that Scheele is reckoned a hero among chemists.

It cannot be said that the memoir which accompanies these essays is worthy of the subject. Mr. McIntosh has apparently considerable enthusiasm for the solid virtues of Scheele and for the material outcome of Scheele's discoveries, but he shows little critical insight or literary taste. Speaking, for example, of the discovery of chlorine, he says: "Let us now glance at the radical errors of the French school, the chief of whom was Berthollet, the man who was the first to make practical application of Scheele's discovery, and, as is usually the case with such men, they propound a theory of their own, so that some at least of the merit, if not all of the original discovery, may descend upon their own mantle."

The violence here done to Berthollet, to the rules of English composition, and to a time-honoured metaphor is very remarkable.

On the following page it is stated to be "a well-known fact at the present day" that the product of distilling fluorspar and sulphuric acid in a glass retort is gaseous hydrofluosilicic acid.

The essay concludes with a comparison of Scheele with Shakespeare, somewhat to the disparagement of the poet, and with a very comical lament that so few people ever visit either Scheele's birthplace, "if it still be in existence," or his shrine at Köping, "where he died and where presumably his remains are interred." One might even suspect that Mr. McIntosh had not been there. A. S.

Use-Inheritance; Illustrated by the Direction of Hair on the Bodies of Animals. By W. Kidd. 8vo. pp. 47. Illustrated. (London: A. and C. Black, 1901.) Price 2*s.* 6*d.* net.

EVERY naturalist who has studied the ungulate mammals must have been struck with the curious variation in the direction of the hair which occurs even in closely-allied species, and has probably been much puzzled to account for these differences. Why, for instance, do the hairs on the back of all the Asiatic buffaloes point towards the head and those of their African allies in the opposite direction? In the former animals, as in all analogous instances, a whorl (in this case on the haunches) marks the point where the change in the direction of the hairs from the normal backward slope occurs. In the work before us the author, although he has not attempted to give a reason for the variation in the hair-slope of closely allied species, has done good service by classifying these "whorls" and "featherings," as typified in the horse. He has also shown that these features always occur at spots where two or more muscles are acting against one another, as is well exemplified on the forehead of the horse. It is therefore suggested that the production of such whorls has a dynamical origin. It is noteworthy that while whorls and featherings are very commonly developed in short-haired mammals, they are either absent or rudimentary in those with long hair.

The main argument of the book is, however, connected with certain peculiarities of the hair-slope in man. In normal instances this slope on the back of the head and neck diverges obliquely from the middle line, somewhat after the simian fashion. But in a second, or "exceptional," type the direction is just the reverse of this. It is suggested that while the normal type has been directly inherited from simian ancestors, the exceptional type (which is considered to be an acquired one) has been derived from the female line. It is further shown than on the human back the direction of the hair-slope is quite different from that which obtains in all apes and monkeys. "This aberration of hair-slope I have suggested," writes Dr. Kidd, "to be produced by the habit which man has of spending about a third of his life, during sleep, in lying mostly on his side, and, for some millenniums at least, with some sort of rest for his head."

These peculiarities in the hair-slope of man and other animals, adds the author, are congenital and not due to selection; hence, unless originally created with the forms of life in which they occur, they must have been produced in their ancestors by use or habit. From this it follows that, if the creation hypothesis be discarded, in this particular instance, at any rate, acquired characters are inherited.

While claiming recognition for his own views on this point, Dr. Kidd (p. 8) deprecates the idea that they militate seriously against the merits of Weismann's theory as a whole. It may be added that the language in which this tribute to a great thinker is couched would have been more elegant had the author avoided the triple use of the word "which" in a single sentence. R. L.

Foundations of Botany. By Joseph Y. Bergen, A.M. Pp. x + 257. (Boston, U.S.A.: Ginn and Co., 1901.)

THIS book is intended, or at least so we gather from the preface, to provide a year's work in an advanced school class. Much of the matter is to be commended, and some of the new figures are admirable. From this side the Atlantic one can only regard with envy the amount of energy expendable in American schools if a work of this proportion and scope is really suited to their possible requirements; for the book covers a wide range of subjects, and will make no small demands on the time of the student who aims at mastering its contents. The author clearly intends that the work shall be grappled with thoroughly, and from the concrete and practical side. He gives directions for laboratory work, and suggests problems to be solved by observation and experiment. These are incorporated in the text as appendices to the chapters, after the prevailing fashion in modern American text-books. It may, perhaps, be questioned whether the book might not be improved by the separation of the purely systematic portion into a volume by itself.

LETTERS TO THE EDITOR.

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

The Exploration of the Atmosphere over the Ocean.

THE experiment of flying kites in calm weather from the deck of a moving tug-boat, which was mentioned in NATURE of September 5 (p. 453), was continued by my assistant, Mr. Sweetland, and myself on a steamship that performed the voyage from Boston to Liverpool between August 28 and September 5. Flights were made on five days, the greatest height reached by the meteorograph being one-third of a mile, and the records of barometric pressure, air-temperature, relative humidity and wind-velocity, which are probably the first to be obtained above the North Atlantic, were shown to Section E of the British Association at Glasgow.

These experiments demonstrate conclusively that, with a steamer that can be manœuvred at will, kites can be flown at sea in almost all weather conditions, and, consequently, a most important field is opened for their use in meteorological researches, especially in the tropics, where the conditions existing above the trade-winds are imperfectly known. It is to be hoped, therefore, that such an investigation will be undertaken either by the Government or by private enterprise, and I am now endeavouring to bring this about. A. LAWRENCE ROTCH.

Blue Hill Observatory, Hyde Park, Mass., U.S.A., October 25.

A Curious Flame.

THE kind of phenomenon described by Mr. Garbutt (p. 649) is frequently to be met with in "washed-out" flames, that is, in flames which are diluted to the point of extinction. In such cases the velocity of inflammation is so low that flame cannot propagate itself against the stream of gas. If the current of gas be baffled by an obstacle, then a flame may originate in the "slack waters" round the obstacle. No doubt the temperature of the obstacle is of some importance if the object be small, since rapid withdrawal of heat at any point of a gaseous current is a hindrance to the development of flame at that point. But it will be found that in the experiment described by Mr. Garbutt a flame may be obtained by opposing a large baffling surface of even an enduringly cold body such as a 56-pound weight. In this case a very large portion of the gaseous mixture is made stationary and the cooling down does not affect more than a small film next the metal. A kindred phenomenon is described in NATURE (vol. xlix. p. 86).

The flame obtained when a Bunsen lamp is lighted both at the bottom and the top of the tube is very feeble, and large tracts of it may be extinguished by holding in it beads of volatile salts. ARTHUR SMITHELLS.

November 4.

WITH regard to the flame described by Mr. Garbutt in your issue of October 31, I would suggest the following explanation, which, however, I have not as yet quite proved.

The products of the partial combustion at the bottom of the

Bunsen tube will, in this case, burn with the aid of external heat; but not without some such assistance, because the heat of combustion is so much absorbed by the diluting gases that the temperature of ignition would not otherwise be maintained.

The experiment reminds one of the burning of ammonia, and of a coal-gas flame rendered non-luminous by the admission of steam.

A consideration of Prof. Smithells' method of cone separation by a glass rod (*vide* NATURE, November 1892) might lead to the suspicion that the obstruction of the rod played some part in the phenomenon, but the above explanation is supported by the fact that the copper wire which, when cold, extinguishes a candle flame, does not, when warm, do so.

HERBERT KING.

The School, Wolverhampton, November 2.

The Colours of Guillemots' Eggs.

I AM glad to see that my friend Captain Barrett-Hamilton has written on the above subject, though it seems inconceivable to him that "the beautiful varieties of colouring must help each bird to distinguish her egg from others lying near until they all become stained and soiled." The quotation is from "The Birds of Ireland" (p. 364), in which I put forward, as an opinion, the conclusion that I have been led to after many a day spent in climbing among breeding guillemots.

Discussion of such opinions is to be welcomed, but they must be tested by close observation of the birds and their ways; and the guillemot finding its own egg among many is not the same thing as an animal finding its young, which has voice, smell, movement and expression, nor has the guillemot a nest to find.

It is asked, "Why should each guillemot be provided with a conspicuous private egg-pattern when other sea-birds, her neighbours, have to find their homes without such aid?"

Well, let anyone look down on a guillemot-ledge the last week in May, before the birds have begun to sit close, and he will be struck by the fact that each is provided with a conspicuous egg-pattern, the green eggs contrasting with the white ones and those heavily blotched with the streaked ones; and this is most obvious, even at some distance. I know no other eggs that show such vivid contrasts.

Does this contrast supply any want that the guillemot may have above other birds to enable it to find its egg? Her neighbours, my friend remarks, find their homes without such aid. But then each has her "home." The gulls and cormorants have their nests. Each puffin has its burrow. The razorbills lay much more in separate nooks than guillemots, but still they approach nearest to them both in the nature of their breeding places and in the varieties of egg-colouring. But guillemots lay and sit in packs, often touching one another, on open surfaces of rock (see the plate, "Birds of Ireland," facing p. 362). At first the eggs are often left uncovered and other guillemots alight, lay beside them, and they roll more or less. Must not the special colouring greatly enable the parent bird to find her egg while this is going on? Why should we deny her intelligence in a matter that concerns her, even though other birds are satisfied if they know the way to their nests and do not seem to distinguish whether the eggs in them are their own or not. Thus the cuckoo's egg is unquestioningly accepted by the foster-mother.

It is objected that my suggestion about the colour helping guillemots to distinguish their eggs is disproved by the subsequent admission that they all become stained and soiled as incubation advances; but at that stage each bird clings to her treasure and never leaves it, unless her mate relieves her (a point which needs proof).

The colouring of the eggs of this species is not protective, for it makes them gaudy. It is peculiar, and why should it not be useful during laying-time considering the very peculiar conditions under which guillemots breed? They sometimes come down with a thump among others which are hatching, they sometimes fight, they are awkward on their feet; eggs are not only moved, but many are thrown down, broken or lost in pools.

I wish some ornithologist would contrast from observation the guillemots' colonies on surfaces of rock with those of other birds that breed in packs without nests. Penguins appear to lay on earth and leave lanes between the nesting-places on which the birds travel on foot. That being so, their eggs would not be in such danger of being rolled about.

Cappagh, co. Waterford. R. J. USSHER.

THE TERCENTENARY OF TYCHO BRAHE'S DEATH.[1]

ON October 24, 300 years had elapsed since Tycho Brahe died at Prague, expressing in his last moments the hope that he might not appear to have lived in vain. When saying this he doubtless did not fear that the work he had accomplished might not turn out to be of permanent value, but merely regretted that the great goal he had looked forward to from his early youth, the complete reformation of astronomy, had not yet been fully reached. Could he have foreseen how brilliantly Kepler, who stood at his deathbed, was to complete the work, Tycho would have had no fear as to the lasting nature of his reputation.

It is difficult nowadays to realise that only a little more than 300 years ago it was not a self-evident proposition that the science of astronomy could only be firmly established by observing the heavens systematically year after year, and not merely by taking an odd observation now and then. And yet this does not appear to have occurred to anybody before Tycho, as even Copernicus records very few observations taken during his long life, so that the values of most astronomical quantities had still to be borrowed from Ptolemy. But in August 1563 the young Danish noble, then a student at the University of Leipzig, only sixteen years of age, commenced the series of observations which he carried on, with few interruptions, till the end of his life, thirty-eight years later. The instruments he used at first were crude enough, but already at that time the future reformer of practical astronomy was aware that a very inferior instrument may produce good work if all sources of possible errors are investigated and corresponding corrections are applied to the results of the observations. It is also worth noticing that the planets almost from the beginning claimed his undivided attention, so that the youthful observer had perceived that the existing planetary tables could only be improved if the computed places of the planets were systematically compared with observed places and the errors of the tables thus brought to light. Thanks to the great liberality of King Frederic II. of Denmark, Tycho was afterwards able for more than twenty years, with a multitude of instruments of improved construction and assisted by a number of pupils, to follow the motions of the sun, moon and planets, while he at the same time, by his observations of a thousand fixed stars, gave to the world a catalogue of accurate positions of these bodies which took the place of the old catalogue of Ptolemy and held its own for more than a hundred years, until the use of telescopes and clocks of precision enabled Flamsteed to produce much better star places.

That Kepler made use of Tycho Brahe's observations to find the laws which govern the planetary motions and thereby to free the Copernican system from the excentric circles and epicycles which it had taken over from the Ptolemean system is too well known to require repetition here. But Tycho did a great deal more than merely amassing materials for his successor. Not only was he the first observer who did not assume his instruments to be faultless but who studied their errors of construction, but he was also the first to investigate refraction and to attempt to correct his observations for it, and he succeeded in improving his instruments so much that it is difficult to see how a much greater accuracy could have been attained by succeeding generations, if the telescope had not been invented a few years after his death and if the application of the pendulum to clocks had not simplified many methods of observing. And Tycho was able to deduce many important results from his own observations. By showing that the comets

[1] "Tychonis Brahe Dani die xxiv Octobris A.D. MDCI defuncti operum primitias De Nova Stella summi civis memor denuo edidit Regia Societas Scientiarum Danica. Hauniæ, die xxiv Octobris A.D. MDCCCCI." Pp. 16 + 54 ff. + pp. 30; 2 plates.

observed by him had at most a very small parallax he proved that they were celestial bodies and not mere phenomena in the earth's atmosphere. Important as this discovery was, it is quite eclipsed by the splendour of Tycho's discoveries with regard to the motion of the moon. The ancients knew that the moon's orbit forms an angle of about 5° with the ecliptic, that the two points of intersection (the nodes) travel round the ecliptic in the direction from east to west in about nineteen years, also hat the earth is not at the centre of the lunar orbit, and hat the line of apsides completes a revolution (from west to east) in less than nine years. The great perturbation in longitude now known as the evection, by which the place of the moon may be put forward or backward as much as 1° 16′, was also known, having been dimly perceived by Hipparchus and clearly demonstrated by Ptolemy. But since his time no advance had been made (Sédillot's assertion that Abul Wefa discovered the variation has been clearly and finally disproved). The accurate and long-continued observations of Tycho Brahe revealed the existence of another inequality in longitude, known as the variation, which affects the place of the moon to the extent of 40′, by which amount the moon is ahead of her mean place about three and a half days after new and full moon, and as much behind it about three and a half days after the first and last quarters. He also found the annual equation or the lengthening of the moon's period of revolution in winter and its shortening in summer. Finally, Tycho discovered the variation of the inclination of the lunar orbit and the irregularity of the motion of the nodes. After this series of brilliant successes he cannot have doubted that his observations were destined to reveal the mysteries of planetary motion, and already in 1591 he had commenced to suspect the existence of unknown complications in the motion of Mars, which he afterwards alluded to in a letter to Kepler in 1598, in which he stated that the epicycle of Mars appeared to vary in size. Preparations had already been made for commencing the discussion of the observations of the planets, when an early death closed the life-work of Tycho and obliged him to leave the completion of it to Kepler.

The 300th anniversary of Tycho Brahe's death has been celebrated in his native land by a festive meeting of the Academy of Science at which the venerable King Christian was present, and at which orations were delivered setting forth the importance of Tycho's scientific work. At Prague, where he died, the monument over his recently restored tomb in the Teyn Church was again unveiled, and the interest which the citizens of Prague have always shown in the illustrious exile was manifested in various ways. But though Tycho towards the end of his life felt himself neglected in Denmark and left the country in order to enjoy the society of learned and congenial minds elsewhere, he never forgot the land of his ancestors and his birth, and on the titles of his last writings, as on his first, he describes himself as "Tycho Brahe Danus."

The Copenhagen Academy has chosen a very fitting way of doing honour to the memory of the greatest scientific man Denmark has produced by publishing a facsimile reprint of his earliest publication, "De nova stella" (1573). Tycho's four principal works are found in all great libraries and are not unfrequently met with in the lists of second-hand booksellers. But the book on the splendid new star which appeared in Cassiopeia in November 1572 is so extremely scarce that not a single historian of astronomy had ever seen it or even been able to give the title correctly until the writer of these lines gave an account of it in 1890. Tycho says himself that not many copies were printed and only a few were sent abroad, for which reason he afterwards reprinted the more important parts of it in his larger work, "Astronomiæ Instauratæ Progymnasmata," on which he was engaged during the last fourteen years of his life and which was published after his death. But the whole of the original book, as it left the hand of the young author, is of great historical interest, and we are glad to see the fine reprint now issued, as the star of 1572 was so intimately connected with the progress of Tycho's work.

