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## A FIELD NATURALIST'S SCIENCE.

*The Primrose and Darwinism.* By a Field Naturalist, M.A. Camb. Pp. xiii + 233. (London: Grant Richards, 1902.) Price 6*s.* net.

IT is hard to tell why this book was written. The preface alone is enough to condemn it, for in the preface we have in miniature the chief defects of the book—inaccuracy and want of scientific method.

At the foot of p. vi. the author makes the astonishing statement that Darwin's predecessors are to be

"commended for strictly subordinating theory to natural facts. They thus happily avoided the error into which Darwin, in this instance at least, most assuredly and most conspicuously fell."

On p. vii. the author continues,

"We consider that it was most unfortunate for Natural Science that Darwin relied almost so exclusively on artificial observation, or, in other terms, on experiment, for the investigation and interpretation of natural laws in facts connected with the fertilisation of flowers."

That is to say, the botanists are to be commended for not having attempted to solve the problem of the sexual relation between the two forms of dimorphic flowers in the only possible way in which that question can be attacked.

The preface is followed by a chapter of three pages in which some technical terms are defined, and an incomplete account of dimorphism is given. This, we gather, is intended for the general reader, but it is useless for the purpose; indeed, we fail to see what interest such a reader can find in the book. If he is convinced by the Field Naturalist, and consequently gives up his belief in Darwin's work on the fertilisation of flowers, what does he gain? He has lost a coherent and interesting doctrine which, whatever may be its faults, is undoubtedly in agreement with an enormous range of authentic observation and experiment, and one that has stood the test of time, having been before the world in its modern shape since 1862. The reader is told by the Field Naturalist that *Arum maculatum* is a "purely self-fertilised flower"; if his faith endures up to this part of the book, and if he accordingly swallows the statement, he must for the future give up all attempt to find a function for floral structures, the whole build and habit of reproductive mechanism having become meaningless. It is the same throughout the book; we have pages of weak argument directed against well-authenticated conclusions—arguments which, if accepted, would leave floral structures unexplained and inexplicable. And when the author ventures on suggesting a function, we are liable to come across such a theory as that the orifice in the carina of Lotus (through which pollen is obviously and visibly pumped out) is to serve for the ventilation of the pollen stored within the carina!

If the general reader desires to read this book, let him prepare himself by reading a discussion on floral biology by some candid and competent person. And if, after he has seen how the subject can be treated by a rational writer, he still insists on reading "The Primrose and Darwinism," we must leav him to his fate, though we shall continue to be sorry for him.

We do not propose to go through the whole book, but to discuss one or two points and to leave our readers to judge of the remainder; we must indeed confess that we have found it impossible to read the whole.

The author's principal objection to Darwin's experiments is that in order to exclude insects he made use of a covering of netting. This treatment the author assumes, without any evidence, to be injurious to the pollen. He gives (p. 8) his general reasons for believing in this astonishing conclusion.

(1) "The influence of the solar rays would be greatly diminished," and "would be much debarred from exercising their full maturing power on the anthers, . . ."

This may or may not be the case; but what botanist would make such a statement, unsupported by a single experiment?

(2) "Radiation would likewise be almost entirely prevented by the net, and the dew would consequently fail to fall on the anthers. . . . In the mornings of early spring, . . . . we have frequently found the flowers of the primrose bedrenched with dew."

The general reader would naturally assume that pollen is known to be improved in quality by being wetted. No botanist would have been likely to frame such a hypothesis, for it is well known that pollen is injured by water. And when a Field Naturalist theorises in this way, without giving a shred of experimental evidence, he must be plainly told that he gives up all claims to be considered a man of science.

(3) "In calm weather" the net would prevent "the free access of the wind, and would prevent it from shaking, and so from freely disturbing and distributing the pollen."

Here again not a particle of evidence is given for his point of view.

In Chapter iv. the author gives instances intended to prove the injurious effect of the net. They are quoted from Darwin's "Cross and Self-Fertilisation." One is the case of *Salvia tenori*, which when protected by a net was quite sterile except for two or three flowers on the summit of the spikes which touched the net when the wind blew.

The Field Naturalist (p. 11) says:—

"To attribute the capacity for fertilisation" in the unprotected "flowers to the bees is perfectly gratuitous, as the flowers under the net (when bees were excluded), 'when they touched the net and the wind blew,'[1] produced seeds without any cross-fertilisation."

How the Field Naturalist accounts for the flowers which touched the net when the wind blew being in a more natural condition than those which did not touch it we are unable to guess. He does not show that they were more wetted with dew, and gives, in fact, nothing that can be called a reason for his conclusion. Yet he has to account for a striking difference, since those flowers that did not touch the net were quite sterile. How Darwin accounts for the fertility of the flowers is not clear. They may have been visited by bees. Why does not the Field Naturalist go into this point, which would

[1] An incorrect quotation.

probably entail a discussion of the several types of floral structure found in the genus Salvia? We also look for a discussion of the question whether or no the fact that the flowers were pressed against the netting could so far disturb the mutual relations of the parts as to bring about self-fertilisation.

The same want of full discussion is felt in his critique on Darwin's observation on the broom (*Sarothamnus scoparius*). Darwin says the flowers were

"extremely sterile when the flowers are neither visited by bees, nor disturbed by being beaten by the wind against the surrounding net."

The Field Naturalist quotes this passage incorrectly, omitting "when the flowers are neither visited by bees"—and these words are of some importance, for they show that the disturbance by the wind was believed to have an effect analogous to that produced by insects. In another passage ("Cross and Self-Fertilisation," edit. ii. p. 164) Darwin states that "if the flowers are not dashed by the wind against any object, the keel never opens." If the flower is not opened the style remains in the keel surrounded, but either not fertilised or imperfectly fertilised by its own pollen. But if the style and stamens are freely exposed, as would be the case in the flowers opened by the wind's action, the flowers may conceivably be "dashed against" each other and fertilised, even if they cannot be visited by insects. The whole economy of the broom flower should be thoroughly known, and, indeed, fresh observations should be made, before it is possible to draw the conclusion of the Field Naturalist, that the sterilising action of the net accounts for the results.

The same sort of thing is put forward in the case of *Reseda lutea*. Here Darwin says,

"The bees were able to suck the flowers through the meshes, and brought pollen to them from the neighbouring plants."

The Field Naturalist says (p. 13),

"The bees could not possibly reach with their proboscis the side or inside flowers, yet 'the branches were loaded with capsules.'"

As the Field Naturalist was not present when the bees brought pollen to the mignonettes, and as one of the best observers in the world was present, we need not waste more time over this case.

In "Cross and Self-Fertilisation," from which the Field Naturalist takes his cases, he might have found, if he had looked for them, facts which he will find difficult to fit to his theory of the "denaturalising" effect of the net. Darwin gives ("Cross and Self-Fertilisation," edit. ii. p. 357-369) two lists:—(1) Containing plants which, when insects are excluded, are quite sterile, or produce, as far as he could judge, less than half the normal number of seeds. (2) Containing those which, when protected from insects, are either quite fertile or yield more than half the normal number of seeds. The Field Naturalist is bound to account for the fact that many plants are extremely fertile under the net, and he must account, too, for the fact that, broadly speaking, there is a difference between the type of flower found in the two classes. Or, to put it more accurately, in the first or sterile lot 65 per cent. of the genera have asymmetrical or otherwise specialised flowers, while in the fertile lot the specialised genera are 43 per cent.

Why, according to the Field Naturalist's view, should the net be less hurtful to the simple unspecialised flowers? According to the rational view of the matter taken by most botanists, it was to be expected that specialised flowers would be more highly sterile, when insects are excluded, than simple unspecialised flowers. But it is useless to argue thus, for if a female diœcious plant were placed under a net, and were found to be sterile, the Field Naturalist would doubtless account for its sterility by the denaturalising influence of the net, not by the fact that pollen could not reach its stigmas.

Chapter xiii., on "The So-called Dichogamous Plants," may be taken as another instance of the Field Naturalist's method of treating a scientific problem. His notions on this subject seem to be taken from Lord Avebury and Dr. Wallace, neither of whom can rank as original authorities on the question, while we look in vain for references to Sprengel, Delpino and Hildebrand. This is only one instance of the author's ignorance of the literature of his subject. It is probably in consequence of want of knowledge that he sets up an incorrect definition of dichogamy against which to direct his arguments. He ought to be aware that dichogamy does not necessarily mean a complete separation in time of the staminal and stigmatic functions. However, allowing this serious flaw in his point of view to pass, let us see how he deals with a strongly dichogamous species, *Arum maculatum*. He tells us that no flower gives clearer evidence of its own self-fertilisation than the Arum. Yet he quotes an observation of Darwin, who saw minute flies emerge from an Arum, dusted with pollen, and subsequently visit a neighbouring plant. Here Darwin found pollen within the spathe, though the stamens had not burst. No one will pretend that this one observation is conclusive, but it points clearly to the view accepted by botanists that flies carry pollen from the older to the younger spathes, thus fertilising the female flowers[1] before the pollen in the spathe is ripe.

The Field Naturalist principally devotes himself to trying to prove that the Arum does not imprison flies with sufficient regularity and in sufficient numbers to be of any use. He writes (p. 80):—

"About the forced imprisonment of small flies, Darwin says, 'this statement has [now] been shown by Hildebrand to be erroneous,' and Darwin proves that it is incorrect, and that the small flies can escape before the hairs above wither, by his own experiment" ("Cross and Self-Fertilisation," edit. ii. p. 420).

It so happens that Hildebrand's statement (according to Darwin) refers to Aristolochia, not to Arum. But even if it had referred to Arum it would only have illustrated another piece of inaccuracy of the Field Naturalist. What was shown by Hildebrand (as quoted by Darwin) to be incorrect was the old statement that flies which enter the flowers *never escape*, whereas the Field Naturalist seems to consider it an argument against imprisonment occurring at all. His own observations are on a level with this loose treatment of the problem, for he does not say in which of Delpino's stages were the

[1] Often described as ovaries.

Arums in which he failed to find imprisoned flies. He is clearly ignorant of Knuth's and Müller's positive statements as to the presence of imprisoned insects, and of Müller's description of the flies flying vainly against the imprisoning hairs. He describes the stigmas as covered with pollen after the anthers of the same spadix have burst—which is by no means surprising since the stigmas secrete nectar after they have ceased to function.

He throws in the gratuitous guess that the dead flies sometimes found at the bottom of the prison are killed by feeding "on the intensely acrid juice which, as is well known, is secreted by the tissues of the flower." As a matter of fact, precisely the opposite is known, namely, that "juice" of the plant is not acrid, the irritating effect of the tissues as a whole being due to minute pointed crystals. He concludes that Arum is "a purely self-fertilised flower." To one with any knowledge of the subject this statement, appended as a justifiable conclusion from such an array of arguments, is enough by itself to condemn the author.

Chapter xxiii., p. 190, is headed "Trimorphic Flowers. The cleistogamic flowers directly disprove the theory."[1] The hasty reader might suppose that the theory in question is the Field Naturalist's own hypothesis that nets are a cause of sterility. For if sterility can be produced by keeping the pollen from sun, rain, wind, &c., as the Field Naturalist states to be the case, then surely a cleistogamic flower, in which the androecium is shut up within the corolla (a covering much more impervious than a net), must be completely sterile, more especially as the reproductive parts are more or less in the dark, a condition known to produce sterility in chasmogamic flowers. This does not occur to our author, who calls the cleistogamic flower Nature's "own natural net."

The Field Naturalist completely misunderstands Darwin's point of view about cleistogamy, which, by the way, is also the view of biologists generally. Cleistogamy is an economical arrangement for securing fertilisation at any price; it is important that cross-fertilisation shall take place, but it is still more important that seedlings of any parentage should be produced. Floral structures are compromises between the two extreme forms, cleistogamy and diœciousness, in one of which offspring is assured, in the other the offspring, *if any*, is cross-fertilised. The existence of cleistogamy, instead of being fatal to "the theory," is a most instructive part of the body of facts on which the modern view is founded. Why the Field Naturalist supposes that "cleistogamic flowers directly disprove the theory," especially in the case of trimorphic plants, is not obvious, for the meaning of cleistogamy is the same in any class of flowers. We fail to see that his discussion throws any light on the subject. The only point which is worthy of notice is a quotation (p. 191) from Darwin's "Forms of Flowers," which has several copyist's mistakes, and, moreover, contains interpolated words which do not occur in the original, the whole being within inverted commas. It is this sort of treatment of Darwin's text that makes it almost impossible to read the Field Naturalist. We can never know whether the quotations are correctly given, and life is not long enough for the verification of his innumerable citations. There is, however, little in the book but quotations and criticism, and when the reader distrusts the quotations and can see no value in the criticisms, the task of getting through the book becomes unbearable.

We would urge the author to give up his barren attempt to discredit work of such perennial value as Darwin's by niggling bookish methods. Let him rather imitate Darwin's life-long habit of absolutely honest experiment, coupled with broad-minded discussions in which all facts and considerations which oppose his views are brought into full prominence. Then, and not until then, can we take his writings seriously.

[1] We have omitted the letter "D" which forms part of the title, and shows that the chapter continues the previous section C.

## CHRONOMETRY.

*Exposition universelle de* 1900. *Congrès international de Chronométrie. Comptes rendus des Travaux, Procès-verbaux, Rapports et Mémoires.* Pp. xl + 254. (Paris: Gauthier-Villars, 1902.)

AMONGST the numerous congresses at Paris in 1900 was one on chronometry, of which the work under review is the official publication. In addition to the "minutes" of the meetings, which include abstracts of the communications, it gives the full text of more than thirty papers and reports. These deal with such subjects as the testing of watches and chronometers, the decimalisation of time, questions of units and standards, topics of historical or current interest in horology, the description of novel instruments or materials, and mathematical and physical investigations bearing on chronometry.

M. de Vanssay, one of the secretaries to the Congress, gives an account, pp. 5–12, of the tests applied to watches and chronometers at the chief testing observatories. On pp. 153–156 is the report of a commission appointed to consider the question of watch tests, with a view to securing uniformity at different places. The commission confined its attention to the regulations in vogue at Geneva, Kew and Besançon, which are similar in general character, and to new regulations proposed for Neuchatel. While generally favourable to the Geneva-Kew-Besançon rules, the majority of the commission preferred the Neuchatel method of dealing with the results obtained at different temperatures. The commission recommends the addition of a two days' test with the watch vertical pendant *down*, excessive difference between the rate in this position and in the other vertical position pendant up to be a cause for rejection. It makes other recommendations tending to increase the severity of the tests. It recommends that the marks obtained by a watch be given only in the official list of the testing institution, and expresses a wish that all observatories should assign marks according to some common scheme.

A second subject considerably discussed was the decimalisation of time, papers on this topic occupying pp. 116–145. M. Guyou would accept the existing hour and subdivide it decimally; but he would do so only in the case of clocks or chronometers, "tropomètres," used for astronomical or nautical work, whilst the general public would be left to the existing clock or "garde-temps." M. de Rey-Pailhade is more advanced, though his argument that the metre is "admirablement proportionée à la taille de l'homme" rather savours of

antiquity. He proposes a unit the "cé" or 1/100th of the day, subdividing it into the "décicé" and "millicé." In the meantime, he would confine the system to men of science, but would teach it in the schools as soon as it meets with international approval. M. Goedseels considers the greatest obstacle to progress to be the existence of numerous tables and costly instruments based on the sexagesimal system. To help to remove this obstacle, he contributes seven pages of tables for converting time and angles to a decimal system. He takes the hour and the degree as units for one system; for a second he supposes the day divided into forty hours, the circumference into 400 grades. Dr. F. Jaja advocates a system similar to that of M. de Rey-Pailhade; but instead of "cé" he calls his unit "degré," its multiples "décagrade," "hectograde," its submultiples "décigrade," &c., down to "décimilligrade." For use by the public, he suggests for the subdivisions the titles "minute première," "minute seconde," "moment" and "instant."

The English equivalent of a "minute seconde" would be found rather awkward, and why should an "instant" be shorter than a "moment"? In England decimalisation of time may appear rather a remote topic, but it seems to have met with considerable favour at the Congress. The fact that a standing committee was appointed on the subject may not mean rapid progress, but M. Guyou mentions that his system has had a nine months' trial on five French cruisers.

Units form the subject of short papers by M. Lippmann, pp. 175–6, and Dr. Guillaume, pp. 179–183, and of a report by a special commission, pp. 184–6. M. Lippmann's paper is theoretical, treating of various alternatives to the present second as unit of time. One is based on the Newtonian constant of gravity, a second is a submultiple of the sidereal year, a third is the time of vibration of a simple pendulum the length of which (at a given place presumably) would subtend a certain angle at the earth's centre, a fourth is based on the oscillation period of a condenser. Dr. Guillaume's paper is practical. He suggests the classification of watch movements according to diameter. Taking 2 cm. as point of departure, he suggests that the interval between successive classes should be 2 mm. above this point and 1 mm. below. For balances he takes the formula $T=\pi\sqrt{I/M}$ for a French (or half) vibration, where I is the moment of inertia, and M is the "moment elastique" (stiffness) of the spiral spring. He suggests that the number of the *balance* be the value of $\pi\sqrt{I}$ and the number of the *spring* be $\sqrt{M}$, both expressed in C.G.S. measure. These suggestions meet with considerable favour in the report of the special commission. The institution of definite types, with the elimination of intermediate sizes, is, of course, an important one for watchmakers.

Amongst the papers bearing on topics of historical or current horological interest may be mentioned those by Rodanet on the proper definition of a chronometer, by Ditisheim on the classification of escapements, by Kaiser on the price and scientific value of chronometers, and by Caspari on the chronometers of the French navy. In the paper by Ditisheim, pp. 40–46, there are a number of interesting data bearing on the comparative merits of different escapements. We have also a paper by A. Cornu, pp. 55–59, on the phenomena observed in magnetised watches, with a full discussion of the effect of changing the position of a magnetised watch relative to the earth's field; while Brillouin, pp. 164–174, treats experimentally of rapid variations in the amplitude of oscillation of balances, with special reference to the question of the shape and finish of the teeth of wheels.

Amongst the papers dealing with instruments may be mentioned those by A. Cornu, pp. 47–54, on the clock at Nice, by Maillard Salin, pp. 63–5, on "montres-a-billes," by Féry, pp. 69–72, and Thury, pp. 146–152, on applications of electricity, by Borrel, pp. 204–7, on a kind of Venetian blind semaphore for signalling time to ships, and by C. W. Schmidt, pp. 113–5, on his chronograph. This last instrument appears to be employed in France for measuring the velocity of projectiles, and is said to give velocities up to 700 metres a second correct to about 1 part in 500 A specially important paper is that by Dr. Guillaume, pp. 90–112, on nickel steels and their applications to horology. The substance of this paper has mainly been published elsewhere, but it is presented here in a convenient form and it attracted considerable attention at the Congress. Dr. Guillaume has yet another interesting communication, pp. 195–7, on an instrument for drawing the terminal curves of spiral springs in accordance with the results of Phillips's well-known application of the mathematical theory of elasticity.