In a short Latin preface and a Danish postscript of thirty pages, M. Pechüle, of the Copenhagen Observatory, has given a short summary of the origin and contents of the book. Tycho's manuscript was an astronomical, astrological and meteorological almanac for the year 1573, in which he, after a lengthy introduction (to the almanac proper), had inserted his essay on the new star, another on the lunar eclipse of December 1573 and a poem to Urania. After a good deal of persuasion by several friends, Tycho allowed the book to be printed in the spring of 1573, omitting, however, the main part of the almanac. It contains 53 ff., and has now been exactly reproduced in facsimile, but it has been collated with a MS. copy partly written in Tycho's own hand and preserved in the Imperial library at Vienna, in which way a few corrigenda were noticed which are given at the end of the reprint. The book, which is beautifully got up, also contains a specimen of Tycho's handwriting and a copy of a very fine portrait, drawn with pen and ink, found in the Royal collection of engravings at Copenhagen and by some ascribed to the Dutch engraver Goltzius, by others to the painter Gemperlin of Augsburg, who came to Denmark with Tycho in 1575 and afterwards painted the well-known portrait on his mural quadrant. To anyone acquainted with the contemporary literature on the new star and on comets this book will be of great interest, as it gives a very sober account of the startling celestial phenomenon which had given rise to a host of more or less worthless pamphlets and books, and shows that the want of parallax and motion proves the star to belong to the region of the fixed stars. At the same time, it is interesting to see that the author, who was destined afterwards to give the death-blow to the Aristotelean idea of the atmospheric origin of comets, was still a believer in this doctrine when he wrote his first book, but also that he was already then thoroughly aware that the great desideratum of astronomy was an extensive series of observations which he hoped to be able to supply if health permitted and the necessary means were granted him.

Scania, the province east of the Sound, where Tycho was born, and the little island of Hveen, on which his observatory stood, formed parts of the kingdom of Denmark from before the dawn of history and till 1658, when they were torn from the country which had not sufficiently valued him and incorporated in Sweden. It is therefore natural that the recent anniversary of his death also attracted attention in Sweden, and in honour of the day the Physiographic Society of Lund has published a *Festskrift* (20 pp., 4to., with three plates), in which Prof. Charlier, of Lund, gives an account of the recent exploration of the scanty remains of Tycho's buildings on the island. The foundations of Uraniburg were laid bare, as also the floors of the half-subterranean observatory (Stellæburgum (Stjerneborg), but scarcely anything was found more than what the clergyman Ekdahl unearthed in 1823. It has repeatedly, in 1823, in 1868 after the examination of the site by d'Arrest, and now again on the present occasion, been pointed out that "something ought to be done" to protect the ruins from wind and weather, and we may add from relic-hunters also. If this was desirable formerly, when Hveen was a lonely place to which nobody ever went, it has become infinitely more important now, as the island seems to have become the common resort of Sunday trippers from both shores of the Sound, and it would certainly be safer to cover up the foundations again than to leave them unprotected. It has recently been suggested that the observatory might easily be rebuilt from Tycho's detailed and

illustrated description and on the existing foundations and floors of the crypts, and no doubt this would be quite possible. But we confess we should prefer to see a large shed erected over the few stones that are left so that these venerable ruins could remain undisturbed. Most people would prefer looking at the ruins of Kenilworth Castle to walking through a sham castle erected on them and absorbing them. J. L. E. DREYER.

CELEBRATION AT PRAGUE.

Representatives of Bohemian science have recently shown that they delight to remember that Tycho Brahe, the great pioneer of modern observational astronomy, spent the last two years of his scientific activity in the capital of the Bohemian kingdom at a time when, as a seat of the Imperial Court of Rudolph II., the city was one of the most prominent centres of western European culture. It was at Prague that Tycho (Danish, Tyge) Brahe died on October 24, 1601.

The municipal council of Prague took part in the recent celebration, which excited much interest and received a large share of attention in the daily Press.

We cannot give here a detailed account of the scientific career of the great astronomer, but an outline will be of interest. Frederic II. of Denmark gave Tycho means for building the splendid observatory of Uraniburg, but after the death of his royal supporter Tycho was obliged to leave Denmark and his observatory, together with its valuable astronomical instruments.

Tycho went to his friend Count Rantzau at Wandsbeck in 1597 and two years later to the Court of the Emperor Rudolph II. at Prague. But the life at this Court was much too distracting for a scientific worker like Tycho, so he removed to the Imperial castle of New Benatky, where he founded an astronomical observatory. The brass-wire line on the floor, representing the meridian, still exists and is shown as a relic of the observatory. There was also a chemical laboratory, in which Tycho worked.

In the year 1600 Tycho Brahe, at the request of the Emperor, again returned to Prague, where, near the Royal Castle on the ground belonging to Curtius, arrangements were made for building an observatory surpassing even that of Uraniburg in character.

Meanwhile a house, "At the Golden Griffin," was provided for him and his family; and his library, together with his twenty-eight astronomical instruments, was removed to the summer castle of Belvedere, which is named after Tycho even now. Some time afterwards his observatory was removed to the ground of Curtius, where the Czernin barracks are now standing. Here he was assisted in his work by the young mathematician Kepler, who was called by the Emperor to the capital of Bohemia "quoad calculum."

While Tycho was in the midst of his scientific activity he was seized by a sudden illness and after eleven days he died. He was buried in the Teyn Church, and at his grave the learned Bohemian Dr. Iesenius delivered an impressive Latin oration in which he described Tycho's scientific merits and noble character.

The celebration of the 300th anniversary of Tycho's death began at Prague on October 18, where, at a special meeting of the Bohemian Academy of Science, Art and Literature, Prof. Gruss read an address on Tycho's life and scientific influence.

The Royal Bohemian Society of Science celebrated the tercentenary on October 24. In one of the ancient meeting-rooms of the Prague Town Hall an exhibition was held of several Tychonian relics. There was Tycho's magnificent album which was presented by him to his son and is a treasure of antique book-binding; the manuscript, "Triangulorum Planorum et Sphæricorum Praxis Mathematica,"; a manuscript, "Tychonis Brahe Ottonidis (his father's name) Tabulæ Sinuum, 1682"; the memorandum book of Siebold Plan, with an inscription: "Plures sapiunt palato quam cerebro, Tycho Brahe scripsit Uraniburgi, Anno 1591." From Tycho's printed works were exhibited, a copy of Ptolemy's "Almagest," with Tycho's handwriting of 1560; a copy of Copernicus's "De Revolutionibus Orbium Cœlestium Libri VI.," with Tycho's margin notes; a copy of "Tychonis Brahe Astronomiæ Instauratæ Mecanica, Wandesbergi, Anno MDIIC.," which contains Tycho's signature and a dedication to his friend Baron ab Hasenburg, a book containing *inter alia* extremely interesting coloured pictures of the Uraniburg and of a series of Tycho's astronomical instruments. Several other books from Tycho's library bearing dedications to him were also exhibited. All these objects are described in Prof. Studnička's work, "Prager Tychoniana," of which a notice has appeared in NATURE (vol. lxiii. p. 206). There was also exhibited Tycho's Latin poem on the title-leaf of the book, "Prutænicæ Tabulæ Cœlestium Motuum Autore Erasmo Reinholdo"; and a celestial globe made by Tycho's pupil, Willem Iansoon Blaev, in 1603, and containing the positions of fundamental stars as determined by Tycho. Many photographs of Tychoniana were exhibited; some of them, showing the present state of Uraniburg after recent excavations, were contributed by Prof. Thiele. The books and the globe lent for exhibition were from the monastery of Strahov, the Royal Bohemian Museum, and the Imperial Library of the University.

Among those who attended the celebration were Dr. Thiele, professor of astronomy in the University of Copenhagen and rector of the latter, as a representative of the University and of the Danish Academy of Sciences, with his son and assistant, Holger Thiele; Mr. Harald Mortensen, of Copenhagen; and a great number of representatives of Bohemian science. After visiting the exhibition, the representatives went to the Town Hall, where they were received and greeted by the Mayor of Prague. Prof. Studnička then gave an address of the life and work of Tycho Brahe. The meeting was brought to a close by a few historical remarks by Prof. Tomek, the distinguished historian of the city of Prague and president of the Royal Society of Bohemia.

After this a visit was made to Tycho's tomb and monument in the Teyn Church, opposite the Town Hall. It must be remarked here that this church was partly destroyed by fire in 1675 and that its pavement was restored in 1721. It was therefore doubtful whether Tycho's remains would be found there, especially as, after the battle on the White Berg in 1620, the Teyn Church became a Catholic one and the bodies of persons who had held other beliefs were removed. The municipality of Prague, in view of the anniversary, had this question fully investigated by Profs. Schrutz and Matiegka, and it was found that the brick vault of the tomb had been broken during the catastrophes of the seventeenth and eighteenth centuries and that some earth had fallen in. Two bodies were, however, brought out with the greatest care, and it was recognised by many signs, such as the form of the moustache and the fact that a part of the nose had been cut off and replaced by one of metal (chiefly copper), that the skull undoubtedly belonged to Tycho, whose nose was cut off in a duel in 1566, so that he afterwards wore an artificial nose of metal.

The tomb was put in good order and the remains of Tycho and his wife were placed in a metal coffin and again buried. The grave is covered by a large marble plate bearing the inscription, "Tycho Brahe." The tomb and epitaph are represented in the accompanying reproduction of a photograph. As it appears that one of the authors of the inscription on the epitaph was Kepler, we give it here in its full length:—

"Esse potius quam videri.
Illustris et generosus Dominus Tycho Brahe, Danus, Dominus in Knudstrup, arcis Uraniburgi in insula

Tomb, Tombstone and Epitaph of Tycho Brahe at Prague.

Hellesponti Danici Huenna fundator, instrumentorum astronomicorum qualia nec ante sol vidit, ingeniosissimus idemque liberalissimus inventor et exstructor, anti-

quissima nobilitate clarus, suo auctior animo, quæcunque cœlo continentur, immortali gloria complexus, Astronomorum omnis sæculi longe princeps, totius orbis commodo sumptibus immensis, exactissimas intra minuta minutorumque partes, triginta amplius annorum observationes mundo primus intulit; affixa sidera intra minutum

ejusque semissem restituit: Hipparchi solius ab orbe condito vel diis improbos in octava duntaxat gradus parte conatus longissime antegressus: utriusque luminaris cursum exquisite restauravit, pro reliquis erraticis solidissima *tabularum Rudolphaearum* fundamenta jecit: Mathematicarum rerum peritis inveteratam Aristotelis et asseclarum doctrinam de sublunari cometarum novorumque siderum situ, demonstrationibus invictis exemit: novarum hypothesium autor; in Stagyricis et universa philosophia admirandus; evocatus ab invictissimo Romano imperatore *Rudolpho Secundo*, mira doctrinæ et candoris exempla dedit; ne frustra vixisse videretur, immortalitatem, etiam apud Antipodas scriptorum perennitate sibi comparavit; planeque qualis esse quam haberi maluit, nunc vita functus æternum vivit.

Ejus exûvias uxorisque triennio post defunctæ heredes liberi sacro hoc loco composuerunt. Obiit quarto kalend. Novembris anni Christiani Dionysiaci MDCI ætatis suæ LV.

Non fasces, nec opes, sola artis sceptra perennant." Around the tombstone bearing Tycho's likeness we read: "Anno Domini MDCI die XXIV Octobris obiit illustris et generosus Dominus Tycho Brahe, Dominus in Knudstrup et Præses Uraniburgi et sacræ Cæsareæ Majestatis Consiliarius, Cujus ossa hic requiescunt."

When the visit to Tycho's tomb took place, the Mayor of Prague laid a beautiful wreath upon the tomb which bore the inscription upon ribbons in national colours, "To the great philosopher—the Royal Capital of Prague." Other wreaths bore the inscriptions, "Universitas Hafniensis," "Societas regia scientiarum Danica," "Fra Danske Studenter." There were also wreaths from Prof. Šafařik, the Observatory of Prague, and many others from literary and scientific societies.

The visitors afterwards proceeded to a house on the "Fruit Market," where a memorial tablet of marble was placed stating that Kepler lived there from 1604–1607. In the afternoon the Belvedere of Tycho Brahe was visited and a name "Tycho Street" was given to a new street opposite it. The long row of carriages bearing the numerous visitors then proceeded to a quiet street near the now abandoned Royal Castle, and the house "At the Golden Griffin" was shown, having in front a marble tablet stating that Tycho lived there in 1600 and 1601. Finally, the place was visited where Tycho's last observatory formerly stood and where a new street, bearing the name of Kepler, is now situated.

In this way was celebrated the memory of the great astronomer whose work marks a great epoch in that science, and from whose observations his friend and colleague Kepler calculated his well-known laws.

BOHUSLAV BRAUNER.

CELEBRATIONS IN DENMARK AND SWEDEN.

In Copenhagen the Society of Science celebrated the tercentenary of Tycho Brahe's death in the presence of the King and Royal family and all the members of the Society. The meeting was opened with a short address by the president of the Society, Prof. Jul. Thomsen, who announced that Dr. J. L. E. Dreyer, who was born in Denmark, had had the order of Knight of the Dannebrog conferred upon him by the King. Prof. Fridericia gave a lecture on the personality of Tycho Brahe. He pointed out his scientific enthusiasm and his accurate observations, and showed how towards the close of his life he neglected the mystical side of astrology and regarded astronomy more from the physical point of view. The astronomer's statue in the grounds of the Copenhagen Observatory was decked with wreaths and flowers.

At the University of Lund a bust of Tycho Brahe was unveiled. The Stockholm Academy of Science celebrated the event by a memorial festival in the presence of Prince Eugen and several of the ministers, when speeches were delivered by President Odhner and Prof. Dunér.

STUDIES ON THE ETHNOGRAPHY OF THE NORTH QUEENSLAND ABORIGINES.[1]

ANTHROPOLOGISTS so fully recognised the value of Dr. Walter E. Roth's "Ethnological Studies among the North-West-Central Queensland Aboriginals" that there was considerable satisfaction when the news arrived a year or two ago of his appointment as Northern Protector of Aboriginals in Queensland. We now have the pleasure of receiving two *Bulletins* on North Queensland ethnography, which are the first-fruits of that able investigator's researches in his new sphere, and at the same time we must thank and compliment the Home Secretary's Department in Brisbane for issuing these *Bulletins*, especially as we are promised two or three similar *Bulletins* annually. Dr. Roth expresses his deep indebtedness to the Hon. J. F. G. Foxton for all the kindly encouragement invariably received from him during the prosecution of his scientific labours, and it is due to his wishes, as ministerial head of the Department, that these researches of Dr. Roth's are now being made available to the public. Dr. Roth has anticipated the thanks which anthropologists at home would like to offer to this public-spirited Minister. Publications such as these will do something towards reducing that ignorance of our native races which is largely due to the apathy of our Government as a whole.

The first *Bulletin* consists of an essay by Dr. Roth on "String, and other Forms of Strand: Basketry-, Woven bag- and Net-work." The animal and vegetable products of which strings are made are enumerated, and Mr. F. M. Bailey, the Colonial botanist, has identified the plants from which textiles are made which have been collected by Dr. Roth. The method of making string, including the manufacture of human-hair twine, is fully described and illustrated. Dr. Roth gives in his short direct style accounts of the procedures in which string and other forms of strand are employed. His classification of the processes of construction of basketry, woven bags and network will prove of considerable value to those who have to describe similar textiles from other countries. His explanations are illustrated by nearly a hundred clear diagrams drawn by the author and contained in nineteen plates.

The second *Bulletin* is devoted to the structure of the Koko-Yimidir language, in which Dr. Roth has had the invaluable cooperation of the Revs. G. H. Schwarz and W. Poland, Lutheran missionaries at Cape Bedford Mission Station. This language is spoken from the Annan and Endeavour Rivers to the northern side of Cape Flattery. It is noteworthy that this Koko-Yimidir language is the identical one of which Lieutenant Cook took a vocabulary when visiting the Endeavour River in 1770. A table is given of Cook's words with those in use at the present day; the "kanguroo" of the great voyager is still spoken of as *ganguru*. There are many suggestive notes on the language apart from the interest of the language itself.

We have no doubt that the succeeding numbers will be as valuable as those now to hand, and we shall eagerly await the good things which we are sure Dr. Roth has in store for us.

CHARLES MELDRUM.