The mathematical papers, though mentioned last, are by no means least in evidence. M. Faddegon, pp. 13–33, treats of the effects of changes of temperature on ordinary and on compensated pendulums. The formulæ he arrives at for the "grid-iron" pendulum are complicated and those for the mercury pendulum still more so. In the latter case we encounter on p. 27 a determinant with ten rows and columns, and the mere look of the formulæ on pp. 32 and 33 will probably suffice to damp the ardour of anyone anxious to combat the author's conclusion, on p. 31, that it would be well for scientific purposes to give up attempts at compensation and revert to homogeneous pendulums.

M. Goedseels, pp. 73–89, treats of mathematical processes, less exhausting than least squares, for determining constants in linear formulæ containing a considerable number of terms. Comparing the methods of Cauchy and of Tobie Mayer, he concludes that in point of simplicity the advantage rests sometimes with the one, sometimes with the other, according to the circumstances of the problem. But in the case of the ordinary 6-term formula for the rate of chronometers he decides in favour of Mayer.

The final mathematical memoir, pp. 217–252, consists apparently of a collection of already published papers by M. E. Caspari, the acting president, which the Congress decided to reprint. The common subject is the isochronism of helical springs. Calculations are made, after the methods of Phillips, Resal and Yvon Villarceau, of the influence of the "centrifugal force" acting on the balance through its own motion, of the inertia of the spring, and of air resistance, friction, &c. There is also an investigation into the possibility of obtaining isochronism by varying

the length of the spring without having its terminal portion shaped after one of Phillips's curves. On p. 240 it is concluded that, provided the windings are numerous enough, there are in each turn two points diametrically opposite, the attachment of which to the balance would procure isochronism. The paper contains also references to some experiments, and certain mathematical functions are tabulated. The memoir is one which only an expert elastician can follow, while an unprejudiced technical expert could alone judge of its practical value. This implies a combination doubtfully existent in England.

The book as a whole is full of ideas, and contains in addition many valuable facts. It is well worth the attention of horologists, whether practical or theoretical. In some of the papers, however, there are indications of a little haste, or of careless proof-reading. M. de Vanssay's description of the Kew watch trials seems to be founded on a set of regulations superseded in 1890. He specifies different rejection limits as applying to ordinary class A watches and to those obtaining the distinction "especially good." This is not now the case, the distinction denoting simply the attainment of at least 80 per cent. of the total possible marks. In some of M. Faddegon's mathematical expressions there are a few rather obvious misprints, and the paging is wrong in the few cross-references in the text of his paper.

In M. Féry's description of a pendulum with electric "restitution" the letters employed in the text are omitted in Figs. 1 and 2 on p. 70, rendering the description difficult to follow. There are a good many slight errata in intermediate steps in M. Caspari's memoir. Thus on p. 234 the sign of equation (7) is wrong, and the term containing $b$ in the line above is also given incorrectly. The suffix in $a_1$ is omitted somewhat arbitrarily on pp. 239 and 244, and on the latter page its factor $\sin\phi$ is omitted several times. The errata, however, are seldom of a kind likely to cause serious trouble.

C. C.

## *TRADES' WASTE AND RIVER POLLUTION.*

*Trades' Waste: its Treatment and Utilisation.* By W. Naylor. (London: Charles Griffin and Co., Ltd., 1902.)

IN this volume the author, who is the chief inspector of rivers of the Ribble Joint Committee and consulting engineer on sanitation and rivers' pollution to the Somerset County Council and other public bodies, has put together the results of his experience and observation, as to the causes of the pollution of rivers and as to the best known practical means of preventing it. The subject, it need hardly be said, is of the greatest importance, but it is also one of ever-increasing difficulty and perplexity. It has been forced upon public attention with more or less insistence at irregular intervals during the last half century. In 1867 the whole question was relegated to a Royal Commission, the reports of which are justly styled by the author as by far the best production on the subject hitherto published in any country. The labours of this Commission paved the way for the Rivers' Pollution Act of 1876, but this, as administered by the various local sanitary authorities, proved to be of little practical good. There can be no question that if it had been efficiently administered much might have been accomplished, and by simple means, and we should not have had to wait for the more costly operations which have resulted from the Local Government Act of 1888. Had the local authorities put the Act in operation with the vigour which they showed in the case of the Alkali Works Regulation Act a great public benefit might have been effected with comparatively little friction or irksomeness. The author points out how the opportunity was allowed to slip.

"Land on which to instal plant might have been obtained which cannot now be procured, and machinery might have been put down, and drains laid at levels which would have permitted the interception of the drainage without the resort to pumping now in many cases necessary. But this was not done. Manufacturers are just as much to blame themselves as anybody. In many cases it was due to their opposition as large ratepayers or to their personal influence on the local governing authorities, that the Act remained a dead-letter."

Whether the larger powers vested in such bodies as the two boards of the Mersey and Irwell Joint Committee and the Ribble Joint Committee, some of which have also been acquired, or sought to be acquired, by county councils, will result in a larger measure of good remains to be seen. But it is evident from the manner in which various trade associations, as, for example, the Paper Makers' Association, have been moved that a more stringent administration of the Act throughout the country is in contemplation, and that the opposition, overt or covert, of many of the manufacturers has still to be reckoned with.

In a chapter on chemical engineering the author deals with the general principles underlying the treatment of trades' waste, either as liquid or semi-solid products. He discusses the "laws" regulating the subsidence of solid particles floating in liquids, the conditions determining their aggregation and the various modes in which precipitants are manufactured. He then gives typical illustrations of the application of these principles as carried out in actual practice, as in the Mather and Platt system and in the continental tank systems. He gives details of the mode of construction of precipitation tanks, together with a design of retaining walls for resisting hydraulic pressures, &c. This chapter is illustrated by diagrams and plans, together with a number of well-executed "process" reproductions of photographs of installations in actual use. It is not, however, very obvious why it should be headed "Chemical Engineering," since it is mainly concerned with the application of physical and mechanical principles to the filtration and clarification of more or less turbid liquids.

The remaining chapters, seven in number, deal with some of the special industries which produce waste in notable amounts, such as woollen mills, tanneries and fellmongeries, breweries and distilleries, bleach and dye works, calico printing works, paper making and chemical works. As a matter of fact, however, the author treats only comparatively few of the waste-producing industries.

The various industries, adopting the classification of the Society of Chemical Industry, may be grouped into twenty-two classes. According to the author, only five of these may be said to have no liquid waste of consequence as regards volume, whereas the remaining

seventeen have both liquid and solid waste, and in the greater number of these the liquid waste preponderates.

But those industries selected by the author for special treatment are undoubtedly among the greatest sinners as regards possible river pollution. Their waste is, as a rule, particularly difficult to deal with, and a study of the means adopted in the several instances presents many features of interest to the sanitary and municipal engineer.

The work has been judiciously put together, and the examples of plant selected for special description are in all cases typical examples of their class. It is admirably printed and illustrated, and the diagrams and drawings are such as will commend themselves to the practical man. The work is specially addressed to borough engineers and surveyors, and we trust that it will be as widely read and studied by them as it deserves to be.

## OUR BOOK SHELF.

*Die Weltherrin und ihr Schatten. Ein Vortrag über Energie und Entropie.* Von Dr. Felix Auerbach, Prof. a. d. Universität Jena. Pp. 56. (Jena: Gustav Fischer, 1902.) Price Mk. 1.20.

DR. AUERBACH no doubt undertook a very difficult task when he endeavoured to popularise the exact significance underlying the expressions "energy" and "entropy," and the relations subsisting between them, and it is not easy to say how far he has succeeded in making himself intelligible to an unscientific audience. Doubtless, of energy everyone believes himself to be more or less well informed, but of entropy, though perhaps not really more difficult of apprehension, yet from its less familiar use very great perplexity and uncertainty seem to exist. We can only hope that the author dissipated some of the clouds which hover around this intricate subject. The somewhat fanciful title of "The Mistress of the World and her Shadow" which is attached to the address leads one to expect a more picturesque and imaginative treatment than the subject receives. One looks naturally for a new set of metaphors and illustrations by which a rather dry subject may be illuminated and its treatment rendered more entertaining, but one does not find much that is new or very appropriate, though of course the matter is sound, and doubtless as a popular address the lecture was very effective.

We are glad to see that it has since been published in *Himmel und Erde*, where it is likely to meet with many and appreciative readers, and thus reach a wider audience than is possible in a lecture theatre. The authoritative version is accompanied by a short list of works connected with the general subject, and also some pages of explanatory notes from the professor addressed to those who are supposed to have some slight previous knowledge of the subject. Notes attached in this way are usually a tacit admission on the part of the author that he has failed to accomplish the task that he has undertaken. We see no reason to view these notes in a different light.

*Chemisch-Analytisches Praktikum.* Von Dr. Karl Anton Henniger. Pp. viii + 127. (Brunswick: F. Vieweg und Sohn, 1902.) Price Mk. 1.50.

THE chief interest of this book lies in the fact that the author is head-master of the Charlottenburg Real Gymnasium, and that the course which he describes is the one adopted in that institution. We have thus an opportunity of seeing what kind of practical chemistry is cultivated in one of the first-class German schools. According to the author, the goal to be reached by the great majority of his pupils is a knowledge of the chief reactions of the non-metals and metals, as well as sureness and clearness concerning the procedure of analysis and the use of the distinguishing reagents. This is to be effected by exercising in simple analysis.

If this be the case, it may be said that the book is well calculated to fulfil its purpose, for it is substantially a treatise on qualitative analysis prefaced by some useful exercises on different types of chemical action. Descriptions and equations are given for all the tests that are to be performed, and the pupil is, in fact, put through a regular analytical drill. The amount of detail is surprising considering that we are concerned with school-work, and it is difficult to see what would be left for the university to teach in the way of qualitative analysis if the students came with a mastery of this book.

It is remarkable that the course of chemistry here prescribed for school purposes is of the kind that, with pretty general approval, has been steadily disappearing from English schools during the past fifteen years. In this corner of education Germany can hardly be said to show the way. A. S.

*La Protezione degli Animali.* By N. Licò. Pp. viii + 64. (Milan: U. Hoepli, 1902.)

THE appearance of this "booklet" may be taken as an indication that the proper treatment by man of the inferior animals and the avoidance of unnecessary and wilful cruelty are attracting attention in countries other than our own. Indeed, Turin, like Paris, possesses its own Society for the Protection of Animals, and the crusade against bearing-reins and other forms of minor torture is carried on as vigorously (and, shall we say, as vainly) as in London.

The author commences with a chapter on the duty of humanity to animals in general, and then proceeds to discuss the various groups of animals brought more especially into contact with man, and the cases where amendment in their treatment is most urgently required. In general, the arguments appear to be put temperately and moderately, even in regard to that thorny subject vivisection. Such sports as dog-racing (under the conditions in which it is conducted in some continental countries), cock-fighting and bull-fights the author unhesitatingly condemns. He is likewise averse to all mutilations of animals, whether to "improve" their appearance or for other reasons. But minor matters, such as the treatment of horses by cavalry soldiers and coachmen, and the nature and fitting of their accoutrements and harness, claim a share of attention. Whether the author will succeed in convincing the world that a vegetarian is preferable to an animal diet may be more than doubtful, but if the book leads to a diminution in any degree of certain forms of cruelty to animals from which this country at any rate is free, its publication will not have been in vain. R. L.

*Coal Cutting by Machinery in the United Kingdom.* By Sydney F. Walker. Pp. 144. (London: The *Colliery Guardian* Co., Ltd., 1902.)

THE complaint has frequently been made against mine owners in this country that they are not availing themselves of coal-cutting machinery to anything like the same extent as mine owners in the United States. The complaint is justifiable, inasmuch as any methods by which labour and capital can economise are now absolutely necessary. In his excellent monograph on coal cutting by machinery, Mr. Walker shows that the question is by no means new to this country. The history of the coal cutter in Great Britain is an ancient one. Indeed, the earliest proposal to substitute the labour of a machine for that of a collier appears to have been made by Michael Menzies, of Newcastle-on-Tyne,

towards the end of the eighteenth century. The historical portion of the work shows the evolution of mechanical coal cutting in Great Britain since that date. Descriptions are given of every machine that has been put to practical use, as well as detailed particulars of those that are now in successful operation. The conclusions drawn by the author from his elaborate investigations are that the whole of the coal of Great Britain must be cut by machines, or the industry will find itself in much the same condition as the corn-growing industry, swamped by American production. The pillar and stall method of mining should be replaced by the long wall method, and coal-cutting machines would render blasting unnecessary. The most serious problem to be dealt with is that of cutting coal under a weak roof. The difficulties are perhaps hardly sufficiently emphasised by the author. In a tender coal the roof is crushed down on the machines, or supports have to be set near the faces. These get in the way of a machine. Moreover, machines are so noisy when at work that it is impossible to hear the preliminary warning sounds that the roof generally gives before it breaks down. Eventually, no doubt, it will be ascertained which machine can best be adapted to these conditions, or how the conditions can be modified to suit the machine that promises best.

The author's lucidly written and well illustrated volume cannot fail to prove of great value in directing the attention of mine owners to problems that, at the present time, are of the utmost importance.

*Metallography: an Introduction to the Study of the Structure of Metals, chiefly by the Aid of the Microscope.* By Arthur H. Hiorns. Pp. xiv + 158; with ninety-six illustrations. (London: Macmillan and Co., Ltd.; New York: The Macmillan Company, 1902.) Price 6*s*.

THE study of the properties and constitution of metals and alloys has made great progress during the last few years, and has reached a point when it can no longer be neglected by engineers. Steel workers have already received some guidance from the labours of metallographists, chiefly, perhaps, from investigations on what Osmond called the "pathology of metals," and the time may not be far distant when the microscope and the pyrometer will form part of the outfit required in the ordinary testing of materials. Metallography has been regularly taught for some time at many of the technical schools both in this country and in America, and it is remarkable that no text-book on the subject existed in the English language before the publication of the work under review. The researches on which Mr. Hiorns has based his book are scattered and highly specialised, and the acquirement of a general elementary knowledge of the subject has been a difficult matter for the student. The appearance of this book is, therefore, particularly well timed, and it will be eagerly read by many, who will not be disappointed by what they find.

The author has carefully collected most of the important results which have recently been obtained, and has given a terse and lucid summary of them which is surprisingly complete, considering the modest dimensions of the book. He has not devoted much effort to the philosophic aspect of the subject, but that is, perhaps, just as well, inasmuch as the science is in its infancy. With regard to the illustrations, exception may be taken to many of the photomicrographs, which appear to have been taken from a set of poor negatives. On the other hand, they have been beautifully reproduced on special paper. In the study of steel, the author has handicapped himself unnecessarily by using such low powers of magnification that some of the structures of which he speaks cannot be seen at all. Nevertheless, taking the book as a whole, Mr. Hiorns deserves the thanks of his fellow workers and teachers for the useful aid he has given them.

## 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.*]

### Notes on Young Gulls.

IN northern Bohemia there is a large pond or artificial lake—the Hirschberger Grossteich—with a small, rocky island. This is a favourite breeding-place of gulls. Most of these are *Larus ridibundus*, but some *Sterna hirundo* also breed on the rock. For the purpose of studying its plankton I have repeatedly visited this pond, and have thus had occasion also to make some observations on the gulls which may perhaps be of interest to readers of NATURE.

The rock island which forms the breeding-place is some 400 square metres in extent, and rises in ledges to a height of 15 metres. It is composed of the Cretaceous "Quadersandstein" of those parts, partly bare and partly covered with patches of tough, greenish-brown grass and brighter green thistles. The *Larus ridibundus* nests on this rock are pretty carefully built and entirely composed of dry leaves of bulrushes. There are generally three eggs in each nest. At the height of the breeding season there are about 200 such nests on the rock, besides the much less numerous Sterna nests. The nests usually lie on the bare rock close to the margin of a patch of vegetation. The dirty brownish-yellow and black-spotted, mimetic colouring of the down-covering of the young is very effective. When from two to ten days old these young crouch, on being disturbed, against the half-dry grass-tufts and thistles close to their nest, and are then by no means easy to detect. It seems to me that the colouring of these young gulls is not quite the same as that in young of the same species breeding in different environments. It is quite likely that we have here a case of adaptation of the colour of the young to different surroundings, *unaccompanied* by any difference in the colouring of the adult into which they develop. Older ones, which are already beginning to replace the down with feathers, but in which the head is still entirely covered by the primitive yellowish-brown and black down, do not, as a rule, try to hide themselves in this way, but hurl themselves into the water and swim away rapidly when the boat approaches the rock. The old birds scream loudly and try, first, to entice the intruder away in the usual manner by slowly swimming and flying about near the boat and pretending to be wounded and lame. Besides this, however, they also swoop down on the swimming young, sometimes pushing them right under the water. The first of these actions clearly tends to draw the attention of the intruder away from the young; the second has the very opposite effect. Perhaps it may be accounted for in this way. The young have—this can be observed clearly enough—no idea of the nature of the movements of a boat, and often try to escape it by swimming straight ahead in front of the bow. It gives the impression that the old birds try by their screams to convey instructions to the young about the direction in which they should swim so as better to escape the boat. The young, however, often appear not to understand or to heed these "words of advice," whereupon the old birds pounce down on them and give them one or two good slaps with their wings so as to make them understand and obey. These sharp lessons do not seem to be of much good, however. After being thus slapped, the young continue to swim straight ahead of the boat as stupidly as before.

One of the eggs I brought home and hatched artificially. The bird began to chirp in the egg a few days after I had placed it in the oven, upon which I cut away the blunt end of the eggshell and found, as was natural after hearing the bird give voice, the beak protruding into the air-chamber. On the fourth day after this the young gull left the egg-shell. It then weighed 22·7 gr. We weighed it daily for a fortnight. The average daily gain of weight during this time was 8·5 gr.

The daily increments were quite irregular, varying between 1·6 and 3·2 gr. the first four days, and between 5 and 27·5 gr. the latter ten days. These irregularities were, of course, due to differences in the quantity of the contents of the intestine. One day—not three, as has been stated by Prof. Thomson (NATURE, vol. lxiv. p. 588)—after birth the young bird swam about when placed in water just as well as a young duck. For

the first six or seven days it preferred to stand on its *heels*, and usually rose to its toes, that is, the normal position of the adult, only when walking.