DR. CHARLES MELDRUM was born at Kirkmichal, Banffshire, in 1821, and died in Edinburgh in August 1901. He was educated at Aberdeen University, and after graduation as Master of Arts he joined the Bombay Education Department. In 1848 he was appointed professor of mathematics in the Royal College

[1] "North Queensland Ethnography." *Bulletin* No. 1, C.A. 11-1901, price 8*s*.; No. 2, C.A. 22-1901, price 1*s*. (Brisbane: by Authority, Edmund Gregory, Government Printer, William Street, 1901.)

of Mauritius, and soon thereafter turned his attention to meteorology, of which he continued to the end one of its most ardent students. It was chiefly by his influence and exertions that the Meteorological Society of Mauritius was founded in 1851, he being its first secretary. He was appointed Government Meteorological Observer in 1862 and Director of the Royal Alfred Observatory in 1875; and in recognition of the great public services he had rendered to the colony he was made a member of the Government Council of Mauritius. For his services to science, more particularly to meteorology, his own University of Aberdeen conferred on him the honour of LL.D.; in 1874 he was elected a F.R.S.; and in 1886 he was honoured with a C.M.G.

Meldrum was a man of untiring energy and perseverance, and to this was added the keenest perception of the absolute necessity there was to replace theoretical speculation by accurate observations in all attempted solutions of the problems of meteorology. In carrying on this large and irksome work he soon displayed a genius in devising the methods for obtaining the physical data required for the investigations he took in hand. His self-devotion to the work was unsparing and unremitting to the end.

His first notable contribution to science was in the attractive field of practical meteorology, by which signal service was rendered to the forecasting of storms within the tropics. The data collected for the purpose was of a twofold nature. First, he clearly saw the paramount importance of a statement of the hourly variations through the months of the year of the pressure, temperature, wind and cloud, and to arrive at which he early instituted "Term Day Observations" as part of the systematic work of the Observatory. In a year or two, approximate hourly averages were thus obtained, and, from these averages, deviations were at once apparent from the regular normal hourly march of the pressure, temperature, wind and cloud.

In the second place, a unique and rich collection of maps of the cyclones of the Indian Ocean began to be prepared from the Mauritius observations, combined with observations obtained from ships' logs, on which isobars, isotherms, winds and clouds were entered, thus depicting from strict observations the outstanding features of the cyclones and gales of the Indian Ocean. In a valuable paper read to the British Association at Dundee, it was shown that the gales and hurricanes of the Indian Ocean south of the equator were conveniently grouped into three distinct types: (1) trade-wind gales, in which the wind veers little, these occurring chiefly in the winter months of June, July and August, when the S.W. monsoon prevails north of the equator; (2) the extratropical gales, occurring south of lat. 30°, in which the wind veers or shifts, these storms being somewhat analogous to the storms of north-western Europe and are most frequent and violent from May to August; and (3) the tropical hurricanes, or true cyclones, in which the wind always veers. It was to this last class that Meldrum mainly directed his attention.

A strict and extended inquiry was carried on respecting the relations between the course pursued by individual cyclones and their changing intensity, and the deviations from the normal values of pressure, wind, &c., observed at the Observatory. The inquiry resulted in showing unmistakably (1) that the direction in which the cyclone was from Mauritius could be readily known from the wind; (2) that its distance from Mauritius could be known from the amount of fall of the barometer and the rate of the fall, taken in connection with the variations in humidity, wind and cloud; and (3) that its progressive motion could be known chiefly from the veerings of the wind. These novel conclusions were soon put to practical use in sending to the daily Press prognostics of cyclones which were attended with complete success. This great result was all the greater inasmuch as it showed that what was done at an isolated station in the ocean might equally be done with success at sea.

In 1874 he submitted another important paper to the British Association at Belfast, "The Cyclone and Rainfall Periodicities in connection with the Sun-spot Periodicity," and in several subsequent years he returned to the same subject. He was one of the earliest workers in this attractive department of science, and his contributions, more particularly as regards the rainfall drawn from all climates, were alike remarkable for the enormous labour involved in their preparation and the lucid clearness with which they established and presented the intimate connection subsisting between the sun-spots and the cyclone and rainfall periodicities.

The Observatory of Mauritius stands second to no other Observatory in the world for the excellence of the physical data it has supplied towards the investigation of these periodicities. As regards the prime elements of climate its records afford the requisite data for the last four complete sun-spot periods from 1855 to 1888, and also the annual number of cyclones in the Indian Ocean from 1847 to 1900, or fifty-four years in all. The following table gives a comparison of the periodicities of the rainfall, pressure, temperature and cyclones. The figures for the rainfall, pressure and temperature are given as differences from their annual averages, the differences being "bloxammed" in the usual way.

Year of sunspot period.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	Average.
Sunspots, 1855–1888	10	5	18	49	90	90	84	63	45	29	20	
Rainfall, inches	−1·3	1·2	−0·4	0·4	−1·2	2·5	3·9	5·5	−1·3	−3·5	−5·5	46·9
Pressure, 1000th of an inch	1	1	3	7	11	−1	−7	−10	−4	−2	3	30·069
Temperature, degrees	0·1	−0·1	−0·3	−0·5	−0·3	0·0	0·2	0·3	0·4	0·3	0·2	73·6
Indian Ocean cyclones, 1847–1900 ...	5	3	5	8	12	10	10	10	8	7	5	8

The result shows an intimate connection between the prime elements of meteorology and the sun-spot variation.

In 1866 Dr. Meldrum visited England, one of the chief objects in view being to obtain a complete set of magnetical and meteorological registering instruments suitable for a first-class observatory. These were received in course, and by the end of 1874 were installed, and at work, in the new Royal Alfred Observatory, of which he was appointed the first director. The results have been published in the Annual Reports since, and in the Report for 1899 Mr. Claxton has begun to give the larger results of the work of this Observatory, beginning with the diurnal variation of the atmospheric pressure deduced from twenty-five years' observations (1875–99), and of some of the other chief elements of climate for shorter terms of years. These results are simply of inestimable value, not only to men of science, but also to navigators.

Some time ago there was added to the regular routine of the Observatory the taking of photographs of the sun when the weather permitted. The number of photographs taken in 1900 was 377; they have been

transmitted to Sir Norman Lockyer, director of the Solar Physics Observatory, South Kensington.

In consideration of the valuable work so minutely and ably carried on at this Observatory in the departments of meteorology, general physics and magnetism, the publication *in extenso* of these daily and hourly observations becomes a question of national importance, in view, especially, of the large results now in course of evolution.

ALEXANDER BUCHAN.

NOTES.

THE presidential address delivered by Mr. Charles Hawksley at the Institution of Civil Engineers on Tuesday was very comprehensive in its scope. Being the first inaugural address delivered at the Institution since the commencement of the new century, the opportunity was taken of giving a retrospect of advances made in the past century in the more prominent branches of civil engineering. At the commencement of the nineteenth century engineering works were comparatively few in number. Railways, steamships, electric telegraphs, telephones, the use of electricity for lighting and motive-power, were all unknown. Lighting by means of coal-gas had only just been introduced, and even the steam-engine was then in a primitive stage. Looking backward, and comparing the condition of things a hundred years ago with the present state, the changes which science and invention have brought about certainly appear remarkable. But it is advisable not to rest satisfied with a complacent view of the progress made. There is a prospect as well as a retrospect, and it is essential to push forward into the new fields of work before they are occupied by other nations. This is the lesson which must be impressed upon the minds of the British people, and used to give their political leaders a sense of responsibility for national welfare in the future. Engineers are not usually inclined to accept the view that action is necessary if we are not to be beaten in the industrial war which is now going on, but Mr. Hawksley acknowledges that "British engineers and manufacturers cannot hope to possess in the twentieth century that practical monopoly which they enjoyed during a considerable part of the nineteenth century." The conditions have changed, and unless our engineers and manufacturers adapt themselves to the new environment they will be superseded by men of other nations more in touch with the times. Mr. Hawksley mentioned in his address the serious difficulties and disadvantages under which British manufacturers are placed by the lack in this country of acknowledged standards. A committee formed to consider the subject in June last decided unanimously that it was desirable to issue standard sections and standard specifications, and the Institution of Civil Engineers has taken the work in hand. Four committees dealing with different branches of industry have been formed and are now at work standardising the various sections used in engineering practice.

THE death is announced of Prof. Ralph Tate, F.L.S., F.G.S., professor of natural science in the University of Adelaide, South Australia. Tate was a naturalist of the old school, with a good knowledge of botany, field zoology and geology. His earliest researches were carried out in the neighbourhood of Belfast, and he published papers on the Lias and Cretaceous rocks in the *Quarterly Journal* of the Geological Society. In 1864 he was appointed museum assistant to that Society, a position which he occupied for about four years. During this period and up to the year 1876 he devoted his attention mainly to the Mollusca and especially to the Gasteropoda of the Lias. In conjunction with Prof. J. F. Blake, the well-known "Yorkshire Lias" was published in 1876. In that year Tate left England for the University of Adelaide, and henceforth his labours were devoted to the geology and natural history of Australia. In 1893 he was elected president of the Australian Association for the Advancement of Science. His later contributions to science dealt chiefly with the Tertiary Mollusca of Australia.

DR. A. H. BENNETT, only son of the late Prof. John Hughes Bennett, of Edinburgh, and author of several works relating to diseases of the nervous system, died on Friday last at the age of fifty-three.

AT the ordinary quarterly comitia of the Royal College of Physicians, held last week, it was resolved to send delegates to the congress on medicine to be held at Cairo in December 1902, and also to the International Congress in Medicine, to be held in Madrid in April 1903. A proposal from Mrs. FitzPatrick to found a lectureship in the college, accompanied by a draft for 2000*l.*, was accepted, and it was resolved to send the following expression of thanks on vellum and sealed with the College seal:—"The President and Fellows of the Royal College of Physicians of London, in comitia assembled, tender their cordial thanks to Mrs. FitzPatrick for her munificent gift of 2000*l.* for the purpose of endowing a lectureship on the history of medicine in memory of her late husband, Dr. Thomas FitzPatrick, a member of the college; they gratefully accept the same and undertake faithfully to administer the trust she has committed to them."

IT is stated by the Berlin correspondent of the *Times* that Prof. Paul Ehrlich, of Frankfurt-on-the-Main, has been enabled to devote himself to a special study of the disease of cancer in consequence of a bequest of the interest for three years of a sum of 500,000 marks dedicated to this purpose by a Frankfurt banker, the late Herr Theodor Stern. Other sums contributed by private individuals will bring up the amount to be devoted to this special investigation of cancer by Dr. Ehrlich to 40,000 marks, or 2000*l.* a year. In Berlin there exists a special committee for the investigation of cancer, which studies pathological accounts of cases and collects statistics and medical literature on this subject. Prof. von Leyden is at the head of the committee, and Prof. von Kirchner, of the medical department of the Ministry of Public Instruction, is one of its members.

MR. NORTHCOTE THOMAS has been appointed organising secretary to the Society for Psychical Research.

THE biennial dinner of the Physical Society of London will be held at the Hotel Cecil on Friday, November 15.

THE Christmas course of six lectures to young people, at the Royal Institution, will this year be delivered by Prof. J. A. Fleming, F.R.S. The subject will be "Waves and Ripples in Water, Air and Æther," and the first lecture will be delivered on Saturday, December 28.

THE new session of the Institution of Electrical Engineers will be opened on Thursday, November 21, when the premiums awarded for papers read or published during the session 1900–1901 will be presented, and the president, Mr. W. Langdon, will deliver his inaugural address.

THE Siberia-Oriental Section of the Russian Imperial Geographical Society will celebrate the fiftieth anniversary of its foundation on November 17/30.

THE scientific committee of the Aëro Club of Paris has decided to award the Deutsch prize of 100,000f. to M. Santos Dumont.

AN illustrated public lecture on Jamaica was delivered at the Imperial Institute on Monday by Mr. Herbert Thomas, who had resided continuously for the last twenty-five years in the island. In describing the principal products of the island, Mr.

Thomas said that the lamentable decay of the sugar industry could not be more forcibly illustrated than by the fact that whereas at the beginning of the nineteenth century 800 sugar estates had been under cultivation, there are now only 125. Even Jamaica rum is in less demand than formerly, having been largely superseded—even in the island itself—by whisky. On the other hand, the fruit trade of late years has made great strides; its value was 40,000*l.* in 1879 and 635,000*l.* in 1899. Tobacco is a product with a great future in store for it; also cocoa, the cultivation of which has recently largely increased and its quality improved.

THE conviction having arisen in the minds of many members of the American Philosophical Society that the time has come when the interests of useful knowledge in the United States can be greatly promoted by the holding, in addition to the Society's usual fortnightly meetings, of at least one general meeting in each year, the Society has authorised the holding of a general meeting in Easter week of next year, and a committee has been appointed to make the necessary arrangements. Members desiring to present papers, either for themselves or others, are requested to send to the secretaries at as early a date as practicable and not later than February 15, 1902, the titles of the papers, accompanied by a brief abstract, so that they may be duly announced on the programme, which will be issued immediately thereafter and which will give in detail the arrangements for the meeting.

THE "Chemical Society's Memorial Lectures," delivered between 1893 and 1900, have been published in a separate volume, which can be obtained from Messrs. Gurney and Jackson. There are twelve lectures in the volume, most of them important contributions to the history of chemistry and all of interest as descriptions of work to which the progress of modern chemical science is largely indebted. Several of the lectures were reported or abridged in these columns when they were delivered. The twelve chemists whose scientific careers are reviewed in the lectures, now rendered available in a convenient form, are Stas, Kopp, Marignac, Hofmann, Helmholtz, Lothar Meyer, Pasteur, Kekulé, Victor Meyer, Bunsen, Friedel and Nilson.

WE have received from the Home Office a copy of Dr. Le Neve Foster's general report on the minerals raised in the United Kingdom during 1900, and therein we learn that the value of the output, exclusive of the product of shallow quarries, was no less than 135,957,676*l.*, or nearly thirty-eight and a half million pounds more than that of 1899. The enormous increase is due partly to the larger quantity of coal produced, the excess being more than five million tons, but it is mainly owing to the higher average price per ton. To coal is due 89 per cent. of the total value of the output of our mines and quarries. Next in importance is iron-ore, the value of which is about four and a quarter million pounds. It is satisfactory to note that gold mining in Wales was carried on with an excellent margin of profit; no less than fourteen thousand ounces of bar gold were obtained, and the value was upwards of fifty-two thousand pounds.

TWO quarterly parts of a catalogue of Polish scientific literature, prepared by the bibliographical committee of the Department of Mathematics and Natural History of the Academy of Science at Cracow, have been received. The catalogue is intended to form a complete current list of Polish publications, commencing with the present year, and including separate works and dissertations, papers in scientific journals, and translations into Polish from other languages. It is also intended as a contribution to the international catalogue of scientific literature now in course of preparation. Each title is given alphabetically in its proper section under the name of the author, and a translation of the Polish title is added in English, French, Latin, German or Italian. The subject classification adopted in each part is as follows:—(A) pure mathematics; (B) mechanics; (C) physics; (D) chemistry; (E) astronomy; (F) meteorology (including terrestrial magnetism); (G) mineralogy (including petrology and crystallography); (H) geology; (J) geography (mathematical and physical); (K) palæontology; (L) general biology; (M) botany; (N) zoology; (O) human anatomy; (P) physical anthropology; (Q) physiology (including experimental psychology, pharmacology and experimental pathology; (R) bacteriology.

THE Report of the Royal Prussian Meteorological Institute for the year 1900 shows that steady progress is being made in the work of the various departments. The newly erected observatory on the Schneekoppe began to work regularly on June 1, 1900. The investigation of the upper air is actively carried on by means of kites, provided with self-recording instruments; on one occasion a height of 4255 metres was reached. The number of meteorological stations now amounts to some 200, in addition to 2200 rainfall stations; more than 1400 stations report thunderstorms and unusual occurrences either directly or monthly by post-cards. The results of the observations are published in annual, monthly and weekly reports, and the staff is encouraged to contribute discussions to various scientific journals.