The bird often ate indigestible things, little stones, &c., not, as it appeared to me, altogether accidentally, but chiefly and purposely, after it had made a good meal off some living food—Tenebrio larvæ, Limnæus, or the like. Smaller edible things like ants' chrysalids it picked off the ground itself very early, but larger morsels, bits of fish, mice, &c., it only takes when held in the hand and presented to it even now, when it is eight weeks old. The stones, &c., it occasionally eats, and the hair and larger bones it has swallowed it brings up and vomits in a mass. It lost the thorn of the beak on the fourth day and began to fly a little after four weeks; when seven weeks old it began to make longer excursions, and flew—without precept or example—very well. It has, however, not yet attained to anything like the elegant flight of full-grown gulls, and occasionally makes an involuntary somersault in the air when trying to soar or rest on the wind without flapping its wings. R. v. LENDENFELD.

Prague.

### The Effect of Light on Cyanin.

WHILE working on the reflective power of cyanin mirrors I have noticed some very interesting effects of light on that substance. Freshly fused cyanin is of a deep metallic bronze colour, but exposure to light turns it plum colour and finally a steely blue-black. In the moderate light of a cloudy day the change is perceptible in half an hour, in direct sunlight in less than a minute. The complete change to blue-black requires an exposure of about twenty hours to diffuse daylight or half an hour to direct sunlight. It has long been known that cyanin is unsuitable for use as a cloth dye on account of its rapid fading in sunlight, but recent investigators of the optical properties of this substance appear to have overlooked this light effect. That the effect is purely photographic and not due to any rise in temperature is shown by the fact that long-continued heating in the dark produces no trace of discoloration. On the contrary, the effect of heating is to reverse the effect produced by the light, for a thin coating of cyanin, exposed until blue-black throughout, returns nearly to its original bronze colour on fusion or long-continued heating in the dark. By an exposure of thirty hours I have obtained on cyanin easily recognisable photographs of small, well-illuminated objects. A cyanin mirror, or better yet a piece of ground glass washed over with fused cyanin, exposed for ten hours to the spectrum of a Nernst lamp shows the effect to be very strong in the yellow, just perceptible in the adjacent red and green, and imperceptible in the blue and ultra-violet. It appears to correspond with the absorptive index as determined by Pflüger in various parts of the spectrum. At the same time, the exposure to light greatly decreases the absorbing power where it was originally large, as may be easily seen on looking at a sodium flame or a spectrum through an exposed coating of cyanin. It is as though the absorption were due to molecular resonance and the light produced a fatigue or destruction of this resonating power.

A most noteworthy change in the refractive index accompanies this change in the absorptive index, and is shown by the alteration in the reflecting power. The reflecting power of fresh cyanin is roughly 20 per cent. in the yellow, 2 per cent. in the blue-green and 6·5 per cent. in the ultra-violet. After exposure to light the reflecting power is nearly constant, 6·5 per cent., from the red out to 250$\mu\mu$ in the ultra-violet. Now in the blue-green the absorptive index is so small as not to affect the reflecting power sensibly, so that the refractive index varies from about 1·1 to 1·6. Evidently work on the optical constants of cyanin is of little value unless carried on without exposure of the cyanin to daylight. A decrease in the absorptive index from 0·75 to nearly zero is indicated by the decrease in the reflecting power in the middle of the yellow, where exposure to light does not greatly affect the refractive index. The general effect of exposure to light is, then, to remove the absorption band and to destroy the characteristic anomalous dispersion.

The cyanin used was furnished by Kahlbaum, in Berlin, and is the ordinary diamyl iodide, $C_{29}H_{35}N_2I$, easily soluble in alcohol and ether, but only very slightly soluble in water.

Göttingen, August. P. G. NUTTING.

### Fog Bow at Oxford.

A SOMEWHAT curious phenomenon, presumably an effect caused by the searchlights at Spithead, was visible here in Oxford on the night of Saturday last.

About 11.15 p.m., the night being fine and warm and the sky somewhat overcast, my attention was arrested by the appearance of an arc of whitish light, about 15° above the south horizon, within which the sky appeared of an intense black. The arc rapidly increased in elevation until, in six or seven minutes' time, it had reached the zenith, forming an arch extending, apparently, to the horizon on the east and west; it then declined northwards, and in another four or five minutes had vanished.

In appearance it suggested a brilliant lunar fog bow, but the light was of a more bluish tint, the interior circumference being far brighter than the outer; the brilliancy did not diminish to any great extent until the bow attained its highest altitude, after which it rapidly become fainter. The distance from Spithead is rather more than seventy miles. J. ROSE.

Rawlinson Road, Oxford, August 20.

### Simple Means of Producing Diffraction Effects.

IN the interesting article on "Photography of Diffraction and Polarisation" published in the issue of NATURE for August 7, the writer describes various means of producing diffraction effects. It may possibly interest some readers of NATURE to know that beautiful fringes may be seen with even simpler apparatus than that described in the article referred to. All that is required is an ordinary folding foot-rule, preferably of ivory. To see diffraction bands by its means, it is only necessary to close the two halves of the rule until they are almost in contact and then to fold them over. On looking at the sun or other bright source of light through both slits, a series of brilliant diffraction bands will be seen. WILFRED HALL.

Tynemouth, August 20.

### Time-Signals by Wireless Telegraphy.

MAY I suggest that the wireless telegraph offers a means of enabling Greenwich or other astronomical time being sent to ships at sea for the correction of their chronometers and the finding of their longitude? Distinct signals have already been transmitted from England to America, and these are all that is necessary for communicating time. At certain hours of the day or night, for example 1 p.m., a series of wireless signals, perhaps ten or twenty, at intervals of one second, might be sent from Greenwich far and wide as an extension of the time-ball signal which now serves for ships in the Thames and the Downs. By international regulation these time-signals could be protected from other wireless signals. I need scarcely add that such time-signals would also be useful inland. JOHN MUNRO.

Croydon, August 25.

## *THE BELFAST MEETING OF THE BRITISH ASSOCIATION.*

SINCE the publication of our last article on the approaching meeting, the following additional arrangements have been made:—

The local executive committee (chairman, Sir Otto Jaffe) invites members, associates and holders of ladies' tickets to a garden party in Botanic Gardens Park, near Queen's College, on September 15, at 3 to 5.30 p.m.

In connection with this reception, the new fernery recently arranged by Mr. Charles McKim, curator of the Botanic Gardens, will be opened for the first time, and will be found well worth seeing by those interested in ferns and tropical plants.

On September 16, Lord O'Neill gives a garden party at Shane's Castle, picturesquely situated on the shore of Lough Neagh.

The Belfast Harbour Commissioners invite members, associates and holders of ladies' tickets to a reception in the Harbour Office on September 16, at 8 p.m.

Mr. and Mrs. John Brown will give a garden party at Longhurst on September 11 (by invitation). Their guests will be invited by Mr. G. Herbert Brown, J.P., to inspect St. Ellen damask and linen weaving works close by.

Mr. W. S. Bruce, of the Scottish Antarctic Expedition, has arranged that the exploring ship *Scotia*, recently fitted out, shall, before her departure, visit the harbour during the meeting for inspection by those attending it. The ship is elaborately supplied with instruments and apparatus for zoological, oceanographical and other branches of research, which will be in charge of her scientific staff. The inspection of the ship and her outfit will no doubt form a most interesting incident of the meeting.

Under the able management of Prof. Symington, good progress has been made with the loan exhibition, the following contributions to which will be found of special interest :—

From Mr. W. J. Knowles, a collection of specimens illustrating the various stages in the manufacture of stone implements collected from the remains of an ancient flint implement factory at Cushendal.

From Mr. R. Welch, a collection of Irish jaunting cars illustrating the development of that vehicle from a primitive form ; also series of photographs illustrative of Irish ethnology, local geology and of the more special trade processes of the north of Ireland.

Irish ethnographical collections will also be exhibited by Dr. Scharff, Mr. S. F. Milligan, Mr. W. H. Patterson and Miss E. Davis.

The skeleton of the Irish giant is being kindly sent for exhibition from Trinity College, Dublin.

In connection with Section K (Botany), an interesting collection of Australian plants will be exhibited by Mr. Thomas Steel, as the representative of the Linnean Society of New South Wales.

Mr. R. Lloyd Praeger will exhibit a number of rare Irish plants.

The collection of apparatus employed by the late Prof. Andrews in his researches on the continuity of the liquid and gaseous states and on heats of combination, &c., is being carefully arranged by his daughter, Miss Mary Andrews.

Much private hospitality has been offered, but the large number of distinguished members who have signified their intention to attend has thrown considerable strain on the committee having charge of this department.

A forecast of the papers to be brought before most of the sections has already been given (August 7, p. 344 ; August 14, p. 377 ; and August 21, p. 397). We have now received the following list of papers arranged for the Section of Chemistry :—The president of the Section, Prof. E. Divers, F.R.S., is expected to take the atomic theory as the subject of his address at Belfast. A paper will be read by Dr. G. T. Morgan "On our Present Knowledge of Aromatic Diazo-compounds," and Dr. A. W. Crossley will give a paper "On Reduced Benzene Derivatives containing a Single Nucleus." The following papers, amongst others, will also be read :—"Present Synthetical Research on the Glucosides" and "The Synthetical Action of Enzymes," by Dr. E. F. Armstrong ; "The Alkylation of the Sugars," by Prof. T. Purdie, F.R.S., and Dr. Irvine ; "The Colour of Iodine containing Compounds," by Miss Ida Smedley ; "On Zirconium Hydrate and other Colloids from Elements of the Fourth Group," by Dr. J. H. Gladstone, F.R.S., and Mr. W. Hibbert ; "On some Optical Properties of Tellurium," by Dr. J. H. Gladstone, F.R.S. ; "On the Telluric Distribution of the Elements in Relation to their Atomic Weights," by Mr. W. Ackroyd ; "On the Undesirability of Establishing Standard Analytical Methods," by Mr. B. Blount ; "On the Corrosion of Copper by Sea Water and on the Detection of Traces of Impurity in the Commercial Metal," by Dr. E. A. Letts ; "On Experiments to Ascertain the Amount of Carbonic Anhydride from Sea Water by Air," by Dr. E. A. Letts and Mr. W. Caldwell ; "On the Absorption of Ammonia from Water by Algæ," by Dr. E. A. Letts and Mr. J. S. Jotton ; "On the Action of Distilled Water on Lead," by Dr. F. Clowes ; "On the Decomposition of Urea," by Dr. C. E. Fawsitt.

The following description by Mr. R. Welch of the new path along the face of the Goban's Cliffs will be of interest to visitors.

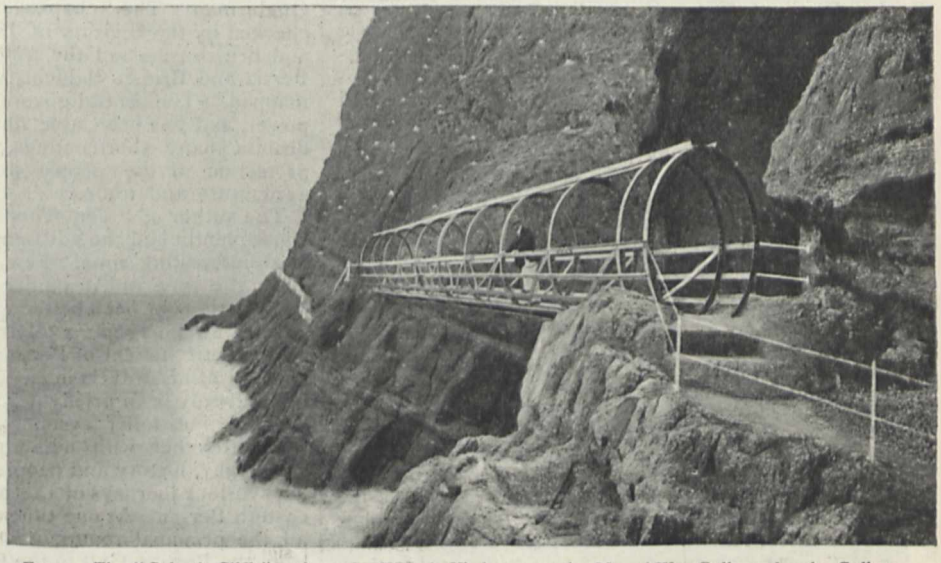

FIG. 1.—The "Goban's Cliffs" path at the Goban's Viaduct over the Man-o'-War Gully under the Gullery.

*A Path around the Goban's Cliffs.*

A fine cliff path along the base of the basaltic marine precipices near Belfast is now rapidly approaching completion ; Mr. Wise, the engineer of the railway company—the B. and N. C. R., which is making the path under great difficulties—is putting forth every effort to have it ready before the British Association meets in Belfast. These mural cliffs of Lower Basalt lavas, in part semi-columnar, in part highly vesicular, with their many caves, will now for the first time be accessible to the geologist and the naturalist generally. At low tide many rock pools and natural aquariums will be available ; some of these are coated with the pretty pink Lithothamnion, and have, like the pools of the Antrim Coast generally, a very varied fauna and flora. The path is carried over the many ravines at the mouths of caves by steel girder bridges ; the troublesome wide gully at the "Man o' War" sea stack has been "negotiated" by a lattice girder, oval in section, 75 feet long, through which the path runs to the stack, thence by a flat girder bridge to the main cliff again.

Owing to the very heavy seas which sometimes break against the cliffs and run far up, the bridges have been set as high as possible ; the "Goban's Lattice Bridge" is almost 30 feet above the sea. The path is tunnelled through one projecting spur of the cliff and runs through a long cave at another, while at the

"Seven Sisters" caves it will be carried by a suspension bridge of novel design, 200 feet long. At another place is a swing bridge, suggested by the famous rope bridge of Carrick-a-Rede; here it is no "rock in the road" of the salmon, but a deep gully into a wide cave, "in the road" of the climber. From the path, seals have been seen almost every day in early August; on one day porpoises were rolling about close inshore, and otters are known to have haunted the place from time immemorial. Some of the fish bones found in digging out a cave which was hidden by a great slip of basalt about forty years ago may be due to otters. Others of birds and mammals certainly are not, but have the appearance of the broken bones so plentiful in the prehistoric middens of Antrim and Down. These were found under from 400 to 500 tons of boulders, partly consolidated with earthy matrix, taken out of the cave, and are now in the hands of the Cave Fauna Committee investigating the Irish cave-deposits. The northern end of the path may not be completed this season, heavy gales having much delayed the work, and the tunnel which it will be necessary to excavate in hard rock at a place where the cliff overhangs very much will take some months to complete.

The first part of the path, that along the picturesque undercliff south of the cliffs section, was completed last year; there the Upper Chalk may be seen in large masses, broken up and slipping over the soft underlying Lias Clay, some sections of which are exposed, with, in a few places, good sections of Chloritic Chalk, Yellow Sands and Marls, and Glauconitic Sands. Details of these sections with lists of their fossil fauna will be found in Dr. Hume's classical paper on the Cretaceous strata of co. Antrim (*Q. J.* Geol. Soc., November, 1897, pp. 557-560, pl. xliv. and xlv.). The Basalts, I am afraid, have not received the attention here which they deserve, but now that these inaccessible cliffs, tier upon tier of thin lava flows weathering in the most varied manner, can by this new path be easily reached from the land, it is to be hoped they will be visited by many geologists in the near future. The *Memoir* of the Geological Survey, Ireland, No. 29, gives a brief description of them, with section at south termination. One may dine in London or Manchester, and by the short sea route *viâ* Stranraer breakfast in Larne or Whitehead, and be right under these cliffs long before noon. Mr. Wise has kept well in mind the motto of the Belfast Field Club, of which he is a member, "Preservation, not Extinction," and the herring gulls which nest along the cliffs here in large numbers were disturbed as little as possible; some even nested on the partly made path. He has been careful to preserve the natural weathered surface of the rock all along the path; it has only been broken where absolutely necessary for safety, and geologists are kindly requested to follow this example. They will find abundance of good material quarried out at many places quite close to the path, including good samples of the vesicular portions of the flows, with the original vesicles now filled with various zeolites.

R. WELCH.

## *A GREAT PERSIAN TRAVELLER.*[1]

THE fascination which countries "old in story" exercise on many minds is more easily recognised than explained. But the existence of this fascination being once admitted, it is not difficult to understand why a peculiar glamour should attach to Persia, a land of which the history extends almost as far back as any authentic record of the human race, other than that derived from fossil bones or implements, can be said to exist. Nor is this the only attraction which Persia possesses, for although it is inhabited by the most civilised people of Asia, the greater portion of the Persian plateau was, until the last thirty years of the nineteenth century, almost unexplored by Europeans, and even at the commencement of the twentieth century no railway has crossed the Persian frontier, and the only road constructed for wheeled carriages, that from Resht to Teheran, is of no great length and is said to be in bad condition. In many respects the Persia of the present day resembles western Europe three hundred years ago, or perhaps in some respects even earlier. The general mode of travel is on horseback, the traveller's baggage and all merchandise are carried on pack animals, the roads are insecure and robbers abound. Even in the latter half of the nineteenth century, in eastern Persia and Baluchistan, raids by armed bands were of common occurrence, whilst less than thirty years ago Turcoman hordes from the north swept over northern Persia as far as the gates of Yezd and Isfahan, and murdered, plundered or dragged away as slaves the unfortunate inhabitants whom they encountered. Almost to this day the history of the tribal chieftains and of the provincial governors in eastern Persia and Baluchistan resembles that of European princes in the middle ages, when it was a rare exception for any man of note to live or die peaceably.

But a great change is gradually being effected in Persia, as in so many other countries. The Turcoman forays were summarily ended by Skobeleff's sweeping destruction of the raiding clans at Geok-tepe, a consummation aptly compared by Major Sykes to the more recent annihilation of the Soudanese slave-drivers at Omdurman. The "chapaos" of the Baluchis have been checked by the division of Baluchistan between Persian and British rule, and the frontiers between Afghanistan, Persia and British Baluchistan have been defined and mapped. The central government in Persia has gained power, and has been able during the last half century, despite many shortcomings, to do something for the protection of the people and the encouragement of agriculture and trade.

The author of "Ten Thousand Miles in Persia" has consequently had the advantage of studying the country at an interesting time. Few of the travellers in Persia since the time of Alexander the Great have had better opportunities or been better qualified than Major Sykes, who is an energetic explorer, a good linguist and a sympathetic student of Persian life and history. Several portions of his travels in eastern Persia and Baluchistan have already been briefly described in the *Geographical Journal*, but fuller accounts are given in the present work, together with numerous notes on the physical geography, history and people of the countries traversed. The various journeys of the author are not confined to eastern Persia. At one time or another he has traversed all the principal routes, including the well-known road from the Persian Gulf to the Caspian by Shiraz, Isfahan and Teheran; but, as he points out in his preface, he has touched but lightly on the provinces and cities of Persia that were fully dealt with in Lord Curzon's work, and has chiefly treated of those parts of the country, in eastern Persia and Baluchistan, that were previously less well known. A very large part of the book treats of journeys and researches of various kinds in the province of Kerman and in Persian Baluchistan, but in the execution of consular duties interesting visits were made to Sistan and Kain in one direction, and to the Persian Gulf, Basra (Bussorah) and Shuster in the other.

The additions made by Major Sykes to our knowledge of the geography of eastern Persia and Baluchistan are numerous, and they have in many cases greatly changed the map. For instance, by ascertaining that the stream flowing past Bampur does not reach the sea by the Rapsh, but is, like so many other Persian rivulets, evaporated in a "kavir," or salt marsh, he has added at least 20,000 square miles to the Persian inland drainage area, from which no water flows to the ocean. He has also aided materially in completing the investigation of the great desert region of Khorassan, called Dasht-i-Kavir or Dasht-i-Lut in maps. He shows that the name

[1] "Ten Thousand Miles in Persia, or Eight Years in Irán." By Major Percy Molesworth Sykes (Queen's Bays), H.M. Consul, Kermán and Persian Baluchistan. Pp. xv + 481; with numerous illustrations and map. (London: John Murray.)

of Lut by itself is that generally used in the region, and that this name is identical with the scriptural Lot. It may be remarked that in some cases the views put forward by Major Sykes as to the origin of geographical terms differ from those of his predecessors. This is especially noteworthy in the case of Makrán, the well-known name for the Baluch seaboard. Instead of adopting Sir T. Holdich's explanation that the term is derived from *Mahi-Khuran*, or fish-eaters, the Ichthyophagi, as the inhabitants were called in the days of Alexander the Great, Major Sykes looks upon it as connected with the people once known as Maka, the Mykians or Mycæans of Herodotus.

One of the most interesting tracts examined by Major Sykes is the Sarhad, or cold country, of Persian Baluchistan. A large portion of the population of Persia consists of wandering tribes, who pass the winter in a Garmsir or warm tract, and drive their flocks and herds in summer to a Sarhad or more elevated region. The Baluch Sarhad had only been visited by one traveller before Major Sykes entered it, and it is remarkable for including within its limits two extinct and dormant volcanoes, the Kuh-i-Basmán, 11,000 feet high, and the Kuh-i-Taftán, more than 12,000 feet, both of which were ascended. There is a great area covered by volcanic formations in south-eastern Persia, the lofty peaks of Kuh-i-Hezar and Kuh-i-Shah, south of Kerman, consisting, in part at all events, of basalt and similar rocks, although these mountains are certainly not volcanoes of recent origin, like those of the Baluchistan Sarhad, some 200 miles further west. Major Sykes, however, is not a geologist, and adds but little to our information on this point, although he ascended and measured both the great peaks south of Kerman, which rise to between 13,000 and 14,000 feet.

Amongst the principal historical questions on which fresh light is thrown by the present work are the travels of Marco Polo and the remarkable march of Alexander the Great, with an army, through Baluchistan, from the Indus to Persepolis. This march, one of the most extraordinary military enterprises ever undertaken, must always remain a puzzle to all who have any acquaintance with the country traversed, for a more hopeless desert than the greater part of Makrán at the present day does not exist. In reference to this march, and to the remains of ancient cities and the evidence of abandoned cultivation in so many parts of Persia, Major Sykes supports the view already adopted by many other travellers in Persia and in Central Asia generally, that the whole area is undergoing gradual desiccation, and that the rainfall must have diminished considerably in the course of the last two or three thousand years. This view has recently been strongly enforced by Mr. Vredenberg's interesting observations in Baluchistan, of which an account has appeared in the *Memoirs* of the Geological Survey of India (vol. xxxi. pt. 2). The diminution of the rainfall may be connected with the disappearance of certain great Central Asiatic lakes, of which important remnants exist in the Caspian and Aral Seas. In one passage Major Sykes is inclined to attribute the diminished rainfall to the destruction of forests, and even appears to believe (p. 365) that India, if all the forests were swept away, would become as barren as Persia. This is rather an exaggerated view. The destruction of every tree in

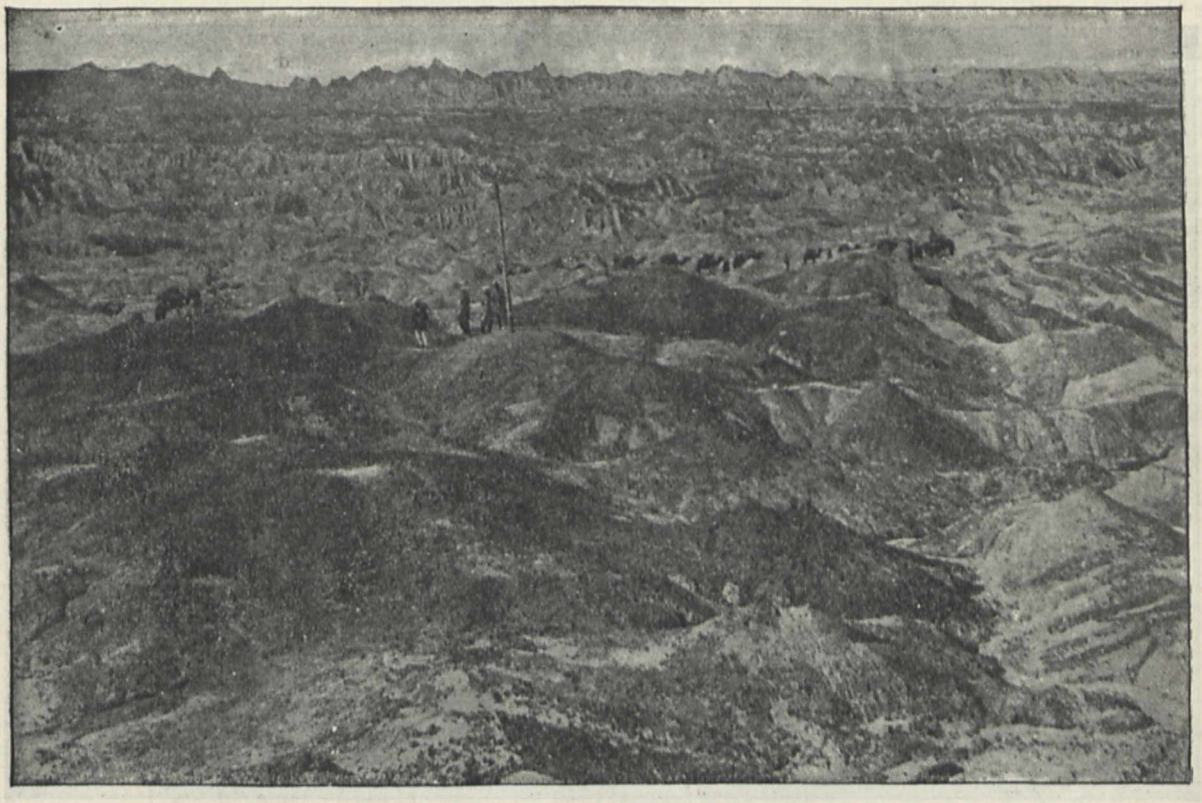

FIG. 1.—Makrán Scenery.

India would not prevent the rain of the south-west monsoon from falling, although it might somewhat diminish the amount, and it would in other ways seriously affect the fertility of the country. It may fairly be doubted whether, at all events within the last three thousand years, anything deserving the name of forest existed in eastern Persia.

The numerous illustrations in the present work, chiefly reproduced from photographs, convey an excellent idea of the barren Persian and Baluchistan hill scenery and of Persian towns and people. On the whole the scenery of Baluchistan, and especially of Makrán, of which two examples are here given, is perhaps better depicted than are the plains of Persia. The enormous distances to which these plains extend probably preclude their effective representation by photographic means, but it is remarkable that none of the views, numerous and varied as they are, gives any idea of one of the most striking characteristics of Persian scenery, the gravel slopes, often many miles wide, that surround nearly all the great plains and often occupy the broad valleys that extend from the plains far into the hills. As the waterless plains themselves are often, in parts, occupied by "kavir" or salt marsh and in other parts by drifting sands, whilst the broken hill-ranges that cross the country are only passable in places, it is on the gravel slopes that the principal trade routes run, and it is in them that are tunnelled the "kanauts" or "karezes," the artificial subterranean channels from which the water-supply for towns and for irrigation is largely derived. Throughout the Persian plateau these slopes are a most striking feature; they are seen from Teheran, north of which city one, on a large scale, extends to the Elburz Mountains, to Quetta, where, east of the town, there is a well-marked glacis-like slope on a smaller scale.

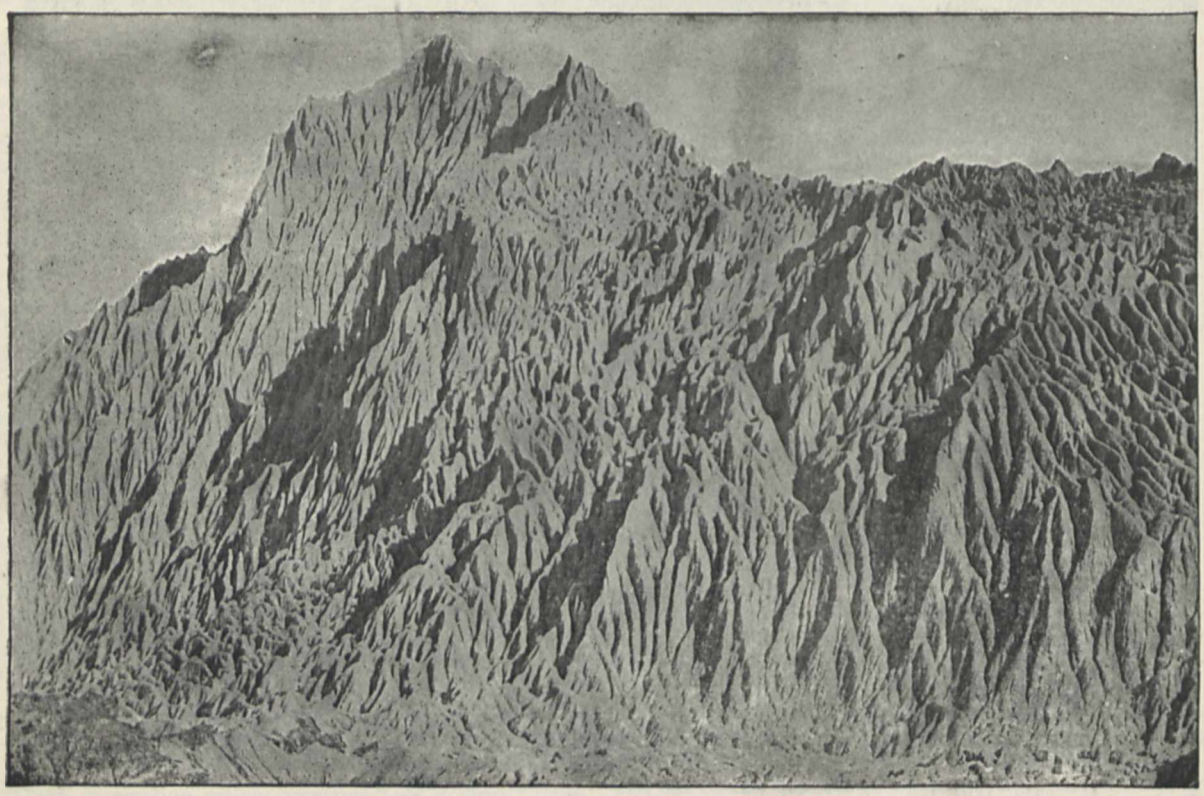

FIG. 2.—Clay Formation, Makrán.

Major Sykes is no zoologist, and it is therefore not surprising that some of the names of animals to which he refers require alteration. It is not quite correct to call the Persian wild goat an ibex, a term belonging to goats with very different horns; but a greater mistake is made in the foot-note at p. 47, where it is stated that "the Jabal Báriz range separates the habitat of the *Gazella Benetii* (it should be *Bennetti*) from that of the *Gazella fuscifrons* of the plateau of Irán." The gazelle of the "plateau of Irán" is *G. subgutturosa; G. fuscifrons* is a variety of *G. Bennetti*. Again, on p. 289 an amusing account is given of the capture of a *hake* at the island of Hormuz, in the Persian Gulf. The hake is a fish peculiar to the North Atlantic.

But if Major Sykes's pages add but little to our knowledge of geology, botany or zoology, they abound in fresh information concerning the curious mixture of Asiatic races which inhabits the wilds of Baluchistan, on the physical geography of the eastern Persian area and on the history of the towns and provinces. The author's views as to the political relations existing between Persia and our Indian Empire are of importance as expressing the opinions of an officer who has had exceptional opportunities of forming an accurate judgment. In one respect Major Sykes has proved himself a model diplomatist, for he appears to have succeeded in establishing friendly relations with almost all the officers of the Persian Government with whom he came in contact.

W. T. B.

## NOTES.

EARLY in this year a petition praying for the incorporation of a British Academy for the Promotion of Historical, Philosophical and Philological Studies was presented to the King, and referred to a committee of the Privy Council. Acting upon the advice of this committee, His Majesty has granted the Academy a Royal Charter. The Charter has not yet been published, but according to the *Times* it states that the Academy aims at "the promotion of the study of moral and political sciences, including history, philosophy, law, politics and economics, archæology and philology." The forty-nine first fellows of the British Academy include leading representatives of many branches of scholarship, but not of poetry or fiction or other departments of pure literature. The Academy will be an independent body, with a separate organisation of its own; and it will not have any closer relationship to the Royal Society than has the Royal Academy of Arts. Our institutions for the advancement of learning and the development of intellectual activity will not, therefore, be coordinated in the way they are in France and several other countries.

THE following reports of eruptions and earthquake shocks have been published during the past few days:—*August* 21.—Severe eruption of Mont Pelée reported by the steamer *Dahomé* to have occurred at noon. No confirmation of the news has reached the French Colonial Office. *August* 22.—Mont Altomonte in Calabria reported from Rome to be in eruption. Subterranean rumblings have been heard, and showers of rock fragments and vapour have been ejected from the crater. An unusually large earthquake was recorded at Shide, in the Isle of Wight. The movement commenced at 3h. 10·9m. a.m. Twenty-five minutes later the amplitude of the large waves exceeded 22 mm. (12″·0). The time interval suggests an origin about 62° distant from the Isle of Wight. Origins for world-shaking earthquakes at this particular distance are Alaska, the West Indies and northern India. Sixty-seven minutes after the maximum movement, but long before its irregular group of followers had ceased to exist, a second group of large waves appeared, the amplitudes of which were 18 mm. (9″·0). The seismographic instruments at observatories in Hungary and Alsace registered several earthquake shocks in the direction from east to west in the afternoon. Two violent shocks were felt at Andishan, and one at Pavlovgk, near St. Petersburg. *August* 25.—Messages from Dominica report that between 10 a.m. and 3 p.m. clouds of dust were seen in the direction of Mont Pelée, while detonations were heard at long intervals until morning. Light showers of volcanic dust fell in Dominica.

DR. L. A. BAUER contributes to *Terrestrial Magnetism and Atmospheric Electricity*, vii. 2, a note on his observations of the magnetic disturbances which occurred during the eruption of Mont Pelée on May 8. At 11h. 59m. a.m., Greenwich mean time, a disturbance occurred which began simultaneously at the two Coast and Geodetic Survey magnetic stations of Cheltenham, Maryland and Baldwin, Kansas. The time of these disturbances was the same as recorded at other observatories, and corresponded to 7h. 54m. of local time at St. Pierre, being about the time at which the principal clock of that town was stopped. The horizontal intensity was the element principally disturbed, and the suddenness with which the disturbance of May 8 began is well illustrated by Dr. Bauer's horizontal intensity curve. Several interesting magnetic disturbances also occurred between April 10 and May 8, possessing striking similarities with each other and with that of May 8, these similarities, both in magnitude and direction, extending to all three elements. During the eruptions, Dr. Bauer observed perturbations of greater or less degree, another striking coincidence occurring on May 20 at the second eruption.

THE nomination of Lord Rayleigh as foreign corresponding member of the Vienna Academy of Sciences has just been confirmed by the Emperor Francis Joseph.

A NUMBER of eminent surgeons representing many countries will be present at the Congress of the Belgian Society of Surgery, to be held at Brussels on September 8–11, when a proposal will be made to found an international society of surgery.

MRS. R. W. LONGFIELD writes from Bandon, co. Cork, Ireland, to say that on August 18 she heard the cuckoo's note distinctly near Bandon. The cry of cuc-koo was repeated several times.

THE address by Sir Archibald Geikie, which we are able to print in full in another part of the present issue, was delivered before a large audience at Cromarty on Friday last, in connection with the celebration of the centenary of Hugh Miller. Many eminent men from America, Canada and Italy, as well as from various parts of the British Isles, assembled to do honour to Miller's memory and to testify to his inspiring influence. The oration delivered by Sir Archibald Geikie was worthy of the occasion, and the eloquent words in which Miller's life and work were described will be read with as much pleasure as they were listened to by the audience privileged to hear them. Among other speakers at the open-air meeting near Hugh Miller's monument, and at the subsequent luncheon, were Principal Rainy, Prof. Clarke, Albany, New York; Sir James Grant, Canada; Dr. Horne, F.R.S., and Prof. Middleton.

IF we may judge from the rarity of reports, the sound of the salutes during the naval review on August 16 does not appear to have been heard at any unusual distance. Mr. H. F. Pinder, writing from Blackbourton, near Bampton, informs us that the salute at 2 p.m. was heard by one, but so far as he knows only by one, person. Earlier on the same day, between 11.30 and 12.15, heavy firing was heard, apparently from the south-south-west, the sound being continuous during the first half-hour. The distance of Blackbourton from Spithead is about 70 miles.

WE learn from the Berlin correspondent of the *Times* that the German Sea Fisheries League recently organised a scientific expedition to ascertain the value of deep-sea fishing in the Baltic. The league, with the assistance of the Ministry of the Interior, chartered the Kiel steamer *Holsatia* and fitted her out for trawl fishing and for scientific investigations. It was also intended to experiment with a view to discover how far the type of boat and the methods of fishing at present in use on the Baltic coast would prove suitable in the open sea. The report has not yet been published, but it appears that no large feeding grounds have been found, and that trawl fishing such as that practised in the North Sea would not pay in the Baltic.