THE Meteorological Office pilot chart of the North Atlantic and Mediterranean for the month of November shows that during September there was a rapid diminution in the quantity of ice on the western side of the Ocean, the latest report of a berg eastward of Newfoundland being as far back as September 11. In the strait of Belle Isle and eastward to the 50th meridian large and small bergs were still numerous, but they were noted as greatly thinned out since the previous month. Various local features of the Atlantic winds in November are dealt with, and as regards the ocean currents it is pointed out that at this season the Gulf Stream exhibits a decided slackening in the vicinity of Cape Hatteras, where the maximum velocities are reduced from 50 to 80 miles in October to as low as 30 to 45 miles. This, however, would appear to be a local check, for to south and north the rates are but slightly altered. On the African coast, between Capes Blanco and Palmas, a distance of more than 1000 miles, there is a westerly to north-westerly current setting away from the land. Mariners are cautioned as to the dangers from wrecks and derelicts, and particularly near the American coast, some portions of which are studded with sunken wrecks. A similar caution is given as to rollers down the west coast of Africa, which sometimes break with great violence in from nine to three fathoms. A new feature of the chart is the monthly discussion of the paths of barometric depressions affecting the Mediterranean. In November there are three main lanes each having its own influence on the winds experienced. The principal one proceeds from the Bay of Biscay across Corsica to Asia Minor, but another important one enters from the south-westward by the Strait of Gibraltar, or further north, passing across Sardinia and Italy, influencing the weather of the western basin, being the primary cause of the severe northerly and north-westerly gales there experienced. Both series of disturbances exhibit a tendency to lag on nearing Italy. The third group of depressions appears to traverse Algeria and Tunis, to enter the Mediterranean about the Gulf of Kabes, and move eastward across Cyprus.

THE autumn of 1899 was marked in the United States by a great development of the fall army-worm (*Laphygma frugiperda*), which probably was as injurious as any other insect that season, being destructive to a great variety of crops over a large

area. In *Bulletin* No. 29 of the entomological division of the U.S. Agricultural Department, Mr. F. H. Chittenden gives an account of this visitation and also of the life-history of this pest, as well as of the variegated cut-worm. The account of the former is the fullest hitherto published, but the sudden disappearance of the insect as a pest in 1900 prevented observations from being taken to complete its history. It is considered probable that the sudden destruction of this and other insect pests of apparently southern origin is due to peculiar atmospheric and other conditions in the late autumn. When the northern localities are restocked the following season, it appears to be owing to an influx of moths from the south.

WE have received two *Bulletins* (Nos. 28 and 30) from the Entomological Division of the U.S. Department of Agriculture, the one dealing with "Insect Enemies of the Spruce in the North-east" and the other recording some miscellaneous results of the work of the Division. Dr. A. D. Hopkins is the author of the former, while Dr. L. O. Howard and several other writers contribute to the latter. It appears that in New England and adjacent territories the valuable forests of red spruce (*Picea rubens*) have during the greater part of the last century been in a very unhealthy condition, numbers of trees dying over large tracts. The chief cause of the mischief is a beetle, described as a new species under the name of *Dentroctonus piceaperda*. After describing the life-history of this pest, the author suggests various remedies for checking its ravages. The more important contents of the second *Bulletin* include a dissertation on the ravages of the "differential grasshopper" in the Mississippi delta, experiments on insecticide, the carriage of disease by flies, the invasion of the codling moth in Idaho during 1900, and the influence of the weather on insect life in the same year. Mr. F. H. Chittenden, the author of the last-mentioned memoir, previously hazarded the suggestion that certain northern forms would continue to flourish after protracted cold weather, which would probably prove fatal to southern types invading the area under observation, and this prediction has been to a considerable extent verified. Both *Bulletins* are well illustrated, the plates in No. 28 being exceptionally good.

IN No. 8 of the *Bulletin* of the Royal Belgian Academy for the current year, M. Julien Fraipont publishes the first instalment of a re-exploration of the Engihoul cavern, Engis, carried out with the assistance of the "Elizabeth Thompson fund." In this communication the author describes the remains obtained from a bears' resort. These are provisionally assigned to *Ursus arvernensis*, *priscus*, *spelaeus*, *ferox* (=*horribilis*) and *arctus*. From comparison with the skull of a large brown bear from the Asiatic coast of Bering Strait, the author makes the suggestion that all these forms may eventually turn out to be specifically inseparable from *U. arctus*.

IN the October issue of the *American Naturalist* Prof. W. M. Wheeler brings to a close his dissertation on the compound and mixed nests of American ants, to which allusion has been made on two previous occasions in our columns. In his concluding paragraphs the author observes: "Wasmann has shown in detail why it is quite unnecessary to assume the existence of anything beyond instinct and simple intelligence in the ants which form compound and mixed nests. I should even be inclined to place a more moderate estimate than Wasmann on the psychical endowments of these animals. . . . Having arrived at the same conclusion as Wasmann, that there are no evidences of ratiocination in ants, we have reached the limits of our brief inquiry. This conclusion, however, even if it be extended so as to exclude all animals except man from a participation in this faculty, does not imply the admission of a qualitative difference between the human and animal *psyche*."

To the *American Naturalist* Prof. Bashford Dean communicates some highly interesting notes on living nautili from the strait between the islands of Negros and Cebu in the southern part of the Philippine group. Hearing that these cephalopods were commonly captured by the inhabitants of those islands, Prof. Dean paid a visit to Negros, but as the time of year was not propitious he succeeded in obtaining only a few examples. In June, which is the best season, as many as twenty specimens are occasionally taken in a single fish-trap. These fish-traps, of which examples are figured by the author, are sunk by the fishermen in deep water (from about 225 to 350 fathoms), and the nautili are taken in considerable numbers. Not that they are an object of the fishery, for although their flesh is eaten it is but little esteemed, and the shells have till recently found little sale, although matters are improving in the latter respect. Prof. Dean gives several figures of the shell, with and without the soft parts, and shows how male are distinguishable from female specimens by the form of the aperture. Twenty hours was the longest time a specimen was kept alive. Nautili in this region appear to have a definite breeding-season, during which the author thinks it probable that the natives not unfrequently obtain eggs. Our readers will recall a description of nautilus eggs from New Guinea by Prof. Willey which appeared in our columns in 1897.

THE first part of a new Cryptogamic Flora of Germany, by Dr. W. Migula, has been issued, in connection with Thome' "Flora von Deutschland, Oesterreich, und der Schweiz."

DR. A. TOMMASI has sent us a copy of a memoir on a collection of Triassic fossils from the Valle del Dezzo, Italy, recently published in *Mem. Ist. Lombardo* (vol. xix. pt. 4). The fauna seems most nearly allied to that of St. Cassian; but a number of new species of molluscs and brachiopods are described.

THE October number of *Climate* is mainly devoted to the subject of malaria, and has in it a paper by Sir William MacGregor entitled "Malaria and its Prevention," articles on the malaria question, and the West African climate, also the general outlines of a course of ten health lectures, which, at the suggestion of the Governor, have recently been given to sanitary inspectors, hospital nurses, teachers and others at Lagos.

THE *Proceedings* of the Liverpool Geological Society (vol. ix. part 1, 1901) contain important communications by the late G. H. Morton on the Carboniferous Limestone series of North Wales, and of especial interest is his tabular list of the fossils, showing their range in the various subdivisions and their occurrence in the four districts of Llangollen, Flintshire, Vale of Clwyd and Llandudno, and Menai Strait and Anglesey. In the same publication Messrs. T. Mellard Reade and P. Holland deal with the Green Slates of the Lake District and discuss the subject of slaty cleavage. They maintain that real slaty cleavage is always accompanied by mineral changes in the body of the rock, which not only give the foliaceous character, but supply the necessary cement to bind together the overlapping constituents and convert what was originally mud into a rock possessing the tenacious and economically useful properties of slate.

THE clays and clay industries of Wisconsin form the subject of a memoir, by Dr. E. R. Buckley, which is published by the Wisconsin Geological and Natural History Survey (*Bulletin* No. vii., Economic Series, No. 4, 1901). Following the plan adopted in many American works, the author commences with the origin of clay, and passes on to the composition, classification, properties and behaviour of clays in general before he deals with the clay deposits of Wisconsin. These are both residual and transported, the residual clays being due to the decomposition of granite, greenstone, limestone, shale and other rocks. The transported clays are by far the more extensive, comprising

those of glacial, lacustrine, fluviatile and even wind-borne origin. The author describes the methods of manufacturing brick and drain tile, and then proceeds to record in detail his observations on the clays, and the local modes of working and manufactures in Wisconsin. In appendices he notes the methods employed in the examination of the clays in the field and in the laboratory, and he gives numerous analyses. A map and many other illustrations accompany this work.

MESSRS. JOHN WHELDON & CO. announce the publication of the first volume of the "Botany of the Færöes," edited by Prof. E. Warming. The present volume is occupied by the land and freshwater flora (phanerogamic and cryptogamic); the remaining volume will be devoted to the marine flora, to agriculture and gardening, and to other general subjects.

THE publication of the Kew *Bulletin of Miscellaneous Information* has been resumed, with Nos. 175–177, containing instalments of the Diagnoses Africanæ, Decades Kewenses, New Orchids, and Fungi Exotici. The *Bulletin* records, with regret, the retirement of Mr. George Nicholson from the curatorship of the Gardens, in which post he is succeeded by Mr. Wm. Watson. Mr. Nicholson had devoted himself largely to the extension and improvement of the arboretum, and was compiler of the hand-list of trees and shrubs grown in it.

THE *Journal of Applied Microscopy and Laboratory Methods* (published by the Bausch and Lomb Optical Co., Rochester, N.Y.) for October gives a full description, with photographic illustrations, of the botanical laboratory and the botanical garden of the Tokyo Imperial University, Japan. The University buildings comprise a herbarium, library, laboratories, museum, lecture-room, and rooms for a professor and three assistants. Special facilities are given for the study of bacteriology and fermentation. The curriculum for lectures comprises courses in morphology and physiology, in systematic botany, and in advanced physiology. The laboratory work includes courses in classification, morphology, histology, physiology, and embryology, as well as special research work. It is an important feature of the University curriculum that exclusive specialisation is not encouraged. Students who specialise in botany are required also to take courses in zoology, including histology and embryology, geology, palæontology, mineralogy, physiological chemistry, and bacteriology. There are special courses in the agricultural college of the University in forestry and agriculture. The botanic garden has been established for about two hundred and twenty years, and is about five acres in extent. In the same number of the *Journal of Applied Microscopy* is an account, with photographic illustrations, of the course of study in invertebrate zoology in the marine biological laboratory at Wood's Holl.

MESSRS. JORDAN AND SNYDER continue their valuable review of Japanese fishes in the *Proceedings* of the U.S. Museum, the last part we have received dealing with the so-called cardinal fishes (Apogonidæ). Two new species of the typical genus Apogon are described, while a new generic type receives the name *Telescopias gilberti*.

NOS. 1246 and 1247 of the *Proceedings* of the U.S. Museum contain lists, by Messrs. Robinson and Lyon, of mammals and birds recently collected in La Guaira, Venezuela; while in No. 1248 Dr. Stejneger deals with the reptiles and batrachians of the same locality. No. 1250 of the same serial is devoted to a review of the Atherine fishes of Japan, by Messrs. Jordan and Starks. In No. 1252 Dr. Stejneger describes a new bull-frog from Florida; and in the succeeding part Mr. N. Banks treats of certain spiders and other arachnids from Porto Rico.

THE U.S. Department of Agriculture has sent us Nos. 20 and 21 of the "North American Fauna," the former containing a revision of the typical skunks, by Mr. H. A. Howell, and the latter an account of the natural history of the Queen Charlotte Islands and Cook Inlet, Alaska, by Mr. W. H. Osgood. The chief feature in the first article is the proposed substitution of the name Chincha for the familiar Mephitis. In treating of the Queen Charlotte group Mr. Osgood mentions that although a supposed new species of reindeer has been recently described from Graham Island, it is more than doubtful whether any of those animals inhabit the group.

MESSRS. TOWNSON AND MERCER, of Camomile Street, London, E.C., have prepared a series of standard colour tubes—specially for the use of the wine trades—to which purchasers of sherry or other wine may refer any particular sample. As one of the factors in the sale of wine is a certain colour, it will be seen that if a trustworthy standard is established for comparison considerable expense and inconvenience will be saved. It is claimed that the tubes are absolutely permanent in colour and brightness, having been sterilised and made antiseptic, and, so far as we have been able to test it, the liquid in the hermetically-sealed glass cylinder forwarded to us has undergone no change. There is much to be said in favour of these standard tubes. It is much more trustworthy to refer a purchase to an accepted standard colour than to some tint which one endeavours to carry in the eye, or to a stored sample that may have undergone change. It is evident, however, that the range of colour tubes must be fairly extensive, particularly if they are to cover more than one class of wine; must be permanent in tint and brightness; and must have the approval of the wine trades.

THE brief description of the Hammer-Fennel tacheometer given in our issue of October 17 (p. 598) contains a sentence which Prof. Hammer desires to correct. Referring to the use of the instrument, the reviewer remarked:—"The diagram and mechanical adjustments are so arranged that by multiplying the observed displacement of the line from the zero by 20, the difference of altitude in metres will result, while another displacement multiplied by 100 gives the distance." This is not exactly the case. Prof. Hammer informs us that it is "not the displacements of any lines which have to be multiplied, but the section of the rod or stadia contained between the zero-line (horizontal wire) of the diagram and two other points of the diagram; these two points are indicated automatically in the diagram by raising or dipping the telescope."

A PRACTICAL aid to reasonable instruction in geography is provided by the *Geographical Teacher*, the first number of which has just been published. The new periodical is the organ of the Geographical Association (which exists for the purpose of improving the teaching of geography), and it is edited by Mr. A. W. Andrews and Dr. A. J. Herbertson. Mr. Douglas W. Freshfield, president of the Association, contributes an introduction, in the course of which he says that the aim will be to show that the question which Dr. Jowett once put to him, "Can you teach geography so as to make people think?" can be answered in the affirmative. The contributions to the first number substantiate this opinion. Among the subjects are methods of teaching geography, with their limitations and possibilities, the study of maps, geography of the world, photography as an aid to geography, and school excursions. The journal will be published three times a year by Messrs. George Philip and Son.

A TRANSLATION, by Dr. W. H. Thompson, of Prof. Pawlow's lectures on "The Work of the Digestive Glands," embodying the results of researches which were recently awarded the Nobel Prize of 11,000*l*., will be published immediately by Messrs. Charles Griffin and Co. This edition will include the later volume, entitled "The Experiment," &c., together with the notes of the most recent researches of Prof. Pawlow.

SEVERAL new editions of scientific books of established reputation have recently been received. The fourteenth edition of Naumann's well-known "Elemente der Mineralogie," edited by Prof. F. Zirkel, has been published by Mr. Engelmann, Leipzig (London: Williams and Norgate). The book stands in the first rank of treatises on mineralogy, and is likely to maintain this position while it is so well kept in touch with scientific progress by revised editions.—A similar standard work is Gray's "Anatomy: Descriptive and Surgical," the fifteenth edition of which, edited by Messrs. T. Pickering Pick and R. Howden, has been published by Messrs. Longmans, Green and Co. The entire work has undergone revision, and the section on embryology has been considerably amplified. The volume will thus secure the attention of students for some time to come.—The third edition of Prof. A. H. Church's "Chemistry of Paints and Painting" has been published by Messrs. Seeley and Co. An elaborate and appreciative review of this book appeared in these columns nearly ten years ago (vol. xlv. p. 243). The plan remains the same as in the first edition, but many slight changes have been made and new pigments, or new varieties of old pigments, are described. In the four last chapters Prof. Church gives "adequate evidence of the instability of several favourite pigments largely used by painters in water-colour during the eighteenth and nineteenth centuries."—Mr. Walter Scott has published the third edition of Mr. Havelock Ellis's book on "The Criminal," which was reviewed in these columns when the first edition appeared (vol. xlii. p. 75, 1890). Since then increasing attention has been given to criminal anthropology, and Mr. Ellis gives a valuable statement of the present position of the subject. His book has been enlarged by more than one hundred pages, and much new material has been examined and summarised.

WE have received a copy of Prof. Letts' report on the scheme of sewage purification for Belfast and its probable effects on the Lough. In this report Prof. Letts first deals in a simple way with the chemical nature of sewage and the various methods of sewage disposal. He then deals with the subject of the vast deposits of sea-lettuce (*Ulva latissima*) which accumulate on the Belfast foreshore and, undergoing decomposition, produce serious nuisance. It is shown that the development of the sea-lettuce, which is extraordinarily rich in nitrogen, is associated with the presence of sewage in sea-water and that it thrives wherever an ordinary sewage effluent escapes into sea-water. Coming next to the proposed method of treating the Belfast sewage by double contact with bacteria beds and the discharge of the resulting effluent into the Lough, Prof. Letts concludes from his experiments that the bacteria beds are dispersers rather than converters of nitrogen, that is to say, they liberate a large proportion of sewage nitrogen in the gaseous form. Hence the effluent from such beds is unlikely to stimulate the growth of the noxious green seaweed, and Prof. Letts considers it probable that the proposed system of sewage treatment will eventually suppress the growth sufficiently to put an end to the existing nuisance. In a series of recommendations appended to his report, Prof. Letts suggests the reclamation of large tracts of foreshore and more systematic removal of the decomposing weed. He thinks it probable that by allowing the sewage effluent to flow into tidal ponds containing sea-water and sea-lettuce the nitrogen content might be reduced almost to the vanishing point. The lettuce could be regularly removed and used advantageously as a manure.