THE thirteenth annual general meeting of the Institution of Mining Engineers will be held at Newcastle-upon-Tyne on September 17–19, under the presidency of Mr. J. S. Dixon. Among the papers to be read, or taken as read, are the following:—On the probability of finding workable seams of coal in the Carboniferous Limestone or Bernician formation beneath the regular Coal-measures of Northumberland and Durham, with an account of a recent boring made at Chopwell Woods, near Lintz Green, Mr. J. B. Simpson; notes on the correlation of the beds of the Carboniferous series in the north-east and north-west of England, Mr. David Burns; the Marl-slate division of the Permian, Prof. G. A. Lebour; steam-generation by the gases from Beehive Coke-ovens, Mr. M. R. Kirby; and the Fernie coal dust explosion, British Columbia, Mr. William Blakemore.

A NOTE on the progress of the Swedish South Polar expedition appears in the *Times*. The vessel *Antarctic*, with five scientific members of the expedition, left Port Stanley, in the Falkland Islands, on April 11 for South Georgia, U.S.A. The expedition

stayed in South Georgia from April 22 to June 15, and during this time a detailed survey was made of Cumberland Bay, one of the largest bays in South Georgia. Investigations into the natural history of Cumberland Bay were carried on, and zoological collections brought home from depths as great as 2700 metres. Soundings have given depths up to 5997 metres north-west from South Georgia. The expedition returned to Port Stanley on July 4, and will up to the end of September carry on work around the Falkland Islands and in Tierra del Fuego. In October, the *Antarctic* will start for Graham Land, in the Antarctic Ocean.

THE United States National Museum has just issued a printed list (24 pages) of the meteorites acquired for the Washington collection before January 1, 1902. The list, which is intended mainly to facilitate exchanges and the increase of the collection, is alphabetically arranged, and gives for each of the meteorites the weight in grams, the date of fall or find, and a brief description of the more salient characters. As many as 348 falls are represented, 143 being those of meteoric iron. There are three full-page plates, photographic reproductions; one illustrates the arrangement of the specimens for exhibition, while the two others are pictures of the Allegan and Casas Grandes meteorites. The list has been prepared by Mr. Wirt Tassin, assistant curator in the Division of Mineralogy.

IN vol. xxiv. of the *Proceedings* of the United States National Museum, Mr. G. P. Merrill gives a detailed description of fragments of a meteorite ploughed up some years ago at Admire, Lyon County, Kansas, U.S.A. As the metallic part is much rusted, probably a long interval of time elapsed between the fall and the find of the material. The meteorite, of which about 44 lb. weight is known to have been collected, belongs to the same group as the iron brought by Pallas from Siberia (1749), but approximates more closely in characters to the meteorite found in 1880 at Eagle Station, in Kentucky. It consists of a continuous mass of meteoric iron enclosing angular crystals of olivine (1 to 30 millimetres in diameter), the crystals having been in almost every case broken and afterwards cemented together by metallic material which had flowed into the fissures. Schreibersite, troilite and also small grains of chromite are comparatively abundant as constituents of the metallic portion, which forms about one-third of the whole mass.

ALASKA would seem to offer opportunities to the bryologist as well as to the gold-seeker. Although several collections of mosses have been made in that country from the year 1867 to the present time, Mr. J. Cardot and Mr. I. Thériot have placed on record twenty-nine new species as the result of collections made by the Harriman expedition in 1899. The descriptions of these, together with a general list of all known mosses from Alaska, are given in the *Proceedings* of the Washington Academy of Sciences bearing the date July 31 of this year. This does not, however, include a collection of more than 200 mosses which have been identified and named by Mr. R. S. Williams since this paper was written. The new species, which are given on the authority of the writers, except most of the Bryum species, for which M. Philibert is responsible, are fully diagnosed and illustrated. In addition, seventeen new varieties are recorded, and *Bartramiopsis Lescurii* is described in full with figures.

IT is not the happy fate of many botanical gardens to be able to put by a surplus of more than 1000*l.* in one year. Such is the announcement which appears in the thirteenth annual report of the Missouri Botanical Garden. The director, Dr. Trelease, presents his report, and in addition a memoir on the tribe Yuccæ of the order Liliaceæ. The latter is the result of a study extending over sixteen years, during which time large numbers of varieties have been examined in their native habitats and certain of them have been taken into cultivation. As this tribe is preeminently American, and in fact almost confined to the United States, and as the writer has taken advantage of every available opportunity to examine interesting or critical specimens, the results and opinions here recorded are extremely valuable. Very interesting by reason of the ordinary dependence of these plants upon the Pronuba moth for pollination is the reference to hybrids which have been raised. It will be noticed that one of the parents in many cases is *Yucca aloifolia*, this species being unique since it is usually self-pollinated. To the two genera Yucca and Hesperalœ, which are combined by Engler, is added a third genus, Samuela, with two species, instituted by Dr. Trelease; also the genus Yucca of Dr. Engler is split into three genera, Hesperoyucca, Clistoyucca and Yucca. The memoir is lavishly illustrated with more than one hundred figures reproduced from photographs.

THE Imperial Engineering Company, of Liverpool, has issued a pamphlet descriptive of apparatus for illustrating Prof. Hele Shaw's experiments on stream-line motions, both for use in schools and colleges and for original research.

A BRIEF account of the bibliography of Gilbert's "De Magnete" is given by Herr G. Hellmann (Berlin) in *Terrestrial Magnetism and Atmospheric Electricity*, vii. 2. It appears that only three editions of this work appeared, namely, Londini 1600, Sedini 1628, and Sedini 1633. Of the Sedini 1628 edition two varieties are known, differing in their title-pages. The rarest edition is the Stettin one of 1628, and of the two varieties that is rarest which has on its title-page the words "*Sumptibus [Authoris].*'

A NEW journal has been started in Glenville, U.S.A., bearing the title *The Aeronautical World*, and dealing with matters relating to aërial navigation of all kinds. It contains a large number of notes on events of current interest in this connection, lists of patents, and other information of this class. We should like to see rather more attention given to the difficulties which have still to be surmounted in connection with the problem of flight, leaving writers like Mr. H. G. Wells to indulge in "anticipations" of a speculative character as to the future of aërial navigation when these difficulties have been overcome. Still, such speculations have a certain attraction for those who cannot appreciate anything but accomplished results.

THE *Comptes rendus* of the Paris Academy of Sciences (July 21) contains a report on a paper by M. Torres dealing with a project for a navigable balloon with an interior keel. The idea contained in this project is very similar in general principle to that underlying M. Severo's ill-fated machine, namely, to bring all the forces acting on the balloon into the same horizontal line, with a view of minimising pitching. Accordingly M. Torres proposes a balloon with several compartments, containing a central beam suspended in its interior, and forming, with its attachments, a rigid internal keel. The propeller will then be attached at the end of this beam, and the car, which is to be reduced to the smallest possible dimensions, will be close up to the balloon. The fatal *Pax* disaster, however, raises doubts in regard to the last feature.

AN astronomical model called the "Rotaplane," devised by the Rev. C. Thomas and provisionally patented by him, has been submitted to us for examination. The model is intended to show the apparent diurnal motion of the horizon of any latitude with reference to the ecliptic at any time of the year. The direction of the polar axis is represented by an upright rod, to which the horizon can be inclined at an angle equal to the latitude of the desired place of observation. A semi-meridian is fixed to the horizon, and outside the whole is a flat ring to represent the plane of the ecliptic. By turning the polar axis, after

setting the ecliptic at the correct inclination, the diurnal movement of the horizon with reference to the sun or other object in the ecliptic can be made manifest. An objection to the model as an educational instrument is that the horizon is only horizontal when the latitude for which it is set is 90°. The student of astronomy who understands the relationship between the fundamental planes of the horizon, equator and ecliptic might find it an advantage to fix his ideas by means of a model of this kind. But such a student would be in a position to use a celestial globe by which he could see the apparent motions, with reference to the horizon, of objects in any part of the celestial sphere instead of being limited to the ecliptic.

THE twenty-fourth Report of the Deutsche Seewarte, Hamburg, for the year 1901, exhibits the usual activity in the various pursuits in which the institution is engaged. Several meetings have been held at Berlin and Hamburg with the view of improving and expediting the telegraphic weather reports. In this most important object andin the establishment of a 7h. a.m. service, several of the European countries are to some extent participating, but the movement is due mainly to the impulse given to it by the Deutsche Seewarte. The sum of six thousand marks has been placed at the disposal of Dr. von Neumayer for the purpose of establishing special weather forecasts for agriculturists, probably on the same lines as those for the harvest forecasts issued by our own Meteorological Office. The collection of observations made at sea, for the construction of sailing directions and meteorological handbooks of the various oceans, has been vigorously carried on. Complete log-books were received during the year from 60 men of war and 538 merchant vessels, in addition to some 300 short logs from steamers. The majority of the voyages refer to the north and south Atlantic, but also include a considerable number in the Pacific and Indian Oceans. Telegraphic warnings of storms were issued on fifty-nine days; the number of telegrams (including those to lower the signals) exceeded 3000, but the percentage of success is not stated.

EXCLUDING the well-known thermophilic group of bacteria, it has generally been considered that an exposure to a temperature of 65° C., or frequently to a lower temperature than this, is rapidly fatal to all non-sporing forms of bacterial life. Messrs. H. L. Russell and E. G. Hastings, however, describe a micrococcus, isolated from milk, the thermal death point of which is 76° C. for an exposure of ten minutes. Not all the cells of this organism are equally resistant; as the temperature is raised to about 70° C. some of the cells begin to succumb, but a small residuum retain their vitality until 76° C. is reached (*Centr. f. Bakt.*, *Zweite Abt.*, Bd. viii. p. 339). Using this organism, Messrs. Russell and Hastings have carried out some interesting observations upon the increased resistance of bacteria in milk pasteurised in contact with the air (*ib.*, p. 462). Heated in bouillon and in milk in closed vessels (sealed tubes) the thermal death point is approximately the same, viz. 76° C., but in milk heated in an open vessel the organism survived a temperature of 80° C. It was found that this resistance is due to the protection afforded by the membrane which forms when milk is heated freely exposed to the air, for in samples of sterile milk seeded with the organism and heated in an open beaker to 80° C., on subculturing numerous colonies were obtained from the membrane, while the milk below this was sterile.

SURRA, a disease affecting horses and other animals, and due to a protozoan parasite, the *Trypanosoma Evansi*, has been found to be very prevalent in the Philippines, causing the death of no less than 2000 of the army transport and cavalry horses in a period of six months. This disease, met with also in India and Burma, is now regarded as identical with nagana or the tsetse-fly disease of Africa. In India, the exact mode of transference of the disease from one animal to another has not been discovered, though certain "horse-flies" have been surmised to be the intermediaries. In the Philippines, Curry states that the intermediary is a fly, the *Stomoxys calcitrans*. The fly lays its eggs in the excrement of horses and cattle, in which its larvæ and pupæ thrive, and as the disease is almost always fatal, prophylactic measures must be employed, especially the destruction of the larvæ and pupæ in the excrements by treatment with lime or petroleum (*Amer. Med.*, July 19).

THE *Zoologist* for August contains notes on Erasmus as a naturalist, by Mr. G. W. Murdock, and a useful account by Mr. G. Smith, of Prof. Bachmetjew's experiments on the temperature of insects.

WE have received a copy of the first number of the *Rural Studies Series*, which contains the report of a lecture by the Rev. E. A. Woodruffe-Peacock on the manner in which horses —especially thoroughbreds—affect the grass-lands on which they are pastured, and the best manner of improving such pastures.

THE *Memorias* of the Scientific Society Antonio Alzate, vol. xvi., Nos. 5 and 6, contain an account, by Señor A. L. Herrera, of the means recently taken to mitigate the plague of mosquitoes from which the city of Mexico constantly suffers. A couple of men provided with tins of paraffin appear to have done wonders in the way of destroying the larvæ which infest the pools and sheets of water in the suburbs.

IN its report for the year 1901–1902, the committee of the Manchester Museum directs attention to the highly satisfactory and commendatory remarks on that institution and its work which appear in the Blue-book recently issued by the Commissioners on the University Colleges of the country. Among the collections received during the year is a fine series of shells presented by Mr. R. D. Derbishire, containing a number of rare forms and also examples of the range of variation presented by particular species. The lectures and addresses delivered during the year have proved attractive to the general public, and will be continued during the current session, when Prof. Hickson will discourse on reptiles, Prof. Weiss on club-mosses and ferns, and Prof. Dawkins on caves.

THE geology and petrography of part of the Ural region of Perm, in the upper basin of the Koswa, a tributary of the Kama, has been elaborately dealt with by MM. Louis Duparc and Francis Pearce (*Mém. de la Soc. de Physique de Genève*, xxxiv. 1902). In particular, the gabbros and dunites of Koswinsky are described, but there are also full accounts of the orography and hydrography of this region.

IN the *Papers* and *Proceedings* of the Royal Society of Tasmania for 1900–1901, a great many subjects are dealt with, including some useful general articles on the botany, the birds, the recent Mollusca, the minerals and the geology of Tasmania. In notes on the microscopic structure of some Tasmanian rocks, Mr. W. F. Petterd describes some aberrant members of the basalt family. Mr. W. H. Twelvetrees describes a new oxychloride of lead, under the name Petterdite. There are notes also on the discovery of amphibian remains in the permo-Carboniferous rocks.

WE have received the annual report for 1901 of the Geological Survey of New Jersey, by Mr. H. B. Kümmel, acting State Geologist. He refers to the fact that New Jersey is the chief clay-producing State, and that a new and exhaustive memoir of the clay deposits is in preparation. The report is accompanied by a memoir and map of the Green Pond Mountain region, a belt of Cambrian, Silurian and Devonian rocks which rest on an eroded surface of gneisses. There are notes on the

iron, zinc and copper mines, on various artesian wells, and on the presence of chlorine in certain natural waters. It is recommended that the State authorities should conserve all watersheds likely to be drawn upon in future by large towns.

THOSE who attended the meeting of the Geological Society of London on January 8 were impressed with the lucid explanations of Glacial phenomena in the north of England then given by Prof. Percy F. Kendall and Mr. Arthur R. Dwerryhouse. Their observations recently published (*Quarterly Journal* Geol. Soc. for August) constitute most valuable contributions to the study of the Great Ice Age in this country. Prof. Kendall deals with the Cleveland Hills, and points out the evidence there existing of the former occurrence of a number of glacier-lakes or "extra-morainic" lakes, such as are produced whenever a glacier or ice-sheet advances against or across the general slope of a country and impounds the natural drainage. Evidence is given of such lakes of large and small dimensions in the Vale of Pickering, in Glaisdale and Eskdale, in Harwood Dale and at Hackness, lakes which must have been formed when the ice occupied the Vale of York and extended along the northern and eastern borders of the Cleveland area. The evidence is furnished by shore scarps, occasional lacustrine deltas with fan-like forms, by laminated lacustrine deposits such as the warp clays of the vales of Pickering and York, by overflow channels whence the impounded water escaped in gorges which trench the main watershed or sever spurs independent of the present natural drainage, and by crescentic valleys excavated in the face of a hill by water flowing round a lobe of ice. The Glacial deposits are, of course, fully considered from sections and from borings, some of which were carried out by Prof. Kendall. The assemblages of boulders and rock fragments lead to the conclusion that three main ice-movements affected the area—a northern from Scotland and Northumberland, a western from Stainmoor Pass and the Tees valley, and an eastern from the North Sea and Scandinavia. The general sequence which may be inferred from a study of the somewhat complicated phenomena is (1) the unobstructed passage of the Teesdale glacier to the coast; (2) the arrival of the Scandinavian ice; and (3) the invasion of the Scottish ice. The author finds no signs of the presence of the sea in the Cleveland area at any time during the Glacial period. Mr. Dwerryhouse describes the glaciation of Teesdale, Weardale and the Tyne valley, a region in which, like that of Cleveland, the higher tracts stood out as "nunatakkr," while the grounds beneath were buried by ice. He also points out that at the period of maximum glaciation a number of lakes were formed, owing to the obstruction of the drainage of lateral tributary-valleys by the ice of the main glaciers.

DRS. H. M. HILLER and W. H. Furness have privately issued bound copies of the "Notes of a Trip to the Veddahs of Ceylon," which were published in vol. iii. of the *Bulletin* of the Free Museum of Science and Art, Philadelphia (April, 1901). The "Notes" do not contain much that is new, but they are illustrated with several excellent photographs, the most interesting of which are those illustrating a Rock Veddah shooting (standing) with a bow and arrow, and one making fire with a "fire-drill."

THERE is in *The Reliquary and Illustrated Archaeologist* (vol. viii. No. 3) a well-illustrated article, by Mr. R. Quick, on the Carib stone implements in the Horniman Museum. These implements show the technical skill of the aborigines of the West Indies in working hard rock. Some of the implements are really remarkable examples of stone-work. One example which is figured has a most irregular contour; from its high finish it was evidently greatly prized, and was probably a symbolic religious object, of which the significance is at present unknown.

The early Christian monuments of the Isle of Man are becoming well known to students through the enthusiastic labours of Mr. P. M. C. Kermode. In the July number of *The Reliquary and Illustrated Archaeologist* he gives numerous illustrations of recently discovered crosses and runic and ogam inscriptions. One of the most interesting discoveries is a carved stone with very characteristic Scandinavian interlacing; on one side is seen the figure of Loki in the act of heaving stones at the otter which is eating the salmon it has just caught in the foss; above this is the steed Grani with the chest containing the hoard won by Sigurd upon his slaying the dragon Fafni.

MESSRS. PERKEN, SON and CO. have issued a new revised and enlarged edition (the eighth) of their "Beginner's Guide to Photography." The book is now in its seventieth thousand.

IN the article on "The Older Civilisation of Greece," which appeared in NATURE of August 21, the following corrections should be made:—P. 391, *col.* 1, *l.* 9 from bottom: *for* "the un-Aryan 'Pelasgian'" *read* "the probably un-Aryan 'Minoan'"; p. 393, *col.* 2, *l.* 12 from top: *for* "ἐν μυχῷ, Ἄργεος" *read* "ἐν μυχῷ Ἄργεος"; *ibid.*, *l.* 14 from top: *for* "casements" *read* "casemates"; p. 394, *col.* 1, Fig. 2: *for* "Clay Seal. Impression" *read* "Clay Seal-impression."

A MINUTE investigation of the composition of Pennsylvania petroleum has recently been carried out by Mr. C. F. Mabery, and an account of the hydrocarbons with boiling points above 216° C. is published in the *Proceedings* of the American Academy of Arts and Sciences (vol. xxxvii. p. 565). Hydrocarbons of the methane series from tridecane $C_{13}H_{28}$ to octocosane $C_{28}H_{58}$ have been isolated, and according to the molecular-weight determinations carried out by the freezing-point method the products obtained by the author as the result of repeated fractional distillation under low pressure are almost pure. No account appears to have been taken, however, of the possibility of the occurrence of different isomeric forms. In addition to these saturated compounds the hydrocarbons $C_{22}H_{44}$, $C_{23}H_{46}$, $C_{24}H_{48}$, $C_{26}H_{52}$ and $C_{27}H_{54}$ belonging to the ethylene series and $C_{28}H_{54}$ a homologue of acetylene, have been obtained.

MUCH remains to be learnt about the numerical relationships of the atomic weights of the elements. It has long been realised that when referred to the standard O = 16 many of the atomic weights approach whole numbers to an extent out of all proportion to the probabilities of the case. In the *Chemiker-Zeitung* for July 19, Mr. Arthur Marshall, as well as directing attention to this fact, shows that very remarkable relationships exist in many cases between the atomic weights of allied elements. Taking from the tables of the German Chemical Society the eighteen values given to two places of decimals, the theory of probabilities shows that the chances against their approaching as close as they do to whole numbers are as high as 4120 : 1. If, on the other hand, the atomic weights are referred to H = 1, there appears to be little or no tendency to become whole numbers. It is, however, only when certain of the atomic weights are referred to entirely different standards that the most striking relationships appear. The weights of the atoms of the halogen elements and silver, for instance, are exactly in the ratio Cl : Br : Ag : I = 90 : 203 : 274 : 322. In the case of the alkali metals the proportions are even simpler, Li : $NH_4$ : Na : K : Rb = 7 : 18 : 23 : 39 : 85. Again, the horizontal series, V : Cr : Mn : Fe : Ni : Cu : Zn = 54 : 55 : 58 : 59 : 62 : 67 : 69. It is yet premature to work out relationships for all the elements, for there is still great uncertainty about most of the atomic weights, but the values for most of the above substances are thoroughly well established.

MESSRS. HABER AND GEIPERT have been investigating the conditions under which aluminium is obtained by the electrolytic method, and have published their results in recent issues of the

*Zeitschrift f. Elektrochemie.* They point out that no trustworthy details of the method employed in the various works where the metal is now produced have hitherto been made public. Using a small experimental fusion cell, and the ordinary lighting supply current of the Karlsruhe Technical Institute, they were able to reduce alumina without difficulty and to obtain as much as 230 grams of the metal in one operation. The metal obtained was remarkably pure, one sample tested containing only ·05 per cent. C and ·034 per cent. Si. The mechanical tests made with six samples of the aluminium gave an average tensile strength of 21,425 lb. per square inch. The fused mixture used in the carbon cell contained 33 per cent. $AlF_3$, 33 per cent. NaF and 33 per cent. $Al_2O_3$, the high percentage of aluminium fluoride being conducive to fluidity. The current density employed was about 2800 amperes per square foot, and the E.M.F. varied between 7 and 10 volts. The authors, as the result of their experiments, have come to the conclusion that the steady improvement in the efficiency of the process as carried out in the aluminium works is due, not to secret modifications in the process, but to the more careful attention now given to the purity of the raw materials employed. They also point out that the carbon contained in the aluminium obtained in their experiments was not present in the combined form, and as it was graphitic in character they assume that it represented mechanically enclosed particles, due to the disintegration of the anode and kathode carbon. By remelting the aluminium, it was possible to remove a portion of this impurity from the metal. The necessity of employing carbons comparatively free from ash is insisted on, since any impurities of the carbon used will be found in the final product.

The additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. J. S. Sweetman; a Ring-tailed Lemur (*Lemur catta*) from Madagascar, presented by Colonel Ewart; a Tiger (*Felis tigris*) from India, presented by Mr. A. Forbes; two Two-spotted Paradoxures (*Nandinia binotata*) from West Africa, presented respectively by Major D'Arcy Anderson and Mr. Walter O'Brien; two Bank Voles (*Arvicola pratensis*) British, presented by Mr. G. T. Rope; a Broad-fronted Crocodile (*Osteoloemus tetraspis*) from West Africa, presented by Dr. W. F. Macfarlane; a White-collared Mangabey (*Cercocebus collaris*) from West Africa, a Black-faced Spider Monkey (*Ateles ater*) from Eastern Peru, a White-fronted Capuchin (*Cebus albifrons*) from South America, a Common Marmoset (*Hapale jacchus*), a Six-banded Armadillo (*Dasypus sexcinctus*) from Brazil, a Vulpine Phalanger (*Trichosurus vulpecula*) from Australia, two Petz's Conures (*Conurus canicularis*) from Mexico, a Western Boa (*Boa occidentalis*) from Argentina, deposited; five American Pochards (*Fuligula americana*) from North America, received in exchange.

## *OUR ASTRONOMICAL COLUMN.*

ASTRONOMICAL OCCURRENCES IN SEPTEMBER:—

Sept. 3. 7h. 59m. Minimum of Algol ($\beta$ Persei).
6. 8h. 1m. to 11h. 43m. Transit of Jupiter's Sat. III.
13. 11h. 28m. to 15h. 11m. Transit of Jupiter's Sat. III.
15. Venus. Illuminated portion of disc = 0·945, of Mars = 0·948.
22. 9h. 2m. to 9h. 25m. Moon occults $\delta^1$ Tauri (mag. 4·0).
22. 9h. 14m. to 10h. 2m. Moon occults $\delta^2$ Tauri (mag. 4·7).
23. 8h. 13m. to 13h. 6m. Transit of Jupiter's Sat. IV.
23. 9h. 41m. Minimum of Algol ($\beta$ Persei).
Sept. 23. 10h. 34m. to 11h. 12m. Moon occults 115 Tauri (mag. 5·4).
23. 12h. 0m. Sun enters Libra. Autumn commences.
23. 13h. 28m. to 13h. 53m. Moon occults 120 Tauri (mag. 5·3).
24. 17h. 0m. Mercury at greatest elongation (26° 11′ E.).
24. 17h. 32m. to 18h. 38m. Moon occults 26 Geminorum (mag. 5 1).
25. 13h. 40m. to 14h. 40m. Moon occults 68 Geminorum (mag. 5·0).
26. 6h. 30m. Minimum of Algol ($\beta$ Persei).
27. 15h. 22m. to 15h. 38m. Moon occults $\omega$ Leonis (mag. 5·6).

NEW DISCOVERIES OF VARIABLE VELOCITIES IN LINE OF SIGHT.—In addition to the thirty-two binaries previously announced, Prof. Campbell records the data of six more spectroscopic binaries which have been detected with the Mills spectrograph; they are the following:—

$\phi$ *Persei*: $\alpha$ = 1h. 37m.; $\delta$ = + 50° 11′. The maximum variation as yet recorded is from +24 km. (December 16, 1900) to −12 km. (November 11, 1901). This star has bright hydrogen lines, H$\gamma$ appearing as a narrow absorption line with very bright borders.

$\eta$ *Geminorum*: $\alpha$ = 6h. 09m.; $\delta$ = + 22° 33′. Maximum variation as yet recorded is from +14 km. (January 15, 1900) to 25 km. (February 2, 1902).

$\gamma$ *Canis Minoris*: $\alpha$ = 7h. 23m.; $\delta$ = + 9° 08′. Range of variability as yet detected is from +40 km. (November 6, 1901) to +54 km. (December 22, 1901).

$\zeta$ *Herculis*: $\alpha$ = 16h. 38m.; $\delta$ = 31° 47′. This is a well-known visual binary having a period of about thirty-three years, but the earlier observations of Belopolsky, Campbell and Newall in 1893, 1898 and 1897–99, respectively, did not establish the variability. However, by taking the means of these early observations and comparing them with the mean of the recently observed velocities determined at the Lick Observatory, it is found that the velocity has changed by about 4 km. since 1898.

$\alpha$ *Equuleï*: $\alpha$ = 21h. 11m.; $\delta$ = +4° 50′. The velocity of this star varied from − 26 km. on June 25, 1900, to − 2 km. on June 25, 1901, and then returned to − 26 km. on June 2, 1902.

$o$ *Andromedae*: $\alpha$ = 22h. 57m.; $\delta$ = + 41° 47′. The range of variability, so far as it is yet known, is from − 11 km. (October 9, 1900) to − 20 km. (June 25, 1901).

Miss Maury, of the Harvard College Observatory, has discovered the composite character of the spectra of the two last-mentioned stars.

Out of the 350 stars observed up to date, 41 have proved to be spectroscopic binaries, giving a proportion of one binary to every eight stars observed, not taking into account a number of suspected cases which await confirmation.

The variable velocity of the sun has a double amplitude of only a few hundredths of a kilometre, and Prof. Campbell suggests that, with increased accuracy in our methods of observation, we shall probably find that there is a regular gradation from this comparatively minute quantity up to the much greater velocities already recorded, and that it will be found that a star which is *not* a spectroscopic binary is a rare exception (Lick Observatory *Bulletin*, No. 20).

THE NAMING OF NEW VARIABLE STARS.—No. 3808 of the *Astronomische Nachrichten* contains a list of the titles which have been assigned to the 24 variables discovered during the years 1900, 1901 and 1902 by the commission appointed to this duty. Among the 24 there are only four variables of the Algol type, one of which has the remarkable period of 31·3 days.

The published table gives the star's number in Chandler's catalogue, its temporary name, the assigned permanent name, the maximum and minimum magnitudes, and the data regarding the position for 1900.

THE SPECTRUM OF NOVA PERSEI.—Prof. Campbell and Mr. Wright subscribe a short note to the Lick Observatory *Bulletin*, No. 20, on the later spectrum of Nova Persei (1901).

Spectrograms, obtained throughout the autumn and winter, up to January 7, 1902, showed no appreciable difference from the immediately preceding ones, the fine dark H (calcium) line referred to in *Bulletin* No. 8 still remaining visible. It was suggested that the corresponding K line did not appear because there was no light in that region of the spectrum for the calcium vapour to absorb, but this suggestion has been proved incorrect

by the appearance of the K line on a negative, obtained by Mr. Wright, which was given a very long exposure with the intention of deciding whether this line did, or did not, exist in the Nova spectrum.

The writers suggest that it would now be an exceedingly interesting experiment to test the presence of the absorption lines of calcium, sodium and other elements, in the gaseous nebulæ, by giving exposures long enough to record their continuous spectra.

THE CHANGES IN THE NEBULA SURROUNDING NOVA PERSEI.—Prof. Louis Bell, writing in the *Astrophysical Journal* (No. 1, vol. xvi.), discredits the "simple reflection" explanation of the changes which have taken place so rapidly in the nebulous matter surrounding the Nova, for the following reasons:—(1) Reflected light would be more or less polarised, and Perrine reports the total absence of polarisation in the light received from this nebula. (2) Reflection does not satisfactorily explain the persistence of strongly illuminated nebulosity at small angular distances from the Nova. (3) At the enormous distances (210 light days) from the Nova that some of the bright portions are situated, reflection would not account for the brightness of these parts.

Prof. Bell supports the theory of Seeliger, which accounts for the apparent movements of the brightest portions of the nebula, by supposing that the various parts of this highly tenuous matter are successively lighted up by the effects of a travelling electromagnetic wave-front, and shows that this theory agrees entirely with the observed phenomena.

## *HUGH MILLER: HIS WORK AND INFLUENCE.*[1]

AMONG the picturesque figures that walked the streets of Edinburgh in the middle of last century, one that often caught the notice of the passer-by was that of a man of good height and broad shoulders, clad in a suit of rough tweed, with a shepherd's plaid across his chest and a stout stick in his hand. His shock of sandy-coloured hair escaped from under a soft felt-hat; his blue eyes, either fixed on the ground or gazing dreamily ahead, seemed to take no heed of their surroundings. His rugged features wore an expression of earnest gravity, softening sometimes into a smile and often suffused with a look of wistful sadness, while the firmly compressed lips betokened strength and determination of character. The springy, elastic step with which he moved swiftly along the crowded pavement was that of the mountaineer rather than of the native of a populous city. A stranger would pause to look after him and to wonder what manner of man this could be. If such a visitor ventured to question one of the passing townsmen, he would be told promptly and with no little pride, "That is Hugh Miller." No further description or explanation would be deemed necessary, for the name had not only grown to be a household word in Edinburgh and over the whole of Scotland, but had now become familiar wherever the English language was spoken, even to the furthest western wilds of Canada and the United States.

A hundred years have passed since this notable man was born, and nearly half that interval has elapsed since he was laid in the grave. The hand of time, that resistlessly winnows the wheat from the chaff of human achievement, has been quietly shaping what will remain as the permanent sum of his work and influence. The temporary and transitory events in his career have already, in large measure, receded into the background. The minor contests in which, from his official position, he was so often forced to engage are mostly forgotten; the greater battles that he fought and won are remembered rather for their broad and brilliant results than for the crowded incidents that gave them such vivid interest at the time. His contemporaries who still survive him—every year a sadly diminishing number—can look back across the half century and mark how the active and strenuous nature whose memory they so fondly cherish, now

> "Orbs into the perfect star
> We saw not when we moved therein."

A juster estimate can doubtless be formed to-day of what we owe to him than was possible in his lifetime. That the debt is great admits of no dispute, and that it is acknowledged to be due could hardly be more fittingly shown than by the widespread desire which has brought us here to-day from so many distant places in order to raise in the town of his birth, which he made a place of pilgrimage to many a lover of English literature, a visible memorial of him in an institution of which he would himself have heartily approved.

In order adequately to realise the nature and extent of the work achieved by Hugh Miller during his too brief career, we should clearly picture to ourselves the peculiar conditions in which he grew up. Happily he has himself, in one of the most charming pieces of autobiography in the language, told the story of his youth and early manhood. Descended from both a Highland and a Lowland ancestry, he combined in his nature the vivid imagination and poetic impulse of the Celt with the more staid and logical temperament of the Teuton. He was born amidst an English-speaking community, but at a distance of only a few miles from the fringe of the mountainous region within which men use the Gaelic tongue. He knew some survivors of Culloden, and had heard his own grandfather tell how, when a stripling, he watched, from the hills above Cromarty, the smoke wreaths of the battle as they drifted along the ridge on the further side of the Moray Firth. From infancy he was personally familiar with the people of the hills and their traditions, as well as with the ways of the hardy fisher-folk and farmers of the plains. The hereditary predispositions of his mind were in this way fostered by contact with the two races from which they sprang.

Happy in the possession of this racial blending, he was still more fortunate in the place of his birth. He used to remark with satisfaction that both Sir Roderick Murchison and he had been born on the Old Red Sandstone of the Black Isle; but while the career of the author of the "Silurian System" owed practically nothing to his birthplace, which he left while still an infant, Miller's life from beginning to end bore the impress of the surroundings amid which he was born and educated. It would hardly be possible to choose in this country a place of which the varied features are more admirably fitted to stimulate the observing faculties, to foster a love of nature, and to appeal to the poetic imagination than the winding shores, the scarped cliffs, the tangled woods, the wild boulder-strewn moors and distant sweep of blue mountains around Cromarty. And how often and lovingly are these scenes portrayed by him under every varying phase of weather and season! They had stamped themselves into his very soul and had become an integral part of his being.

> "The sounding cataract
> Haunted him like a passion; the tall rock,
> The mountain, and the deep and gloomy wood,
> Their colours and their forms were then to him
> An appetite, a feeling, and a love."

But while Nature was his first and best teacher, he has told us in grateful words how much he owed to two uncles—hard-working, sagacious and observant men, by whom his young eyes were trained to discriminate flower and tree, bird and insect, together with the teeming organisms of the shore, and whose high moral worth he, even as a boy, could appreciate. Having learnt to read while still of tender years, he developed an insatiable thirst for books. What he acquired in this way for himself seems to have been at least as useful as the training gained during the rather desultory years spent by him at the town grammar-school. He was an intelligent but wayward boy, as much ahead of his schoolmates in general information as in all madcap adventures among the crags and woods. When the time arrived at which he had to choose his calling in life, he selected an occupation that would still enable him to spend his days in the open air and gratify his overmastering propensity for natural history pursuits. Much to the chagrin of his family he determined to be a stone-mason, and at the age of seventeen was apprenticed to that trade. For some fifteen years he continued to work in quarries and in the erection of buildings in various districts of the north country, and even extended his experience for a short time into Midlothian. Deeply interesting and instructive is the record he has left of these years of mechanical toil. But amidst all the hardships and temptations of the life, the purity and strength of his character bore him nobly through. His keen love of nature and his intense enjoyment of books were a never-failing solace. He continued to gain access to, and even by degrees to possess, a considerable body of the best literature in our language, reading some of his favourite authors over twice in a year. He thus laid up a

[1] An address given at the centenary celebration of the birth of Hugh Miller held in Cromarty on August 22, by Sir Archibald Geikie, D.C.L., F.R.S.

store of information and allusion which his retentive memory enabled him eventually to turn to excellent advantage.

While still at school he had gained some notice for the verses which he wrote. In the intervals of his subsequent labours with mallet and chisel, he continued to amuse himself in giving metrical expression to his feelings and reflections, grave or gay. Conscious of his power, though hardly yet aware in what direction it could best be used, he resolved to collect and publish his verses. At the age of seven-and-twenty he accordingly gave to the world a little volume with the title "Poems written in the leisure hours of a Journeyman Mason." Not without some misgiving, however, did he make this first literary venture. Even before the voices of the "chorus of indolent reviewers" could travel up from the south country, with their sententious judgments of the merits and defects of this new peasant-poet, he set himself to prepare some contributions in prose which might perchance afford a better measure of his quality. Some years before that time he had been out all night with the herring fleet, and he now sent to the *Inverness Courier* some letters descriptive of what he had then seen. These made so favourable an impression that they were soon afterwards reprinted separately. They marked the advent of a writer gifted with no ordinary powers of narration and with the command of a pure, nervous and masculine style. The reception which these letters met with from men in whose judgment and taste he had confidence formed a turning point in his career. He now realised that his true strength lay, not in the writing of verses, but in descriptive prose. Some years, however, still passed before he found the class of subjects on which his pen could most effectively be exercised. In the meantime he began to record the legends and traditions of his native district. Most of these had been familiar to him from childhood, when he heard them from the lips of old grey-headed men and women, but they were dying out of remembrance as the older generations passed away. Part of his leisure for several years was given to this pleasant task, until there grew up under his hand a bulky volume of manuscript. This time he was in no hurry to publish; the book did not make its appearance until 1835, as his charming "Scenes and Legends of the North of Scotland." In this work some of the most striking passages were to be found, not so much in the tales themselves which were narrated as in the local colouring and graphic setting that were given to them. The writer displayed a singularly vivid power in the delineation of scenery, and his allusions to the geology of the district, then almost wholly unknown, attracted attention, since they showed that besides his keen eye for the picturesque above ground, he knew something of the marvels that lay beneath. He was feeling his way to what ultimately became his most cherished and most useful task. He had realised that his main object should be to know what was not generally known, "to stand as an interpreter between nature and the public," and to perform the service of narrating, as pleasingly as he could, the facts which he culled in walks not previously trodden, and of describing, as graphically as might be, the inferences which he drew from them.