THE additions to the Zoological Society's Gardens during the past week include a White-fronted Capuchin (*Cebus hypoleucus*) from Central America, presented by Mr. G. B. Apostoloff; two Syrian Bulbuls (*Pycnonotus xanthopygos*) from Tayif, Arabia, presented by Mr. G. P. Dovey; a Hocheur Monkey (*Cercopithecus nictitans*, ♀) from West Africa, a Simpae Monkey (*Semnopithecus melalaphus*, ♂) from Sumatra, three Ogilby's Rat Kangaroo (*Bettongia penicillata*) from Australia, a Zebra (*Equus* —— ♂), four Young Lions (*Felis leo*, ♂ ♂ ♂ ♂), a Caracal (*Felis caracal*) from Abyssinia, an Indian Antelope (*Antilope cervicapra*), a Ruddy Ichneumon (*Herpestes smithi*) from India, a Goshawk (*Astur palumbarius*), European; five Smooth-clawed Frogs (*Xenopus laevis*) from Africa, deposited; twelve Changeable Troupials (*Quiscalus versicolor*), six Painted Terrapins (*Chrysemys picta*), two American Box Tortoises (*Cistudo carolina*), a Copperhead (*Ancistrodon contortrix*), two Horrid Rattlesnakes (*Crotalus horridus*) from Pennsylvania, three White-eyebrowed Finches (*Zonotrichia leucophrys*), three Lark Buntings (*Calamospiza bicolor*), three Mexican Quails (*Callipepla squamata*), two Painted Box Terrapins (*Cistudo ornata*), five Poinsett's Lizards (*Sceloporus torquatus*, var. *poinsetti*), ix Lesser Horned Lizards (*Phrynosoma modestum*), a Say's Snake (*Coluber catenifer*, var. *sayi*), a Confluent Rattlesnake (*Crotalus confluentus*), two Testaceous Snakes (*Zamenis flagelliformis*), two Western Diamond Rattlesnakes (*Crotalus atrox*) from Pecos, Texas; two Common Rattlesnakes (*Crotalus durissus*), two Couper's Snakes (*Spilotes corais*, var. *couperi*) from Marion co., Florida, received in exchange.

OUR ASTRONOMICAL COLUMN.

THE PERIOD OF ALGOL.—Prof. S. C. Chandler has made a further investigation of the minor inequalities of the period of Algol. These have probably escaped notice up to the present owing to their being so minute as to be of the same order as the errors of observation.

This later inquiry indicates that the deviations of the observed from calculated times of minima have been periodic, distinct changes occurring in the course of a few months, but it does not appear that the periodicity is of a regular character. More frequent and continuous observations of the minima, however, are required to decide this question.

It appears from the curves representing these minor inequalities that the length of the principal of them is about 15,000 periods, this period from the most recent computations being

$$2d.\ 20h.\ 48m.\ 55{\cdot}60s. + 3{\cdot}694s.\ \sin(133^\circ - 0^\circ{\cdot}024\ E.) + 1{\cdot}784s.\ \sin(16^\circ - \tfrac{1}{13}^\circ\ E.)$$

Tables are then given showing the influence of including these new terms in the comparison of observed with computed epochs of minima (*Astronomical Journal*, vol. xxii. pp. 39-42, 1901.

THE MELBOURNE OBSERVATORY.—The annual report of Mr. P. Baracchi, the Government astronomer at Victoria, has recently been issued. All the usual routine work in astronomy, meteorology, terrestrial magnetism, &c., has been carried on as usual, and considerable progress has been made in the endeavour to lessen the accumulated arrears of unreduced records.

With the astrographic instrument 261 plates have been obtained, including 63 chart triple exposures, 49 chart single exposures, and 39 catalogue plates. The chart series of single exposures of 60 m. is now complete. The new Repsold micrometer made from the designs of Sir David Gill is found to work very satisfactorily, and measurements are made at twice the former speed, dealing with about 170 stars per hour.

The Milne seismograph is now adjusted in position and a continuous photographic record of seismic disturbances will be started as soon as possible.

ROYAL ALFRED OBSERVATORY, MAURITIUS.—The annual report of Mr. T. F. Claxton, director of the Royal Alfred Observatory, has recently been distributed, giving details of progress made during the year 1900. The meteorological and magnetic observations have all been continued as in previous years, but much of the astronomical work with the prime vertical and equatorial had to be abandoned on account of the unhealthiness of the district. Photographs of the sun with the photoheliograph were taken whenever weather permitted, and 311 negatives with 301 prints were forwarded to the Solar Physics Committee.

THE SIGNIFICANCE OF CERTAIN FEATURES AND TYPES OF THE EXTERNAL EAR.

IN these days the search for some characteristic of the human body which will give unequivocal evidence of the mental nature of the individual still goes on as merrily as ever. To some men the bumps of the head tell everything; to others the lines of the palm are hieroglyphic expressions of the qualities of the brain, not to speak of what they tell of things past and events to come; in fact, there is scarcely a feature of the human body that has not, at one time or another, been advocated as an index of certain faculties, and now it is the turn of the external ear. Although not one of these many pretensions has ever stood the test of scientific investigation, or even that of a casual every-day experience, yet their advocates continue to thrive and abound unabated. If those handmaidens of the brain—the muscles of expression—those that set the eye and strengthen the mouth, fail to yield a clue, then it is vain to seek for it in any other structure of the body.

There are three classes of observers, however, which have made a special study of the external ear, deserving of the utmost consideration. The first of these is the school of workers founded by Lombrosa, which believes that *a certain class* of criminals are criminals because of an imperfection in the development of their brains. It is probable, as this school supposes, that such imperfectly developed brains will be wrapped in defective bodies; by the presence of bodily defects, and they have used very largely those of the external ear as an index, the imperfections and unbalanced nature of the brain may be detected. It is clearly a matter of the utmost moment for a State to be able to recognise its criminals, who are criminals because of their constitutional imperfections, and this undoubtedly is the aim of the Lombrosa school. In their investigations of the external ear they found certain features to exist in those of the criminal and insane classes with a much greater frequency than in the sane. With their results I wish to compare a wide series of observations made on the criminal and insane classes of this country.

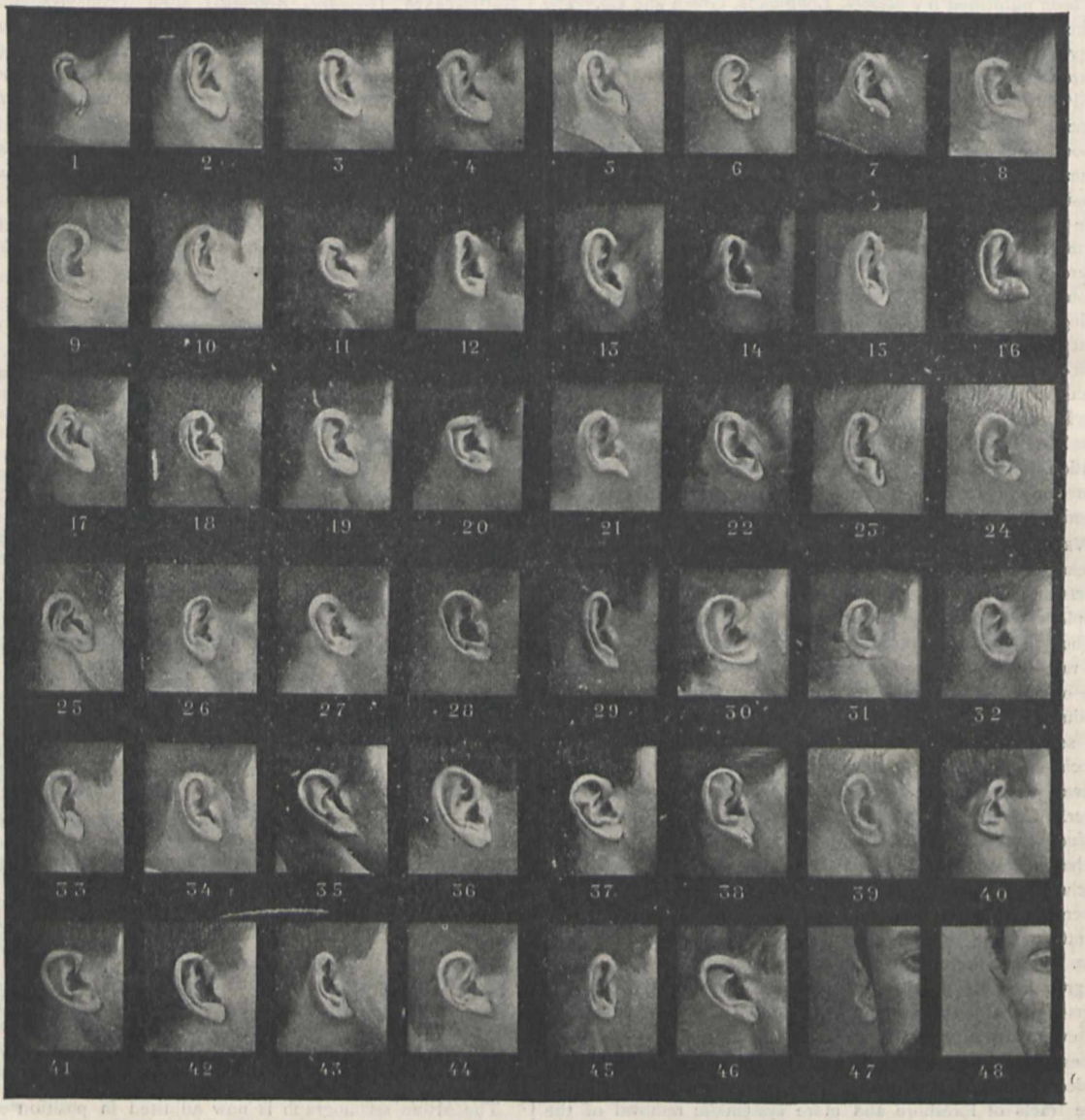

FIG. 1.—Illustrating certain types of ear referred to in the text.

The second class of observers, which deserves attention, is that which has contributed to our knowledge of the development, anatomy and evolution of the human external ear. Its contributions make up quite an extensive literature. Prof.

Schwalbe, who may be regarded as the chief of this class, gives references to 145 papers[1] in his latest work on the ear—most of which deal only with the external ear.

The third class is that of which Bertillon[2] is the chief. To this class the characters of the external ear are important only so far as they may assist in the identification of the criminal. Its system of observation is purely empirical, and the large masses of facts which it has accumulated are useless for the scientific advancement of the subject.

In a paper contributed recently to *La Nature*,[3] from which Figs. 1 and 2 are borrowed, Mr. Henri Coupin remarks that writers of fiction, while describing with a fulness of detail the features of the eye, mouth, nose and hair of the heroine or hero, carefully abstain from any mention of the external ear. Yet there is no doubt that the ear is a subject of common remark among friends and acquaintances, but often in an inarticulate way, for I suspect that most people, as well as the novelist, find a lack of descriptive terms by which the numerous varieties of the external ear may be fully indicated.

There are two types of ear which everyone must have noticed, although they have found no name for them. They are contrasted types and mark the opposite poles of ear development. One of these is that which the novelist occasionally condescends to notice, describing it as "a beautifully modelled, small, shell-like ear." Popularly it is regarded as a sign of high breeding. Examples of this type may be seen in Fig. 1, Nos 1, 5, 8, 11, 18, 20, 25, 27, and in Fig. 2, Nos. 8, 12, 16, 19, 25, 34, 35.

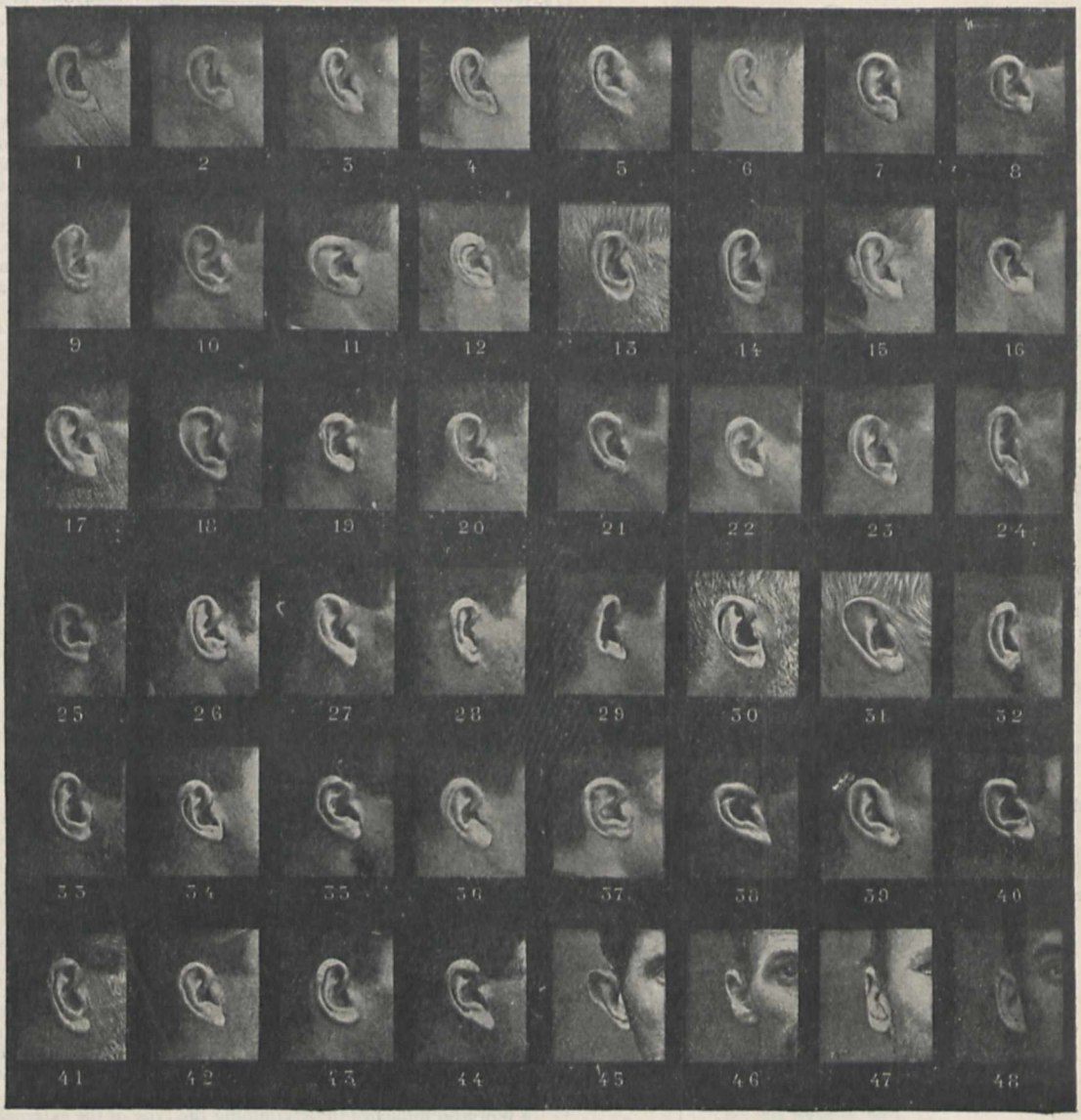

FIG. 2.—Illustrating certain types of ear referred to in the text.

An example of the same type will be seen in Fig. 3, which is a tracing from a photograph of a typical ear of the orang. For the reason that the chief features of the orang's ear are present in the type of ear I have just cited, I have named it the "orang-type" of human ear.

The type of human ear contrasted to this is one never alluded to in fiction, but is frequently the subject of everyday remark. It is large, expansive, and projects like "wind-sails from the port-holes of a steamer in the tropics." A very good illustration of it is seen in Fig. 2, No. 45, but further examples may

1 "Handbuchs der Anatomie des Menschen," von Bardeleben. Abtheil ii. Band v., 1898.
2 "The Bertillon System of Identification." Translated by McClaughry. 1896.
3 "Notre Oreille," *La Nature*, p. 138, July 27, 1901.

be detected in the same figure, Nos. 13, 17, 31, and in Fig. 1, Nos. 9, 13, 15, 28, 29, 30, 35, 36, 38, 46. An ear of the same type is shown in Fig. 4; it is a tracing from the ear of "Sally," the chimpanzee, and is typical of her species. This may be called the "chimpanzee type" of human ear.