Ever after his first day's experience as an apprenticed mason in a stone-quarry, of which he has left more than one impressive account, he was led to interest himself in the diversified characters of the rocks of the district. Even as a boy he had been familiar with the more obvious varieties of stone to be met with in a tract of country wherein the sedimentary formations of the Lowlands and the crystalline masses of the Highlands have been thrown side by side. But he had been attracted to them rather on account of their singular shapes or brilliant colours than from any regard to what might have been their different modes of origin. Now, however, he had discovered that these rocks are really monuments, wherein are recorded portions of the past history of the earth, and he was full of hope that by patient study he might yet be able to decipher them. The supply of elementary treatises and text-books of science, in the present day so abundant, had hardly at that time begun to come into existence. Geology, indeed, had but recently attained a recognised position as a distinct branch of science. And even had the young stone-mason been able to possess himself of the whole of the scanty geological literature of the time, it included no book that would have solved for him the problems that daily confronted him as he pursued his labours in the quarry, or rambled in leisure hours along the shore. The best treatise which could have fallen into his hands and which would have been full of enlightenment and suggestion for him—Playfair's immortal "Illustrations of the Huttonian Theory"—had appeared seventeen years before; but we have no evidence that it came in his way. He had laboriously to work out his problems for himself.

Innumerable as are the subjects for geological inquiry offered by the district of Cromarty, it was fortunate for Hugh Miller, and not less so for the cause of science, that chance placed him face to face in the most practical way with the Old Red Sandstone, and that he was, as it were, compelled to attempt to understand its history. While the lessons taught by the strata of the quarry had greatly impressed him, the abundant and well-preserved fossils among the Lias shales of the Eathie shore, which at spare moments he visited, had deepened that impression. It was while endeavouring to find these shales nearer home, on the western side of the Southern Sutor, that he stumbled upon the clays which contain the fish-bearing nodules of the Old Red Sandstone. This happy discovery, which was made in the autumn of 1830, the year after the publication of his "Poems," marks an eventful epoch in his life, as well as an important date in the history of geological investigation.

At that time comparatively little was known of the Old Red Sandstone. Its very existence as a distinct geological system was disputed on the continent, where no equivalent for it had been recognised. It was alleged to be a mere local and accidental accumulation, which could hardly be considered as of much historical importance, seeing that no representative of it had been found beyond the British Islands. Yet within the limits of these islands it was certainly known to bulk in no inconsiderable dimensions, covering many hundreds of square miles and attaining a thickness of more than 10,000 feet. It had been clearly shown by William Smith, the father of English geology, to occupy a definite position beneath the Mountain Limestone and above the ancient "greywacke" which lay at the base of all the sedimentary series, and he had indicated its range over England and Wales on his map published as far back as 1815. In Scotland, too, its existence and importance as a mere mass of rock in the general framework of the country had long been recognised. Ami Boué had published in 1820 an excellent account of its igneous rocks, but without any allusion to the organic wonders for which it was yet to become famous. The extraordinary abundance of its fossil fishes, where it spreads over Caithness, had been made known to the world by Murchison in 1826, and in more detail the following year, when Sedgwick and he read their conjoint paper on the conglomerates and other formations of the north of Scotland. But it may be doubted if any of these publications had found their way to Cromarty when Miller was gathering his first harvest of ichthyolites in the little bay within half a mile of the town. He had passed over that beach many hundreds of times in his boyhood without a suspicion of the treasures wrapped up in the grey concretions that lay tossing in the tideway. On breaking these stones, hoping to meet with a repetition of the Liassic organisms with which he had grown familar at Eathie, he found a group of forms wholly different. At each interval of leisure he would repair to the spot, and, digging out the nodules from their matrix of clay, would patiently split them open and arrange them along the higher part of the beach, according to what seemed to be the natural affinities of the fossils enclosed within them. Scouring the parish for fresh exposures of the nodule-bearing clay, he was soon rewarded by the discovery of some six or eight additional deposits charged with the same remains. There was a strange fascination in this pursuit. He had, as it were, discovered a new world. No human eye had ever before beheld such strange types of creation. Though he was well acquainted with the marine life of the adjacent firths, he had never seen any creature that in the least resembled them, or served to throw light on their structure.

With no chart or landmark to guide him into this new domain of nature, he continued for years quietly to collect and compare. The first imperfect knowledge which he was able to acquire regarding the few modern representatives of the creatures disinterred by him at Cromarty was derived in 1836 from a perusal of the well-known memoir by Hibbert on the limestone of Burdiehouse. Next year, however, he made the acquaintance of Dr. Malcolmson, who eventually carried some of his specimens to London and the continent, and was the means of bringing him into correspondence with Murchison and Agassiz. Hugh Miller was thus at last placed in direct communication with the world of science and into relation with the men who were most thoroughly versed in the subjects that had

so long engrossed his thoughts, and most capable of helping him to clear away the difficulties that beset his progress.

Meanwhile an important change had taken place in his condition of life. During the year 1834, after having worked for fifteen years in his calling of stone-mason, he was offered the accountantship of the Commercial Bank agency to be opened at Cromarty. This offer, which came to him unasked and unexpected, was a gratifying mark of the esteem and confidence with which his character was regarded. He accepted it, not without some diffidence as to his competence for the duties required. It would, however, retain him in his native town, enable him to marry the accomplished girl to whom he had for years been attached, and afford him opportunity to prosecute the researches in the Old Red Sandstone, of which he had now come to realise the importance. It likewise provided him with leisure to prepare contributions to different periodicals, which, though of no great consequence to his reputation, were of service in adding to an income narrow enough for the support of a wife and family. These writings had this further advantage, that they gave him a readier command of the pen and accustomed him to deal with lighter as well as with graver subjects of discussion, thus furnishing a useful training for what was ultimately to be the main business of his later life.

At this time ecclesiastical questions occupied public attention in Scotland to the exclusion of almost everything else. The Church was entering on that stormy period which culminated in the great Disruption of 1843. Hugh Miller, who was at once an earnest Christian and a devoted son of the Church, watched the march of events with the deepest sympathy. As a thoroughly "Establishment man" he had taken but slender interest in the previous Voluntary controversy, but the larger and more vital conflict now in progress filled him with concern. It was his firm conviction that the country contained "no other institution half so valuable as the Church, or in which the people had so large a stake." The anxiety with which the situation impressed him affected his sleep, and he would ask himself, "Can I do nothing for my Church in her hour of peril?" The answer which he found was to write his famous "Letter from one of the Scotch people to Lord Brougham." This pamphlet was soon after followed by another, entitled "The Whiggism of the Old School, as exemplified in the past history and present position of the Church of Scotland." These writings, so cogent in argument and so vigorous in style, had a wide circulation, and undoubtedly exercised much influence on the progress of the ecclesiastical controversy throughout the country. The leaders of the non-intrusion party, with whose cause he showed such keen and helpful sympathy, soon after the appearance of the first pamphlet invited Miller to confer with them in Edinburgh, and offered him the editorship of their projected newspaper, the *Witness*. With some misgiving as to his competence to meet all the various demands of a journal that was to appear twice a week, he accepted the proposal. Thus, after his five years' experience as a bank-accountant, he became at the beginning of 1840, when he was thirty-seven years of age, the editor of an important newspaper, and he retained that position until his death.

Up to this time the name of Hugh Miller was but little known beyond his native district. His political pamphlets first gave it a wide reputation, and thenceforth his conduct of a journal that represented the interests of one of the great parties into which his country was divided kept him constantly before the eyes of the public. The *Witness* rapidly attained a large circulation. It appealed, not merely to the churchmen whose views it advocated, but to a wide class of readers, who, apart from ecclesiastical polemics, could appreciate its high tone, its sturdy independence, its honesty and candour, and the unusual literary excellence of its leading articles. It not only upheld, but raised the standard of journalism in Scotland. As a great moral force it exercised a healthy influence on the community. There cannot be any doubt that the powerful advocacy of the *Witness* was one of the main agencies in sustaining the energies of the non-intrusion party and in consolidating the position of the young Free Church. It is my own deep conviction that the debt which that Church owes to Hugh Miller has never yet been adequately acknowledged.

Before he had been many months in the editorial chair he began to publish in the columns of his paper the first of that brilliant succession of geological articles which attracted the attention of men of science, as well as of the general public, and which continued to be a characteristic feature of the *Witness* up to the end of his life. The first articles, describing his discoveries in the Old Red Sandstone of Cromarty, created not a little sensation among the geologists who had gathered in the year 1840 at the memorable meeting of the British Association at Glasgow. It was there that Agassiz, who had come fresh from the study of Swiss glaciers to the Scottish Highlands, announced that he had found clear evidence that the mountains of this country had once also nourished their glaciers and snowfields. It was then, too, that the same illustrious naturalist gave the first account of the fossils found by Hugh Miller at Cromarty, one of which he named after its discoverer. In that gathering of eminent men, Murchison declared that the articles which had been appearing in the *Witness* were "written in a style so beautiful and poetical as to throw plain geologists like himself into the shade." Buckland, famous for his own eloquent pages in the Bridgewater Treatise, expressed his unbounded astonishment and admiration, affirming that "he would give his left hand to possess such powers of description." The articles were next year collected and expanded into his "Old Red Sandstone, or New Walks in an Old Field"—the first and, in some respects, the freshest and most delightful of all his scientific volumes.

In subsequent years there appeared in the same columns his "Cruise of the Betsy"—a series of papers written among the Western Isles, and full of the poetry and geological charm of that marvellous region; his "Rambles of a Geologist," in which he included the results of his wanderings over Scotland between 1840 and 1848, and other essays, the more important of which were collected with pious care by his widow and published in a succession of volumes after his death. His "First Impressions of England and its People" appeared in 1846, and greatly increased the reputation of its writer as an observant traveller, an able critic and an accomplished writer, possessing a wide and sympathetic acquaintance with English literature. The "Footprints of the Creator," which followed in 1847, was of a less popular character. Its detailed account of the structure of some of the fishes of the Old Red Sandstone is, however, of lasting value, though its controversy with the "Vestiges of Creation" has now little more than an historical interest. The "Schools and Schoolmasters," after running as usual through the pages of the newspaper, was issued as a separate volume in 1852, and was everywhere hailed as one of the most delightful and instructive of all his works. The "Testimony of the Rocks," with the final proofs of which he was engaged on the last day of his life, was issued a few months after he had been laid to rest beside his friend Chalmers. Altogether of his collected writings, including those that appeared in his lifetime, a series of twelve volumes has been published, but many hundreds of articles of less permanent interest, yet each marked by the distinctive charm of its writer, remain buried in the files of the *Witness*.

If, from his writings alone, we judge of the extent and value of the work achieved by Hugh Miller, we can have little hesitation in believing that it is mainly his contributions to the literature of science that will hand his name down to future generations. Like so many other men who have attained distinction in the same field, he from the beginning to the end made geology his recreation, in the midst of other paramount preoccupations. It furnished him with solace from the toils of the quarry and the building yard, it supplied him with a healthful relief from the labours of the bank, and when in later years he escaped each autumn for a few weeks of much-needed leisure from the cares and responsibilities of the editor's desk, it led him to ramble at will all over his native country, and brought him into acquaintance with every type of its rocks and its landscapes.

Unquestionably the most original part of his scientific work, that wherein he added most to the sum of acquired knowledge, is to be found in his reconstruction of the extinct types of fishes which he discovered in the Old Red Sandstone. The merit of these labours can hardly be properly appreciated unless it be borne in mind that he came to the study of the subject with no preliminary biological training save what he could pick up for himself from an examination of such denizens of the neighbouring firths as he could meet with. But after prolonged search he could find in these northern seas no living creatures the structure of which afforded him any clue to that of the fossil fishes of Cromarty. Some men had concluded that the organisms were ancient turtles, others that they were crustaceans or even aquatic beetles. He had the sagacity, however, to surmise that they were probably all fishes, and he

enjoyed the satisfaction afterwards of learning that Agassiz pronounced even the most bizarre amongst them to belong to that great division of the animal kingdom. He was guided by his own intuitive conception of what must have been the plan on which these long-vanished types of organic structure had been fashioned. Huxley, who twenty years afterwards had occasion to subject the Old Red Sandstone fishes to critical study, and who brought to the inquiry all the resources of modern biology, has left on record the impression made on his mind by a minute revision of Hugh Miller's work. "The more I study the fishes of the 'Old Red,'" he remarks, "the more am I struck with the patience and sagacity manifested in Hugh Miller's researches, and by the natural insight which in his case seems to have supplied the place of special anatomical knowledge." He refers to the "excellent restoration of Osteolepis," in which even some of the minute peculiarities had not escaped notice, and he declares that Hugh Miller had made known almost the whole organisation of Dipterus, and had thus anticipated the most important part of Prof. Pander's labours in the same field, the distinguished Russian palæontologist not having been aware that the work had already been done in Scotland.

But it is not, in my opinion, by the extent or value of his original contributions to geology that the importance of Hugh Miller's scientific labours and writings should be measured. Other men, who have left no conspicuous mark on their time, have surpassed him in these respects. What we more especially owe to him is the awakening of a widespread interest in the methods and results of scientific inquiry. More than any other author of his day, he taught men to recognise that beneath the technicalities and jargon that are too apt to conceal the meaning of the facts and inferences which they express, there lie the most vital truths in regard to the world in which we live. He clothed the dry bones of science with living flesh and blood. He made the aspects of past ages to stand out once more before us, as his vivid imagination conceived that they must once have been. He awakened an enthusiasm for geological questions such as had never before existed, and this wave of popular appreciation which he set in motion has never since ceased to pulsate throughout the English-speaking population of the world. His genial ardour and irresistible eloquence swept away the last remnants of the barrier of orthodox prejudice against geology in this country. The present generation can hardly realise the former strength of that bigotry, or appreciate the merit of the service rendered in the breaking of it down. The well-known satirical criticism of the poet Cowper expressed a prevalent feeling among the orthodox of his day, and this feeling was still far from extinct when Miller began to write. I can recall manifestations of it even within my own experience. No one, however, could doubt his absolute orthodoxy, and when the cause of the science was so vigorously espoused by him, the voices of the objectors were finally silenced. There was another class of cavillers who looked on geology as a mere collecting of minerals, a kind of laborious trifling concealed under a cover of uncouth technical terms. Their view was well expressed by Wordsworth when he singled out for contemptuous scorn the enthusiast

> "Who with pocket hammer smites the edge
> Of luckless rock or prominent stone,
> Detaching by the stroke
> A chip or splinter, to resolve his doubts,
> And, with that ready answer satisfied,
> The substance classes by some barbarous name
> And hurries on;
> He thinks himself enriched,
> Wealthier, and doubtless wiser, than before."

But a champion had now arisen who, as far as might be, discarding technicalities, made even the dullest reader feel that the geologist is the historian of the earth, that he deals with a series of chronicles as real and as decipherable as those that record human events, and that they can be made, not only intelligible, but attractive, as the subjects of simple and eloquent prose.

The absence of technical detail, which makes one of the charms of Hugh Miller's books to the non-scientific reader, may be regarded as a defect by the strict and formal geologist. Like every other branch of science, geology rests on a basis of observation, which frequently depends for its value upon the minuteness and accuracy of its details. To collect these details is often a laborious task, which is seldom undertaken save by those to whose department of the science they specially belong. A palæontologist cannot be expected to devote his time to the study of the microscopic characters of minerals and rocks. He leaves that research to the petrographer, who, on the other hand, will not readily embark on an investigation of the minute anatomy of fossil plants or animals. This specialisation, which has always to some extent existed, necessarily becomes more pronounced as science advances. The days are far past for Admirable Crichtons, and it is no longer possible for any one man to be equally versed in every branch of even a single department of natural knowledge.

Hugh Miller's researches among the Old Red Sandstone fishes showed him to be above all a naturalist and palæontologist, capable of expending any needful amount of patient labour in working out the minutest details of organic structure. In other fields of geological inquiry, while he was far from undervaluing the importance of detail, he avoided the recapitulation of it in his writings. It interested him, indeed, only in so far as it enabled him to reach some broad conclusion or to fill in the canvas of some striking picture of bygone aspects of the earth's surface. Hence he did not apply himself to the minute investigation of problems of geological structure, and when he undertook any inquiry in that direction he was apt to start rather from the palæontological than the physical side. Thus the work of his last years along the shores of the Firth of Forth, wherein he sought to accumulate proofs of the comparatively recent upheaval of the land, was mainly based on the position of shells with reference to their present habitat in the adjacent seas. As a youth enthusiastically geological, I was privileged to enjoy his friendship, sometimes accompanying him on an excursion, and always spending an evening with him after one of his autumn journeys that we might exchange the results of our several peregrinations. Only a week or two before his death, on the last of those memorable evenings, he had his trophy of shells spread on the table, which enabled him to prove that at no very distant date Scotland was cut in two by a sea-strait that connected the Firths of Forth and Clyde. He had found marine shells at Bucklyvie, on the flat ground about midway between the two estuaries. Finding I was not quite clear as to the precise geographical position of his shell-bed, he burst out triumphantly with the lines placed by Scott at the head of the chapter in "Rob Roy," which tells of the journey of Bailie Nicol Jarvie and Osbaldistone into the Highlands:

> "Baron of Bucklyvie
> May the foul fiend drive ye,
> And a' to pieces rive ye,
> For building sic a toun,
> Where there's neither horse meat, nor man's meat, nor a chair to sit doun."

I remember, too, that on that occasion I had brought with me the detailed map of Arthur's Seat at Edinburgh, of which I had just completed the geological survey, and I explained to him in some detail what I had found to be the structure of the hill. Having grasped the main succession of the rocks, he with characteristic rapidity passed from the particulars which I had given him to the events of which they were the record, and turning to his daughter, who was sitting near, he exclaimed to her, "There, Harriet, is material for such an essay as has been prescribed to you at school." Then in a few graphic sentences he drew a picture of what seemed to him to have been the history of the old volcano.

While various causes no doubt contributed in this country to the remarkable and rapid increase in the general appreciation of the interest of geological investigation, I feel assured that one of the chief of them has been Hugh Miller's imaginative grasp of the subject and his eloquent advocacy. The personal experience of a single individual can count for little in an estimate of this kind; but for what it may be worth, I gladly avail myself of this opportunity to state mine. It was Hugh Miller's "Old Red Sandstone" that first revealed to me the ancient history that might be concealed in the hills around me, and the meanings that might be hidden in the commonest stones beneath my feet. I had been interested in such objects, as boys are apt to be who spend much of their time in the open country. But it was that book which set me on the path of intelligent inquiry. And this experience must doubtless have been shared by many thousands of his readers who never saw his living face and who never became geologists.