This nomenclature, of course, does not imply that people with the orang-type of ear are related any more to the orang than the chimpanzee-type indicates an affinity to the chimpanzee. The resemblances are due to the fact that in the orang the external ear has undergone marked retrograde changes; in the chimpanzee the ear has retained its pristine development. The one marks

FIG. 3.—An Orang's Ear.

the ebb tide of retrogression, the other the full tide of development; the corresponding types in man mark the same extremes. The anatomical parts of the ears of the three great anthropoids and man are the same (see Figs. 3, 4, 5 and 6), but in men are found types exemplifying the retrograde changes which have overtaken the ears of all orangs, and also examples of the full development which marks the ears of chimpanzees. Curiously enough the gorilla, like man, shows an amplitude in the variations of its ear, but on the whole it inclines towards the orang-type.

But what is meant by retrogression, and what by full development of the ear? The explanation entails a reference to the seven parts which compose the outer ear. Each of the seven springs as a separate part round the opening of the ear in the embryo, and by the fourth month they have fused to form the whole structure.

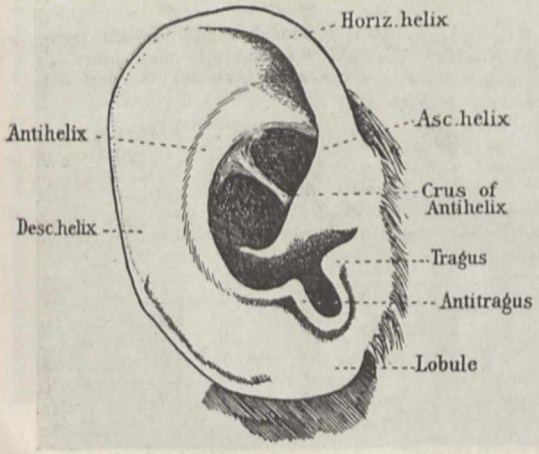

FIG. 4.—Ear of Chimpanzee.

Three of these parts surround the concha, or cavity, and opening of the ear-passage, viz. the tragus, the antitragus and the antihelix (see Fig. 5). The remaining four parts form the circumference of the ear, viz. the ascending helix—in front and above; the horizontal helix—above; behind, forming the wide posterior border of the ear—the descending helix; and below—the lobule. Now only one of these seven parts suffers *markedly* from progressive or retrogressive changes, and that is the descending helix. In Fig. 5 a human ear is represented—somewhat diagrammatically with the descending helix fully developed; that is to say the descending helix is wide, expansive, and its margin is not inrolled; the ear of the chimpanzee (Fig. 4) shows similar characters in its descending helix. On the other hand, the orang's ear (Fig. 3) shows the descending helix not only markedly reduced, but its margin, like that of a cankered leaf, is inrolled. A reference to the orang types in Fig. 1 (such as No. 11) and Fig. 2 will show inrolling of the margin of the descending helix, similar to that in the orang. The various degrees to which the inrolling may be carried is shown diagrammatically in Fig. 5. Four degrees of inrolling are recognised, viz. 0, 1st, 2nd or 3rd degree. It should be remarked, however, that the reduction in size of the descending helix and inrolling of its margin do not constitute all the characters of the orang type—with these the development of the ear as a whole also shows reduction in size. The height of the ear of a chimpanzee is nearly twice that of an orang, yet the orang is the larger animal of the two.

There is one prevalent conception of the human ear which I believe to be a mistaken one, and which I wish to correct now. It is usual to speak of it as a decaying structure. This is remarkable, if true, for with the introduction of speech the means of catching sound are more needed than ever. Although the helix, especially the descending helix, which in mammals generally makes up the greater part of their trumpet-shaped ears, has undergone and is undergoing retrogression in man, that part of the ear which bounds and deepens the concha, the antihelix (Fig. 5), has reached a development in man which it never had before. At least, no other primate shows such a development. That is the change which appears to be going on in man now,

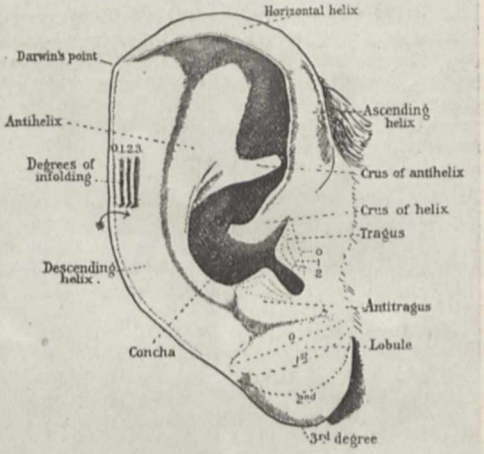

FIG. 5.—Diagram of the human ear.

viz., that in him a new type of ear is being evolved in which the antihelix plays the chief part in collecting sound-waves, while the circumference—the outer helix—undergoes retrogression. In this the orang-type of the human ear differs from the ear of the orang; in the orang the antihelix is in as retrograde a condition as the other parts of the outer ear, even the crus of its antihelix is only occasionally developed (Fig. 3); in the orang-type of the human ear the antihelix is especially well developed.

I should like to proceed at once and inquire into the relationship which those two types of human ears bear to the mental bias of the individuals in which they are found. But in order to avoid the mistakes made by the followers of Lombrosa on the Continent, it is necessary to allude to certain factors which have a powerful influence in determining the type of the external ear. I need not allude to age; that influences shape to some extent, but its effect is principally on its size. Schwalbe found that, on an average, the length of the ear increases 20 mm. from the twentieth to the eightieth year and the breadth at a corresponding rate. The ears of old people are always large and hence in my statistics I excluded those over sixty. This increase is a factor which those who use the ear for identification purposes should remember more than they do.

Sex is a powerful factor. The following table (table 1), in which are given the number of ears observed, the locality in which they were observed, the sex of the individual and the percentage in which the orang- and chimpanzee-types of ear occurred, will show its influence.

TABLE I.

Place.	No. of observations. Male.	Female.	Orang-type. Male.	Female.	Chimpanzee-type. Male.	Female.
			Per cent.		Per cent.	
Aberdeenshire	1135	776	27	40	14	5
London, E.	700	492	17	44	13	2
Jews (London)	109	62	16	51	17	8
Kerry	281	205	18	41	34	1
Carmarthen	296	256	18	48	19	6
Peterborough	306	227	19	50	19	6
Cork	256	245	24	50	28	3
Dublin	278	268	22	38	33	7

The table shows that the orang-type occurs in from 38 to 51 per cent. of women, while in men it varies between 16 and 27 per cent. Taking the average of this table, the orang-type may be said to occur in 18 per cent. of men and 45 per cent. of women. The chimpanzee-type, on the other hand, occurs four or five times more frequently in men than in women. That the orang-type should be characteristic of women and the chimpanzee of men is what one may expect; for in bodily characters, always excepting those of a sexual nature, woman apparently foreshadows the coming characters of the race.

My statistics are not sufficiently wide to allow of more than a partial statement as to the orang-type of ear being a sign of aristocratic birth, but of eight peeresses I find five have ears of this type, which certainly lends some support to the popular supposition. On the other hand, of five leading lady singers only one shows this type of ear.

Race, too, has an influence on the proportion with which the two types occur. That may be seen from Table I. The prevalence of the chimpanzee-type in Kerry, and the orang-type amongst the Jewish women may be noted. The orang-type occurs in about 90 per cent. of Hottentots; it is very frequent, although of a characteristic type, in certain races of negroes.

The ear-types, too, are correlated with the colour of the hair. In Table II. statistics are given of observations made at twenty-seven different localities of the United Kingdom.

TABLE II.

	No. of Observations. Male.	Female.	Orang-type. Male.	Female.	Chimpanzee-type. Male.	Female.
			Per cent.	Per cent.	Per cent.	Per cent.
Fair-haired ...	2015	1127	31·3	46·7	15·8	4·1
Black-haired..	1796	1463	15·8	40·3	36	4·7

The individuals with hair of intermediate shades of brown are omitted, and only those with distinctly fair or distinctly black hair are included. It will be seen that the orang-type occurs in fair-haired men twice as frequently as in black-haired men; the chimpanzee-type occurs in exactly the reverse proportion. Curiously enough the colour of hair scarcely affects the ear of the woman; black and fair show both types with an equal frequency. Both this table and the last draw attention to the fact that the variations in one sex are not necessarily correlated with those of the other.

It will be readily seen how necessary it is to consider those various factors which influence the ear before proceeding to consider the ears of those who have their liberty temporarily or permanently suspended because they are no longer able to conform to recognised social standards of conduct. The variation according to race or locality is wide (*vide* Table I.); sex and other qualities are influencing factors. In the following table (Table III.) are given the proportions with which the orang- and chimpanzee-types of ear occur (1) in habitual criminals, obtained through the courtesy of Dr. Garson; (2) the insane of four asylums in different parts of the kingdom; (3) congenital idiots.

TABLE III.

Locality.	No. of observations. Male.	Female.	Orang-type. Male.	Female.	Chimpanzee-type. Male.	Female.
			Per cent.		Per cent.	
Scotland Yard	326	208	35	33	15	12
Aberdeen Asylum ...	190	211	23	40	16	8
Durham Asylum ...	211	208	26	40	18	3
Cork Asylum	202	205	12	37	19	3
Dublin Asylum (Richmond)	189	204	29	33	12	3
Congenital idiots... ...	27	9	26	66	4	0

Taking the insane first, it will be observed (compare Tables I. and III.) that on the whole the insane, so far as relates to the prevalence of the two types of ears, do not show a marked deviation from the sane of their neighbourhood and that there is no constant difference between the two classes. The insane men of Aberdeen and Cork show the orang-type less frequently than the sane; in Dublin the case is the reverse. In the insane women a similar variation is shown in the prevalence of this type; in one case it is lower, in another higher and in still another the same. It is so also as regards the chimpanzee-type. We must, therefore, conclude, so far as concerns these two types of ears, that there is no correlation between them and a bias towards insanity.

The congenital idiots show a prevalence of the orang-type, considerably above the average, and an occurrence of the chimpanzee-type below the average, but the number of the observations is too small to allow of any certain conclusion.

When, however, the confirmed criminal class is dealt with a striking departure from the normal is encountered—quite unlike the statistics gained from any other series of observations. The sexual ratio becomes inverted; the orang-type, instead of occurring in the female twice as frequently as in the male, which is the normal ratio in the sane, occurs with the greatest frequency in the male. So, too, with the chimpanzee-type, it is found almost as frequently in the female as in the male. In short, male criminals show a preponderance of the orang-type, female criminals of the chimpanzee-type. There is a reversion of the normal sexual ratio.

Thus it will be seen that, taken as a *class*, not as individuals, criminals show a departure from the sane in their physical constitution. But what does this really mean? It means, I take it, that the criminal class is recruited in undue proportion from the group of men who manifest the orang-type of ear and the women who possess the chimpanzee-type. A larger proportion of individuals of these two classes is predisposed towards crime than those with opposite types. But clearly the presence of the orang-type of ear in any individual is of itself no evidence of this predisposition.

I have already shown that the ratio in which these two types of ear occur is correlated with the colour of the hair. On comparing the colour of the hair of the criminal class with that of groups of people in various parts of the country, for the criminals I dealt with were drawn from almost every county, I found that the criminal class was drawn in an undue proportion from the black-haired men, in a lesser degree, also, from the black-haired women, and that therefore the orang-type should occur in them with a decreased, and not as it does with an increased, frequency.

Darwin's Point.—Since Darwin drew attention to the remnant of the tip of the human ear, an enormous literature has grown up around it. Vali found that it occurred with thrice the normal frequency in the insane; but before considering the relationship which its presence bears to an unstable mental equilibrium it is necessary to clear away some popular misconceptions that still prevail as to its nature.

It is not the case, as the following table (Table IV.) will show, that it is only in the human ear that the tip has become lost; it will be seen that this is also the case in all the anthropoids, a group that is genetically closely related to man. In all

TABLE IV.—*The Occurrence of Darwin's Point.*

(1) In Apes and Anthropoids.

	No. observed.	Present.
Baboons ...	15 ...	100 per cent.
Macaques ...	21 ...	95 ,,
Cercopitheques	19 ...	80 ,,
Semnopitheques	29 ...	45 ,,
Gibbons ...	12 ...	0 ,,
Orangs ...	15 ...	40 ,,
Chimpanzees...	23 ...	9 ,,
Gorillas ...	19 ...	26 ,,

(2) Races of Men.

	No. of observations. Male.	Female.	Present. Male.	Female.
			Per cent.	
African Negroes	29	—	7	—
Hottentots	18	—	6	—
Andamanese	52	15	38	40
Turin (Gradenigo) ...	—	—	3·5	3
English (Peterborough) ...	306	247	12	4
Lower Alsace (Schwalbe)	—	—	36	11
Upper Alsace (Schwalbe)	—	—	21	14
Kerry	282	209	13	9
Dublin	267	268	12	10
Cork	254	254	14	7

the anthropoids the tip occasionally recurs, showing that they come of a stock in which the ear was tipped. Only two groups of the old-world monkeys constantly retain the tipped form of ear—these are the macaques and baboons; in the other three groups of old-world monkeys (see Table IV.) the tip has already begun to disappear. It is probable, then, that the tipped form of ear began to disappear during an early stage in the evolution of the anthropoid and human stocks.

There can be little doubt that in the ear of the baboon or macaque (see Fig. 6) we have preserved for us approximately the form out of which the different types of ear seen in the higher Primates, including man, have been evolved. The tip occurs at the junction of the horizontal and descending helix; in this position it has to be looked for in man.

The complete or partial disappearance of the tip of the ear is part and parcel of the retrogression of the descending helix. When the descending helix (posterior border) becomes inrolled, then the tip is also inrolled. In the third month of fœtal life, the descending helix is not yet inrolled and the tip is constantly present on the human ear (Schæffer). Some trace or indication of the tip can be made out in 75 per cent. of adult men (Schwalbe). But in the statistics I give here relating to this structure, only those cases are included which showed Darwin's point in an unmistakable and pronounced form.

It is clearly evident from Table IV. that, before any deduction as to the presence of this structure on the ears of the criminal and insane classes can be made, the influence of race and sex must be taken into account. It is more frequently present in the male than the female; Schwalbe found it three times more so in the males of Upper Alsace, and this agrees with what I found in a typical English place, such as Peterborough.

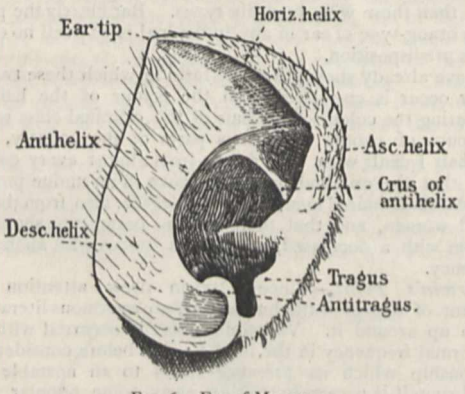

FIG. 6.—Ear of Macaque.

In the African negro it is rarely present; the helix of his ear has undergone so marked retrogressive changes; but in the Andamanese it is frequently present—more so in the women than men. The ratio of its presence varies widely with the race and locality.

In Table V. are given the results of observations made on (1) the insane, (2) criminals, (3) congenital idiots.

TABLE V.—*The Occurrence of Darwin's Tip in the Insane, in Criminals and in Congenital Idiots.*

Place.	No. of Observations. Male.	Female.	Present. Male. Per cent.	Female. Per cent.
Aberdeen Asylum[1] ...	198	209	13	15
Durham Asylum ...	211	206	22	19
Cork Asylum ...	203	205	23	20
Dublin Asylum ...	189	203	26	18
Scotland Yard ...	328	201	27	17
Congenital Idiots ...	27	—	37	—

Unfortunately I have no "control" observations on the population from which the insane of Aberdeen and Durham are drawn, but in the case of Cork and Dublin I have, and it is seen that Darwin's point comes out in the insane with double the frequency, or rather more, than that with which it occurs in the sane. The criminals also show it with a much greater frequency than I have found in any locality throughout the country. Its frequency is especially marked in congenital idiots and those vagabonds that congregate at the doors of the police courts and night shelters in London and Liverpool.

Darwin's point, the structure which we now deal with, differs very materially in nature from the subject last considered, viz., the type of ear. The two types of ear were symptoms merely of progressive or retrogressive development, but Darwin's point is the persistence of an ancestral or, what amounts to nearly the same thing, a fœtal form, and with this persistence might be expected a correlated persistence, to some extent at least, of the ancestral faculties of the brain. This certainly does not hold true of the individual; it does to some extent of the mass. Clearly the insane and criminal classes are drawn with an undue proportion from those in which Darwin's point is pronouncedly present.

The Lobule.—Before concluding, I wish briefly to refer to this structure, because it differs in nature from the two features of the ear already considered. It is a structure of comparatively recent addition to the ear. It is not the case that it is a feature peculiar to man; it may be detected, as Table VI. shows, in the ears of the three great anthropoids, but it is only in man that it finds a full and almost constant development, and therefore may be regarded as a recently added and progressive structure.

TABLE VI.—*The Development of the Lobule in Anthropoids and Races of Men.*

	Number of observations. Male.	Female.	Index of development. Male.	Female.
Orangs	13	both sexes	·25	
Chimpanzees ...	23	,,	·3	
Gorillas	19	,,	1·	
Negroes	29		1·1	
Andamanese ...	52	16	1·3	1·5
Aberdeen ...	473	563	1·5	1·7
Peterborough	182	140	1·3	1·3
London, E. ...	684	383	1·4	1·5
Jews	119	83	1·7	1·9
Hamburg ...	252	164	1·3	1·5
Cork	254	254	1·7	1·8
Dublin	264	285	1·7	1·9
Aberdeen Asylum	211	208	1·4	1·5
Durham Asylum	211	206	1·5	1·6
Cork Asylum	202	205	1·8	1·8
Dublin Asylum	189	203	1·5	1·6
Scotland Yard	330	201	1·5	1·7
Congenital idiots	27	9	1·2	1

It is necessary to allude to the manner in which the index of the development or size of the lobule was obtained. A reference to Fig. 5 will assist in the explanation. I became accustomed to measure with the eye the various degrees to which the lobule was developed and arranged them in four groups:—(1) those in which the lobule was extremely small or absent; (2) those in which it was developed to the first degree; (3) those in which it was developed to the second degree; and (4) those of the largest or third degree. Those degrees are indicated in Fig. 5. An index of 1·6, for instance, signifies that the average lobule in that group of individuals reached, in my artificial standard, 1·6 degrees of development. The method is not accurate; nothing less than actual measurements would render it so; but before such a laborious process is undertaken one requires to be assured that some very definite result will be accomplished. My method is accurate enough for the purposes of comparison and for eliciting any decided factor which may be at work.

It will be seen that it is the case with the lobule as with the two other features of the ear, that its development varies with sex and race. It is larger in the female than in the male; it is larger in the white races than in the black.

Its development in the insane and criminal classes does not depart to any marked extent from that of the normal classes. In the insane of Aberdeen and Dublin, the lobule was smaller than that of the sane of the same localities, but in Cork the difference was rather the reverse. It appears to reach an average development in criminals, but in congenital idiots, on the other hand, it rather approaches the degree of development met with in the gorilla.

To sum up. This investigation was originally undertaken to see how far the characters of the external ear might

[1] I am greatly indebted to the superintendents of these four asylums for the opportunities and help they afforded me.

be utilised in unravelling the genetic connection of human races; it was only incidentally, when I became aware of the extraordinary degree of individual variation, that I was drawn into the investigation of features which have been described as "marks of degeneration." The result of my inquiries in this direction has been to show that only two out of the seven features of the external ear which I investigated are correlated with a mental bias towards crime or insanity, viz. a retrograde development of the helix and a persistence of the ear tip.

My results are the more valuable because I was at first sceptical of the very definite results obtained by continental observers on the insane and criminal classes. It appeared very probable that the definiteness of their conclusions would disappear if allowances were made for the populations from which the criminals and insane were drawn and for the influence of race, sex and colour. After making those allowances, however, there remain a certain number of characters peculiar to these classes, of which those I have cited in the ear are only examples. But, unfortunately for any practical application of Lombrosa's doctrine to the detection of the socially unfit, the physical differences between the sane and the insane or criminal classes are those of degree or ratio, not of kind. The characters may assist in the detection of the class, but not of the individual.

All that can be deduced from the present investigation is that a slightly greater proportion of the people who have ear tips and retrograde helices give themselves over to crime than those in which these two features are absent. The evidence is just sufficient to justify the suspicion that a small proportion of criminals are criminals because of their physical constitution, and it is certainly the duty of every anatomist to discover how such individuals may be recognised. As yet all the criminal marks we know of can only be stated in relative terms of the class, and have, unfortunately, no application to the individual.

ARTHUR KEITH.

SCHOOL BOARD EXHIBITION OF SCIENTIFIC APPARATUS.

ONE of the reasons often given as an excuse for not introducing instruction in the elementary principles of science into the curriculum of elementary schools is the expense involved in providing the necessary apparatus for experimental demonstrations. It is common to find that school managers have very exaggerated ideas as to the amount of really necessary equipment. Though it has been the custom for some years, at institutions like the Royal College of Science, to instruct the students in training to become science teachers how effective apparatus can be made at a very small cost and with a minimum of mechanical dexterity, the great majority of science teachers, notably those of elementary schools, have had few opportunities of acquainting themselves with the use that may be made of the odds and ends of domestic life to construct instruments which can be effectively used in simple work in experimental science.

The School Board for London has recently taken steps to remedy this defect in the training of its teachers. Influenced by the heavy expenditure on apparatus to which it has been put, and convinced that the construction of simple instruments can be made a valuable assistance in teaching science, the Board has for some months encouraged its teachers to make apparatus themselves and to give their pupils opportunities of making models to illustrate the principles of the lessons they have received. The exhibition at the Examination Hall on the Embankment (see NATURE, p. 656) represents the results of these efforts up to the present time. Though satisfactory if considered as the first exhibition and as showing that an earnest attempt is being made to give science its proper place in training children for the business of life, there are some directions in which improvement is easily possible. It must be understood that in pointing these out we do not lose sight of the difficulties the organising committee has had to overcome, but desire simply to suggest what may be done to ensure a better set of exhibits next year.

In the present exhibition the work of teachers, adult students in evening classes and children in day schools are indiscriminately mixed up. The work of comparison is consequently very difficult, and it is to be feared that the boys and girls will be a little disheartened to find their work side by side with that of their instructors and their big brothers in the continuation school. Nor is it easy to form an idea of the work of the pupils of different schools. It is only after consulting a catalogue, or reading a label affixed to the exhibit, that the visitor is able to find the school from which the maker of the apparatus comes. It would be better in the future to have together typical sets of apparatus from different schools.

It is difficult to estimate the relative importance given to different branches of science by the Board. There is a large number of exhibits in statical electricity, but only two pieces of apparatus shown in connection with the study of light and three to illustrate the teaching of physiography. The subjects of heat and voltaic electricity are, judging from the number of exhibits, popular, while acoustics meets with very scant recognition. It is disappointing, too, to find so little attention given to Nature-knowledge. From the conditions of city life it is hard for children to get even a nodding acquaintance with the beauties of organic life, whether animal or vegetable, and the school should be able to help the youngsters to learn something of the joys of country life. So much has been accomplished in recent years in the direction of providing simple school museums of common botanical and zoological objects, that it is to be hoped the teachers and scholars will be encouraged to do something in this direction. Then, why is nothing done to familiarise the children with the "starry heavens"? We looked in vain for a simple home-made telescope. Yet teachers have been shown for many years past in the astrophysical laboratory at South Kensington how a really effective instrument can be made with cardboard tubes at a trifling expenditure.

But a good beginning has been made. If more attention is in the future given to some of the subjects we have indicated, and if the work of teachers is separated from that of the taught, the utility of the exhibition will be much enhanced.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An election to the Isaac Newton Studentship in Physical Astronomy and Optics will be held next term. Candidates must be Bachelors of Arts under twenty-five on the first day of 1902. The studentship is of the value of 200*l.*, tenable for three years. Applications are to be sent to the vice-chancellor between January 16 and 26.

On November 4, Mr. R. P. Paranjpye, the Indian student who was bracketed senior wrangler in 1899, was elected to a fellowship at St. John's College.

PROF. WILLIAM RAMSAY, F.R.S., commenced a course of twelve lectures on "The Recent Developments of Chemical Theory" at University College, London, on Friday last. This course is especially designed for those who have a previous acquaintance with inorganic and organic chemistry and who may wish to know the present standpoint of chemical thought.

AT the annual meeting of the governors of Dundee University College last week Mr. John Morley referred to the signs of increasing interest in universities and the increasing force which must be given to the movement in order to put ourselves in the position of other progressive nations. He hoped that the movement had not yet attained full flood, because "all those who inquired into the conditions of scientific training in Germany and the United States were really—he was not using an excessive word—dismayed when they found the comparative shabbiness and meagreness of the buildings, funds and equipments in this island. There was no form of care for the public weal more distinctly certain of being reproductive than that care which placed within the reach of the coming generation opportunities for making the best of itself and giving to the Commonwealth the best of its faculties. That was now a commonplace. The immediate question was, what was to be done in order to raise Dundee and other places in Scotland up to the level which public necessities—national necessities—Imperial necessities if they liked—demanded?" The answer is—and it will serve for practically all institutions for higher education in the British Isles—Increase the teaching resources by building and equipping laboratories, encourage original work rather than the multiplication of successes in examinations, create in the public mind a spirit of sympathy with scientific work, and inspire the Government to action before it is too late.

A SCHEME for the extension and better equipment of the University of Glasgow, especially in the departments of

medical and physical science, was approved at an influential meeting of members and friends of the University held in the Glasgow City Chambers last week. Addressing the meeting, Principal Story said that in the beginning of the present year an executive committee was formed to provide funds for carrying out the measures of extension and reform considered of primary importance, and already they had received a sum of more than 62,000*l.*, including 10,000*l.* given for a special lectureship. It was proposed to make good the defects by the erection of additional premises for the class rooms, departmental museums, and laboratories of physiology, materia medica and forensic medicine, and public health. The needs of the chemical department, which could be regarded as belonging both to the faculty of science and to that of medicine, might be met, but only partially and temporarily, by the transference of premises available when physiology was provided for. A set of thoroughly furnished chemical laboratories is one of the most immediate wants, and additional accommodation is needed by the department of physical science. The full realisation of these designs must necessarily be a work of time, and will cost in all probably not far short of 100,000*l.* But it is encouraging to know that within the last few months more than the half of this sum has been subscribed. For the other half the University must depend upon the generosity of its many friends.

SCIENTIFIC SERIALS.

American Journal of Science, October.—On galvanometers of high sensibility, by C. E. Mendenhall and C. W. Waidner. A description of the design and manufacture of a delicate galvanometer of the four-coil Thomson type. There is a detailed discussion of the methods for obtaining the highest sensibility and also of the causes of the changes of zero.—On a method of locating nodes and loops of sound in the open air, with applications, by Bergen Davis. A small mill-like arrangement, constructed by placing four hollow cylinders of gelatine at the end of cardboard arms in such a manner that the closed ends pointed in the same angular direction, was mounted in the mouth of a resonator with the plane of the system perpendicular to the mouth. The resonator was in unison with an organ pipe, and when the pipe was blown the mill was found to rotate with a high velocity, the position of the nodes and loops being readily determined with considerable accuracy. In the open air the effect could be observed up to about sixty feet from the pipe.—The anatomy of the fruit of *Cocos Nucifera*, by A. L. Winton.—Studies of Eocene mammalia in the Marsh collection, Peabody Museum, by J. L. Wortman.—A new crinoid from the Hamilton of Charlestown, Indiana, by E. Wood.—On the estimation of cæsium and rubidium as the acid sulphates, and of potassium and sodium as the pyrosulphates, by P. E. Browning.—Time values of provincial carboniferous terranes, by C. E. Keyes.—The spectra of hydrogen and some of its compounds, by John Trowbridge. The vacuum tubes used in the experiments described were illuminated by a current derived from a large battery of storage cells and not from a Ruhmkorf coil. The conclusions drawn from these investigations, which are at variance with the views generally received, are that hydrogen is an insulator, the passage of electricity through hydrogen, oxygen, nitrogen and their gaseous compounds being conditioned by the water vapour present. Certain carbon bands are always present in glass tubes filled with hydrogen, nitrogen, oxygen and ammonia gas, notwithstanding the greatest care taken during filling. The X-rays excited by the application of a steady current are due to the radiations set up by the dissociation of highly rarefied water vapour.

Bulletin of the American Mathematical Society, October.—Prof. F. N. Cole gives an account of the proceedings at the eighth summer meeting of the Society, held at Cornell University, Ithaca, New York, August 19–24. It was a largely attended meeting, and various circumstances made an adequate provision of time for the reading and discussion of the thirty-two papers presented practically impossible. The titles and abstracts occupy more than twenty pages. The third colloquium of the same Society was also held on the same date. Dr. Kasner gives an abstract of the proceedings at the two previous colloquia, as well as of this one. During the four days, two courses of four lectures each were delivered by Prof. Oskar Bolza, on the simplest type of problems in the calculus of variations, and by Prof. E. W. Brown, on modern methods of treating dynamical problems, and in particular the problem of three bodies. Grateful acknowledgments were made of the hospitality of the University and for the numerous privileges which were afforded to the members present. Short notices are given of two of the papers: upon the non-isomorphism of two simple groups of order 8!/2, by Miss Schottenfels, and concerning surfaces whose first and second fundamental forms are the second and first fundamental forms respectively of another surface, by Prof. A. Pell. Extensive notes of the mathematical courses for the session 1901–1902 at several Universities follow, with other matters of personal interest. Several pages are also devoted to new publications.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, October 2.—The Rev. Canon W. W. Fowler, president, in the chair.—Mr. G. C. Champion exhibited a long series of *Buprestis sanguinea*, Fabr., from Albarracin, Spain, showing the remarkable dimorphism of this species.—Mr. H. St. J. Donisthorpe exhibited on behalf of the Rev. H. S. Gorham, of Shirley Warren, a specimen of the scarce beetle, *Hister marginatus*. He also exhibited a number of rare Coleoptera from the New Forest, including *Velleius dilatatus*, F., from hornets' nests, *Anthaxia nitidula*, L., *Agrilus sinuatus*, Ol.—not taken for many years—*Agrilis viridis*, L., *Platydema violaceum*, F., a species also not recorded recently, and *Collydium elongatum*, F., one specimen taken in the burrows of *Melasis buprestoides* and another in the burrows of *Scolytus intricatus*. Mr. Champion said that Mr. George Lewis associated *Velleius* with *Cossus* and not with hornets.—Mr. C. P. Pickett exhibited varieties and aberrations of *Lycaena corydon* taken during August at Dover, and a series of *Angerona prunaria* (bred June and July), the results of four years' interbreeding, showing a wide range of coloration.—Prof. T. Hudson Beare exhibited a specimen of *Medon castaneus*, Grav., taken at the edge of a pond in Richmond Park.—Mr. A. Harrison exhibited a series of *Amphidasys betularia* bred from parents taken in the New Forest in 1900, including six gynandromorphous specimens.—Mr. C. J. Gahan exhibited a male specimen of *Thamnotrizon cinereus*, L., one of the long-horned grasshoppers taken by Mr. F. W. Terry at Morden, near Wimbledon, and called attention to a very interesting abnormality displayed by the specimen in possessing two pairs of auditory organs instead of a single pair, the second pair being situated on the tibiæ of the middle legs in a position corresponding with that of the normal pair on the fore-legs.—Mr. F. Merrifield exhibited a series of *O. antiqua* much darker than the type, bred from pupæ placed in a refrigerator five weeks and then exposed to a mean temperature of 48° F.—Mr. R. South communicated a paper by the late Mr. J. H. Leech, entitled "Lepidoptera-heterocera from China, Japan and Corea (Pyralidæ)"; Mr. G. C. Champion contributed notes and observations upon the sexual dimorphism of *Buprestis sanguinea*.

October 16.—Mr. E. Saunders, vice-president, in the chair.—Mr. C. Morley exhibited for the Rev. E. N. Bloomfield leaves of hornbeam from Battle, and a photograph of leaves of sweet chestnut from Haslemere, rolled by *Atelabus circulionoides*.—Mr. R. Adkin exhibited a specimen of *Pieris daplidice* taken by him at Eastbourne on August 19 last. He said that the insect was flying strongly, and in that respect and indeed in general appearance resembled on the wing a pale female of *Colias hyale*.—Mr. C. P. Pickett exhibited series of *Melitaea cinxia* bred in June last from larvæ taken in the Isle of Wight, including light and dark varieties, and a series of *Choerocampa elpenor* bred in June last from larvæ taken at Broxbourne in July 1900, including a variety of the male with purplish lower wings and another with purple markings on the upper wings.—The Rev. F. D. Morice exhibited specimens of *Hedychrum rutilans*, Dhl., and *Salius propinquus*, Lep., taken at Lyndhurst by Miss Ethel Chawner, and both new to the British list. He also exhibited two monstrosities, viz. *Allantus arcuatus*; (sawfly) with two perfect wings, and two other imperfectly developed wings on the left side, and *Gorytes quinquecinctus* (fossor) with the abdominal segments extraordinarily twisted out of their proper shape and places.—Mr. Arthur M. Lea communicated a list of the Australian and Tasmanian Mordellidæ, with descriptions of new species; and Mr.

Edward Meyrick, descriptions of new Lepidoptera from New Zealand.—Mr. E. Saunders then read a paper upon Hymenoptera aculeata collected in Algeria by the Rev. E. A. Eaton and the Rev. F. D. Morice, part i., Heterogynæ and Fossores to the end of Pompilidæ.

Royal Microscopical Society, October 16.—Mr. Wm. Carruthers, F.R.S., president, in the chair.—Messrs. C. Baker exhibited a portable microscope on the model of the "Diagnostic," originally designed for Major Ronald Ross's investigations of malaria. It is made of magnalium, an alloy of manganese and aluminium, and weighs but fourteen ounces. This firm also exhibited a microscope intended for the examination of fractures and etched surfaces of metals. The instrument is provided with vertical illuminator, and rack and pinion focussing adjustment and levelling screws to the mechanical stage, now usual in this class of instrument.—Messrs. R. and J. Beck exhibited a portable model of their "London" microscope, which, by the introduction of several ingenious devices, could be packed with the apparatus into a leather case 2¾ inches × 4½ inches × 9½ inches. Messrs. Beck also exhibited a centrifuge, made to run at a high speed by an electric current.—The president showed some specimens of the mycetozoa and gave a brief account of the life-history of this group of organisms. The specimens belonged to a recently described species and had been named *Badhamia foliicola*. He directed attention to the exhibits by Mr. C. L. Curties consisting of a number of mounted specimens of marine zoological objects, accompanied by very full and interesting descriptions.—The president gave a *résumé* of a paper, by Miss A. Lorrain Smith, on fungi found on germinating farm seeds. Miss Smith had been assisting him in his work for the Royal Agricultural Society in examining farm seeds in respect to their germinating power. In the course of their observations Miss Smith had found numerous species of fungi on the germinating seeds, fourteen species in all, of which five were new and one belonged to a new genus.—The secretary announced the receipt of part xiv. of Mr. Millett's report on the foraminifera of the Malay Archipelago, which was taken as read.

MANCHESTER.

Literary and Philosophical Society, October 15.—Mr. Charles Bailey, president, in the chair.—Mr. R. L. Taylor remarked that he had noticed that the Manchester water appeared to contain an unusual amount of dissolved chlorides at the present time, and, on roughly estimating the amount of dissolved solids, found that the total had, curiously enough, gone up from a normal amount of about 4½ grains to about 9½ grains per gallon, due, no doubt, to the recent scarcity of water and to the concentration by evaporation on the gathering grounds and in the reservoirs.—Mr. R. D. Darbishire exhibited a large collection of the Eolithic implements of the Kentish plateau, and illustrated with map and section the outline of the denudation of the valley of the Weald, leaving a drift deposit on the remaining chalk of the north and south encarpments. In the process many levels of river gravels had been fixed, and partly occupied by stone implements of successive ages, mostly much mixed up in the redisposition of the gravels by succeeding movements. He described the general facies of the so-called Palæolithic implements from river deposits in France and England and their peculiar modes of manufacture by "chipping" or flaking, and shapes; and confessed inability to determine the uses of such tools or any characteristics of the men who made them. They were fossil indications of man with mind, skill, and purpose, and that was all.

October 29.—Mr. Charles Bailey, president, in the chair.—Dr. C. H. Lees was elected to the office of honorary secretary in succession to Prof. A. W. Flux.—Mr. C. E. Stromeyer read a paper on explosions of steam-pipes due to water-hammers, dealing with the subject both from a theoretical and practical point of view. He referred to the reports of the Commissioners of the Board of Trade, according to which about fifty steam-pipe explosions have occurred from the above causes during the last seventeen years, and said that the majority were brought about by the opening of drain-cocks of steam-pipes in which water had accumulated, while a few were clearly due to a plug of water having been shot from the boiler ends of the pipes to the engine-ends. Mr. Stromeyer first investigated the pressure which is set up when an elastic body suddenly comes to rest, the solution of which problem was correctly guessed at by Dr. A. Ritter in 1889, but he was unable to give a proof of the possibility of discontinuity of motion, which is part of the phenomena of an elastic blow. This point was illustrated by means of an unloaded helical spring. Having established this theory, it follows that when an elastic prismatic body is moving axially its front surface comes to rest instantaneously on contact with an unmovable obstacle, while the more distant parts of the bar come to rest also instantaneously when the wave of pressure or of change of velocity reaches them. This wave travels with the velocity of sound, and as the tail end of the bar has maintained its velocity, the axial pressure in the bar is the product of the elasticity of the material into the ratio of the velocity of the object to the velocity of sound. With the help of this theory it is easy to calculate the pressure which a plug of water of a given length travelling a given distance under the influence of a given pressure will exert if brought to a full stop.—A paper entitled "A Preliminary Note on the Preparation of Barium" was read by Mr. Edgar Stansfield. Results were given of a critical study of hitherto proposed methods of preparing metallic barium. The most promising results were obtained by the Goldschmidt process, by which alloys of barium and aluminium containing up to 60 per cent. of barium were produced, when the experiment was carried out *in vacuo* to avoid the formation of oxides and nitrides.

PARIS.

Academy of Sciences, October 28.—M. Bouquet de la Grye in the chair.—Experiments on some chemical reactions determined by radium, by M. Berthelot. A comparison of the action of light and of the radium rays in promoting certain chemical reactions. The reactions used were the decomposition of iodic acid, of anhydrous nitric acid, the oxidation of oxalic acid, and the polymerisation of acetylene. In the first two cases the action of the radium rays was exactly similar to that of light, except that the action was much feebler; in the two latter experiments no action was observed. It is suggested as possible that the glass vessels, in which the radium salts were necessarily enclosed, may have cut off that portion of the rays which is capable of the most energetic effects.—On the heat disengaged in the reaction between free oxygen and potassium pyrogallate, by M. Berthelot.—On a prehistoric lamp found in the cave of La Mouthe, by M. Berthelot. An examination of the carbonaceous substance scraped off a prehistoric lamp found by M. Em. Rivière showed that these residues are similar to those which would be left after combustion of a fatty material of animal origin, badly separated from its membranous envelopes.—The junction of a closed network of trigonometrical triangles, by M. P. Hatt. An application of the method of least squares to the method previously developed.—On the flagella of the undulating membrane of fishes (*Trypanosoma*), by MM. A. Laveran and F. Mesnil. The existence of organisms with undulating membrane and with two flagella would appear to be doubtful, and the authors regard the creation of a new genus for these organisms as necessary, and propose the name *Trypanoplasma*.—On Foucault's top, by M. A. S. Chessin.—On the stability of commutators, by M. Maurice Leblanc. A discussion of the cause of irregularity in the motion of a commutator in connection with a number of accumulators, and of the methods of overcoming this.—The minimum value of the total heat of combination, by M. de Forcrand. By an expansion of a formula given in a previous paper the minimum value of the total heat of combination can be calculated. This has been done for a considerable number of substances, and these compared with experimental data as far as available.—A contribution to the study of the copper-aluminium alloys, by M. Leon Guillet. The alloys were obtained by heating aluminium with pure oxide of copper. By the application of this method, which had previously given successful results with molybdic and tungstic acids, three compounds could be isolated, Cu_3Al, CuAl and Al_2Cu. These had been already prepared by a different method by M. Chatelier.—On the separation of iron, by M. Paul Nicolardot. Ferric chloride, after being heated to 125° C. for some hours, forms an insoluble sulphate on adding ammonium sulphate to its aqueous solution. No other metals likely to be present in iron or steel are precipitated. The analysis of certain special alloys is rendered very simple by this method.—The qualitative and quantitative determination of traces of antimony in the presence of large proportions of arsenic, by M. G. Denigès. Two methods are suggested, the first depending upon the separation of the antimony by metallic

tin in a platinum dish, and the second upon the formation of a double salt with cæsium iodide, and examination under the microscope of the crystalline deposit.—Researches in plants on cane sugar with the aid of invertin and of glucosides with the aid of emulsin, by M. Ed. Bourquelot.—On the estimation of the alkalinity of the blood, by MM. August Lumière, Louis Lumière and Henri Barbier. After a comparison of the results obtained by various methods that have been suggested the authors adopt an iodometric method, the results given in this way being regarded as much more exact than those obtained in the usual way.—The liberoligneous bundles of ferns. The union and separation of the liberoligneous elements, and some consequences, by MM. C Eg. Bertrand and F. Cornaille.—On two states of the living substance, by M. Felix Le Dantec.—Remarks concerning the formation and origin of fine pearls, by M. L. G. Seurat. A criticism of the theory put forward by M. R. Dubois.—The nematod of the beet-root (*Heterodera Schactii*), by M. Willot.—On the mode of production of divergent luminous rays at 180° from the sun, by M. G. Sagnac.

NEW SOUTH WALES.

Royal Society, September 4.—Mr. H. C. Russell, F.R.S., president, in the chair.—Recurrence of rain—the relation between the moon's motion in declination and the quantity of rain in New South Wales, by H. C. Russell, F.R.S. The paper was essentially a continuation of that on the periodicity of good and bad seasons, read June 3, 1896. The author stated that while coastal rains were irregular, those of the interior showed a 19-year periodicity. Regretting that observations did not extend over a more lengthy period, it was pointed out that some rain records of Horsham, Victoria, dating back to 1848 were valuable, our first record at Bathurst beginning in 1858. To minimise possible errors, the averages of neighbouring stations were taken. An illustrative diagram accompanied the paper, the author stating that between 1850 and 1851, 1869 and 1870, and 1888 and 1889, the thick vertical lines—nineteen years apart—divided the records in "natural spaces" in which the first six years had abundance of rain, and the remainder was a "dry period." The first bad year of the series we were stated to be now in was 1895, the loss of sheep from starvation between 1895 and 1900 being alleged to be 25,000,000, not including the loss of 20,000,000 natural increase. The diagram showed also the curve of extreme southerly declination of the moon for each year. The author, in conclusion, stated that rain is shown for three periods of nearly nineteen years each, "to come in times of abundance when the moon is in certain degrees of her motion south, and when the moon begins to go north, the droughty conditions prevail for seven or eight years," which he says is "either a marvellous coincidence, or it is a law connecting the two phenomena," and he is convinced that there is some connection between the two.—The theory of city design, by G. H. Knibbs. The subject was systematically treated under the following headings: (1) introductory; (2) general idea of a city; (3) radial street-system; (4) position of radial centres; (5) combination of radial and rectangular street-systems; (6) curved streets; (7) cardinal direction of rectangular streets; (8) width of streets; (9) localisation of the various types of street; (10) grade and cross-section of streets; (11) engineering features of streets; (12) size of blocks between streets; (13) height of buildings; (14) theory of aspect; (15) the æsthetics of design; (16) sites for monumental buildings and monuments; (17) treatment of street; from the standpoint of æsthetics; (18) public parks and gardenss (19) hygienic elements of design; (20) the preliminaries of design; (21) conclusion.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 7.

LINNEAN SOCIETY, at 8.—On the Life-history of the Black-currant Mite (*Phytoptus ribis*): Mr. Warburton and Miss Embleton.—Notes on the types of Species of *Carex* in Boott's Herbarium: C. B. Clarke, F.R.S.

RÖNTGEN SOCIETY, at 8.30.—Presidential Address: Herbert Jackson.

CHEMICAL SOCIETY, at 8.—Note on the Non-existence of a Higher Oxide of Hydrogen than the Di-oxide: Prof. W. Ramsay, F.R.S.—The Electrolytic Reduction of Nitrourea: G. W. F. Holroyd.—(1) The Constitution of Pilocarpine, III.; (2) A New Synthesis of α-Ethyl Tricarballylic Acid: H. A. D. Jowett.—The Action of Nitric Acid on Methyl Dimethylacetoacetate: Prof. W. H. Perkin, F.R.S.—(1) An Incrustation from the Stone Gallery of St. Paul's Cathedral; (2) Note on Asbestos: E. G. Clayton.—Liquid Nitrogen Peroxide as a Solvent: Prof. P. F. Frankland, F.R.S., and R. C. Farmer.

FRIDAY NOVEMBER 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Recent Observations of the Position of Nova Aurigæ, made with the 40-inch Telescope of the Yerkes Observatory: Prof. E. E. Barnard.—The Determination of Selenographic Positions and the Measurement of Lunar Photographs, II.: S. A. Saunder.—Ephemeris for Physical Observations of the Moon for 1902: A. C. D. Crommelin.—A New Method of Interpolation: T. C. Hudson.—On Periodic Orbits in the Neighbourhood of Centres of Libration: H. C. Plummer.—The Spectrum of Nova Persei from February 28 to April 26, 1901: Rev. W. Sidgreaves.—Ephemeris for Physical Observations of Jupiter, 1902-3: A. C. D. Crommelin.—On the Variation of T Centauri: A. W. Roberts.—Comparison of the Geocentric Places of Uranus, Neptune and the Sun, calculated from Newcomb's Tables, with their Places calculated from Le Verrier's Tables, for 1904: Dr. A. M W. Downing.—On the Abnormal Photographic Image of Nova Persei: E. M. Antoniadi.—*Probable Papers*: Determination of Küstner's Magnitude Equation from Comparison of his Meridian Observations in Zones +24° to +27°, with Measures of Photographic Plates taken at the University Observatory, Oxford: H. H. Turner.—On the Place of the Variable RU Herculis and Neighbouring Stars, from Photographic Measures: F. A. Bellamy.—First Reduction of Photographs of Eros made at Cambridge for the Determination of Solar Parallax: A. R. Hinks.

MALACOLOGICAL SOCIETY, at 8.—Note on the Type-specimen of *Belemnoteuthis montefiorei*, J. Buckman: G. C. Crick.—Description of Two New Helicoid Landshells from British New Guinea: H. B. Preston.—On the Fate of the Type-specimen of *Voluta roadknightae*: Mrs. A. F. Kenyon. Description of a New Species of *Helicina* from Guatemala: E. R. Sykes.

MONDAY, NOVEMBER 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Opening Address: The President.—The Uganda Protectorate, Ruwenzori and the Semliki Forest: Sir Harry Johnston, K.C.B.

TUESDAY, NOVEMBER 12.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Discharge of Sewage into a Tidal Estuary: W. Kaye Parry and Dr. W. E. Adeney.—Train Resistance: John A. F. Aspinall.

MINERALOGICAL SOCIETY, at 8.—Anniversary Meeting.—*Papers*: On Baumhauerite, a New Mineral, Dufrénosite and Hyalophane, from the Binnenthal: R. H. Solly.—Analyses of Marshite and Miersite: G. T. Prior.—On the Hornsilvers: G. T. Prior and L. J. Spencer.—On Gibbsite from the Palni Hills in Southern India: Dr. H. Warth.—On the Occurrence of Gold in the Klondike; Results of a Visit in 1901: Prof. H. A. Miers, F.R.S.

THURSDAY, NOVEMBER 14.

MATHEMATICAL SOCIETY, at 5.30.—Linear Groups in an Infinite Field: Dr. L. E. Dickson.—Note on the Algebraic Properties of Pfaffians: J. Brill.—On Burmann's Theorem: Prof. A. C. Dixon.—The Puiseux Diagram and Differential Equations: R. W. H. T. Hudson.—Determination of all the Groups of Order 168: Dr. G. A. Miller.—An Outline of a Theory of Divergent Integrals: G. H. Hardy.—On the Representation of a Group of Finite Order as a Permutation Group; and on the Composition of Permutation Groups: Prof. W. Burnside, F.R.S.

FRIDAY, NOVEMBER 15.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—The President, Dr. Patrick Manson, C.M.G., F.R.S., will deliver his Inaugural Address on the Ætiology of Beriberi.

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