I have alluded to the excellence of his literary style—a characteristic which, unfortunately, is only too rare among writers in science. There can be little doubt that this feature of his work will constitute one of its claims to perpetual recognition. His early and wide acquaintance with our literature enabled him to intersperse through his pages many an apposite quotation and

felicitous allusion. He had set before himself as models the best prose writers of the previous century, and the influence of Goldsmith upon him is especially notable. He thus acquired the command of pure, idiomatic and forcible language wherein to clothe the arguments which he wished to enforce, to describe the landscapes which had imprinted themselves like photographs on his memory, and to present restorations of ancient lands and seas which his poetic temperament and powerful imagination called up before his eyes. Moreover, he had a keen sense of humour, which would show itself from time to time, even in the midst of a scientific discussion. He could not bear dulness in others, and strove to avoid it himself. Where his subject might have been apt to grow wearisome, he contrived to lighten it with unexpected flashes of pleasantry or with some pertinent words from a favourite author. This felicitous style seemed so spontaneous, and yet it was in reality the result of the most scrupulous attention. Even in his newspaper articles on the multifarious topics of the passing day, he continued to maintain the same high standard of composition. He has left as his literary monument a series of works that may serve as models of English writing.

In estimating a man's influence on the world we look, not only at his work, but on his character, often the more important and valuable of the two. Judged from this side, Hugh Miller's claims to our regard and admiration are not less strong for what he was than for what he did. Pious and pure-minded, full of generous sympathies, and alive to all that was noblest and best in human life, he was endowed with a manly independence of nature which kept his head erect in every changing phase of his career, and won for him the respect of all, gentle and simple, who came in contact with him. Though naturally robust, his occupation as a mason had left behind some seeds of disease. He was at different times attacked with inflammation of the lungs and other disorders of enfeebled health. His strong sense of duty, however, kept him at his post when prudence earnestly counselled rest. At last the strain became too great, and brought a noble and well-spent life to a sudden and tragic end.

It is to me a valued privilege to take part to-day in the centenary celebration of such a man. The years slip away, and I am probably the only geologist now alive who knew Hugh Miller well. He was my earliest scientific friend. Some boyish articles I had written in an Edinburgh newspaper on a geological excursion to the Isle of Arran had gained me his acquaintance, and ever thereafter I enjoyed his friendship and profited by his encouragement. To his helpful intervention I owed my introduction to Murchison, and thence my entry into the Geological Survey. His death was one of the great bereavements of my youth. It is therefore with heartfelt gratification that here, in his native town, so early familiar to me from his graphic descriptions, I find myself permitted on this public occasion gratefully to express my life-long indebtedness to him for his noble example, for the stimulus of his writings, and for the personal kindness which I received at his hands.

## *WHAT THE UNITED STATES OF AMERICA IS DOING FOR ANTHROPOLOGY.*[1]

HAVING recently had the good fortune to pay a somewhat extended visit to the United States of America, I have thought it might not be uninteresting to you to hear what our kinsmen and colleagues across the Atlantic are doing for the furtherance of anthropology.

The means for the advancement of the science of anthropology fall under the following heads :—(1) The collection of information in the field ; (2) the publication of such information ; (3) the collection of specimens ; (4) the preservation of specimens ; (5) the publication of museum specimens ; (6) the instruction of students ; (7) independent investigation of collected material.

As no hard and fast line can be drawn between some of these activities, I shall deal first with the museums and with the field work undertaken by the more important institutions in the United States of America, and then very briefly with the teaching of anthropology in the United States.

[1] Abridged from the presidential address delivered by Dr. A. C. Haddon, F.R.S., before the Anthropological Institute on January 28. The address is published in full in the current number of the *Journal* of the Institute.

### I. *Field Work and Museums.*

It is a glory to the nation of the United States that it has recognised the duty of collecting information about the aboriginal Americans. The twenty or more annual reports published by the Bureau of Ethnology constitute a monument to the intelligence of the Government and of its departmental officials of which their country may well feel proud. Nor does the Bureau of Ethnology neglect the collection of specimens, as is evidenced by the very extensive collections transferred to the National Museum. I cannot, however, refrain from remarking that it seems very strange that the anthropography, or physical anthropology, of the native tribes is entirely neglected by the Bureau, and I know that others share with me the hope that this state of affairs will be remedied.

The head curator of the department of anthropology in the National Museum, Dr. W. H. Holmes, is gradually working out his conception of what his museum should be. His object is twofold : (1) to illustrate the cultural history of mankind; (2) to demonstrate the distinctive characteristics of the various races and people.

(1) Numerous series of objects have been installed to illustrate the progress of culture, such, for example, as the various stages of evolution from stone implements, on the one hand, to the most modern steel tools and engineering appliances on the other. In this work the curator has been ably helped by the veteran Dr. Otis T. Mason, whose writings on technology are so well appreciated by students. An admirable land transport series has been got together, and one hall is devoted to a wonderful collection illustrating transport by water. There is also an interesting section devoted to comparative religions, of which Dr. Cyrus Adler is the custodian. No Government in the world does so much for ethnology as does that of the United States.

The Free Museum of Science and Art in Philadelphia contains some very valuable and pleasingly arranged collections of Babylonian, Egyptian and Etruscan antiquities. Good representative collections of American ethnology and archæology are being got together, owing to the exertions of Mr. Culin, the director. Of the special collections given to the university, mention need be made only of the collection of gems, of musical instruments and the Furness-Hose collection from Sarawak. In the museum is also to be found Mr. Culin's very instructive and almost exhaustive collection of games, but unfortunately it is stored away in drawers. If this collection was adequately exhibited it would give to the museum a unique position among anthropological museums.

It is instructive to note that although this is a university museum, no support is received from the university, all the scientific work being prosecuted by funds raised from private sources, a result largely due to the enthusiasm of Dr. Sara Y. Stevenson, the energetic secretary of the department.

In 1869 a little band of public-spirited men was created by the Legislature "a body corporate by the name of 'the American Museum of Natural History,' to be located in the city of New York, for the purpose of establishing and maintaining in said city, a Museum and Library of Natural History ; of encouraging and developing the study of Natural Science ; of advancing the general knowledge of kindred subjects, and to that end of furnishing popular instruction and recreation."

A partnership, under sanction of the law, was entered into by the citizens of New York in their corporate capacity with the president and trustees of the museum, it being mutually agreed that the city should pay for the erection of the buildings, their maintenance and protection, while the trustees took upon themselves the responsibility of providing the exhibits, the library, the lectures and other means of instruction and mental recreation. This arrangement is perpetual and irrevocably binding on both parties.

The anthropological department of the museum has accomplished an unprecedented amount of research during the past year, a large sum of money having been received from private sources for the purchase of several important collections of American archæology and ethnology and for the expenses of many expeditions in the field.

The greater part of the anthropological collections in the Yale University Museum are archæological in character. The Peabody Museum of Harvard University is already overcrowded and fresh collections are constantly arriving, which the curator, Prof. F. W. Putnam, is forced to keep in boxes in the store rooms. The main collections are the results of the

digging of mounds in the Eastern and Central States; thus the archæology of that portion of America can be very well studied in the museum. During the years 1887 to 1893 the late Mrs. Mary Hemenway provided funds for archæological and ethnological expeditions to the Pueblo Indians of Arizona and New Mexico.

The history of the progress of anthropology in Chicago is eminently characteristic of that typical American city.

There is no need to give a detailed history of the anthropological department of this museum, as Dr. Dorsey has already done so in the *American Anthropologist*, n.s., ii. 1890, p. 247; but I will briefly indicate the main collections and their origin.

The anthropological collections which formed the foundation of the department were obtained through special expeditions sent out under the direction of Prof. F. W. Putnam, or by collectors resident in the field, who were commissioned by the department of ethnology to undertake the work. A mass of interesting and valuable material from Alaska to Peru was thus accumulated. A few collections from other quarters of the globe were also obtained. The history of the museum since then has been one of almost unparalleled activity. Expedition after expedition has been sent out to collect ethnological and archæological material in North and Central America; some of these have been paid for out of the museum funds, while others have been rendered possible by special donations from benefactors, most of whom are Chicago merchants.

The more technical aspect of the museum has been so well described by Dr. A. B. Meyer that I need not dwell upon it.

The most recent inauguration of anthropological activity is that displayed by the University of California. A department of anthropology was established by the Regents of the University in September, 1901.

As an encouragement to others and as an expression of her great interest in the new department, Mrs. Phœbe A. Hearst, who is one of the Regents and a most generous benefactor to the University, has promised 10,000*l.* (50,000 dollars) a year for five years for anthropological research. In this manner is struck the key-note of the new department. Research first and foremost. We may look forward in the immediate future to the establishment of a really important museum on the Pacific coast which, being under the jurisdiction of the University of California, will be the centre of considerable anthropological research and instruction.

Now that the financial position of the Stanford University at Palo Alto is permanently secured, it is to be hoped that the claims of anthropology will not be overlooked.

This is not the place to describe the points of interest in the various museum buildings, the installation of the collections and the details relating to museum administration and technique. It is the less necessary as Dr. A. B. Meyer, of Dresden, who is a recognised authority on all matters pertaining to museums, travelled in the United States in 1899, and he is publishing a series of well-illustrated reports on the institutions he visited. These reports are invaluable to all those who are interested in the promotion or maintenance of museums and libraries, and it is to be hoped that no architect in the future will attempt to draw up plans for a new museum or library until he has consulted this work.[1]

### II. *The Teaching of Anthropology in the United States of America.*

In America courses of anthropology were established about fifteen years ago at Harvard University and at the University of Pennsylvania. It was one of the first subjects introduced into the curriculum of the University of Chicago. Seven or eight years ago anthropology was recognised in Columbia University in the city of New York. At the present time some thirty-three universities and colleges offer instruction in anthropology. Limit of space precludes my giving details concerning the instruction in anthropology in these numerous institutions, so I confine myself to a consideration of two of the universities where the teaching is most firmly established. Further information on this subject will be found in Prof. G. G. MacCurdy's report on "The Teaching of Anthropology in the United States" in *Science*, n.s., vol. xv. 1902, p. 211.

It would be impossible to include within the limits of a brief address an account of all the work that is being done in anthropology by the Government, by public and private institutions, or by individual effort in the United States of America. Much as I should have liked to have emphasised the interest exhibited in the subject and the wonderful activity that is being displayed, the bare enumeration of all this activity would make a very weary chronicle.

I must confess that I felt a not inconsiderable amount of envy when on every hand I witnessed this energy and then recalled the apathy which pervades our own country.

The American public is more intelligently alive to the interest and importance of anthropology than is our public. The exponents of the science are energetic, enthusiastic and competent, and they succeed in gaining the practical sympathy of wealthy merchants, who are not averse to spending money freely when they see that the money will be wisely spent for the good of the State or of the city. One cannot say that the wealthy Americans are more intelligent than are our rich men, but they do seem to appreciate the value of learning to a much greater extent than do ours. At all events, they respond more readily to the very pressing need there is for the endowment of research and of those institutions which bring the knowledge of the expert down to the comprehension of the masses.

I am quite willing to admit that the fault in this country may lie as much with the specialist as with the capitalist. In any case we have an inspiriting demonstration in the United States of America of what can and should be done in Great and Greater Britain, and I venture to thank our American colleagues in the name of anthropological science for this good example of strenuous effort and praiseworthy accomplishment.

[1] The two parts already issued are entitled "Ueber Museen des Ostens der Vereinigten Staatne von Nord Amerika." Reisenstudien von A. B. Meyer. (Berlin: R. Friedländer und Sohn.)

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE.*

THE new municipal school of technology in Manchester will be opened by Mr. Balfour on October 15.

DR. W. PALMER WYNNE, F.R.S., professor of chemistry in the School of Pharmacy of the Pharmaceutical Society, will deliver an address at the inauguration of the sixty-first session of the School on October 1.

MR. PARKIN, who has just gone to America to formulate a plan for putting into execution the provisions of Mr. Cecil Rhodes's will, has, a correspondent of the *Times* reports, been trying to interest Mr. Pierpont Morgan in a plan whereby the Rhodes scholarship scheme should be made reciprocal, the same number of young Englishmen being educated at American universities as Americans at Oxford. When he landed at New York on August 20, Mr. Parkin said:—"I think it would be a most splendid thing for some liberal American, or several Americans, to endow in some of your great colleges scholarships for the benefit of English youths similar to those founded by the bequest of Mr. Rhodes for the young men of America at Oxford." The same idea was put forward in several American papers when the terms of Mr. Rhodes's will were announced.

THE Childhood Society was founded some five years ago by the late Sir Douglas Galton, and, as its fifth annual report shows, it continues to grow in importance and usefulness. The objects of the Society are to promote the study of educational methods and of the environment of children during school life, with a view to discover the conditions best suited to ensure the healthy mental and physical development of normal children, and those best adapted to the peculiar needs of the mentally feeble and otherwise abnormal children. For the first time, the council of the Society has printed and issued the lectures and papers delivered at its meetings in book form, under the title of "Volume I. of the Transactions of the Childhood Society." A glance through the list of the Society's officers for the current year reveals a desirable cooperation between medical men and professional educationists which cannot fail to result in an improvement in the structure and equipment of schools as well as in the less material conditions of the class room.

A RECENT return printed by the order of the House of Commons, tabulating the sums applied by local authorities to the purposes of technical education, shows that the total amount expended on technical education in England and Wales during 1900–1 was 1,051,422*l.*, but this does not include sums allocated to intermediate and technical education under the Welsh Intermediate Education Act. The total amount of

money available under the Local Taxation (Customs and Excise) Act for technical education in England (excluding Monmouthshire), or, as the grant is usually called, the "whisky" money, was during the same period 924,360*l.*, but only a part was appropriated to educational purposes, 60,513*l.* going to the relief of rates, the London County Council recognising this unenlightened policy to the extent of 32,711*l.* It is gratifying to find, however, that nine only of the forty-nine county councils included in the return devote part of their funds available for education to the relief of rates, and only six of the sixty-two county borough councils allow any such diversion of funds. More than this, two county councils, twenty-four county borough councils, ninety-nine boroughs and 195 urban districts are making grants out of the rates under the Technical Instruction Acts. In Wales and Monmouth, the whole of the "whisky" money is devoted to education, and in addition to this sum about 24,000*l.* raised by rates was expended for the same purpose during the period under review.

ON August 23, Prof. Geddes presided over the Nature-Study Conference organised in connection with the University Extension Meeting at Cambridge, and Mr. Wilfred Mark Webb gave an address on his "Impressions of 'Nature-Study.'" Mr. Webb showed the importance of the three branches of nature-study which he recognises with reference to four of its non-utilitarian aims. "Scientific teaching will often provide," he said, "a definite hobby or interest in life." Going to the other extreme, simple "nature-lore"—studied out of doors—may be expected to add to "the mere joy of existence," to produce "an appreciation of the country and its pursuits," and in correlation with "unsystematised nature-knowledge"—acquired in school as part of general education—to cultivate "habits of investigation by directing natural curiosity into rational channels." The necessity of emphasising outdoor work, the ease with which it may be undertaken off-hand by any teacher and the possibility of regarding it as nature-study in a restricted sense were touched upon. Mr. Macan's excellent suggestion that special nature-study training colleges should be inaugurated by groups of county councils was strongly commended. In the interesting discussion which followed, Miss Ravenhill showed how nature-study leads to the necessary consideration of man in his environment. Prof. Haddon hinted that the best naturalists, and therefore teachers of nature-study, were not necessarily those who had passed examinations. Mr. Oldham disagreed with those who would confine nature-study to animate objects and thus exclude the consideration of the earth itself. Miss Von Wyss described the voluntary biological work undertaken by all the students in the Cambridge Training College.

## SCIENTIFIC SERIAL.

*Journal of Botany*, August.—Continuing their descriptions of "Crassulas from South Africa," Mr. S. Schönland and Mr. E. G. Baker introduce twelve new species of the genus.—A bryological article, with illustrative plate, by Mr. E. S. Salmon is mainly concerned with a consideration of the genus Thiemea, C. Müll, which he is inclined to sink in the genus Wilsoniella of the same authority, and the description of a variety of *Syrrhopodon Gardneri*, Schwaegr.—Other articles are:—Buchanan's Avan Plants, J. Britten; *Hieracium murorum* and *H. caesium*, F. N. Williams; West Lancashire Notes, C. E. Salmon and H. S. Thompson.

## SOCIETIES AND ACADEMIES.

PARIS.

**Academy of Sciences**, August 18.—M. Bouquet de la Grye in the chair.—The resistance to traction of mortar, by M. Considère. The experiments were carried out on prisms strengthened at the angles with iron wires. The results of the traction experiments were automatically recorded by the testing machine, and reduced facsimiles of these curves accompany the paper.—On the year's work at the observatory at the summit of Mont Blanc, by M. J. Janssen. The researches which are proposed for the present year include a study of the modifications which the hæmoglobin of the blood undergoes with muscular effort at varying altitudes, the relations between the altitude and rarity of the atmosphere, and the richness of the spectrum in violet and ultra-violet rays, studies on atmospheric electricity, and the effect upon the composition of the blood and the respiratory exchanges of altitude alone or combined with muscular effort.—On the assemblage of two bodies, by M. G. Kœnigs.—On some organic addition compounds, by M. P. Lemoult. A description of the preparation and properties of some addition compounds of chlorodinitrobenzene with some diamines.—Experimental researches on the conservation of muscular potential in an atmosphere of carbon dioxide, by M. Lhotak de Lhota. Carbonic anhydride accelerates the fatigue of a muscle by stopping the disengagement of energy. On account of this the muscle cannot be used up; the energy may be given off after the removal of the carbon dioxide, and hence this gas constitutes a favourable factor in preserving muscular energy.—The comparative study of the organic fluids of the sacculina and the crab, by MM. Louis Bruntz and Jean Gautrelet.—On some fossil pollens, male prothallia, pollenic tubes, &c., in the Coal-measures, by M. B. Renault. Many pollen grains of the coal epoch contain a perfectly well-marked male prothallus, the compartments of which contain the mother cells of the antherozoids. This prothallus may emit a pollen tube, as in Stephanospermum, or allow the antherozoids to escape directly from the pollen chamber, as in Aetheotesta.—The influence of cream separation on the principal constituents of milk, by MM. F. Bordas and Sig. de Raczkowski. The removal of the fat to the extent of 98 per cent. takes away at the same time 69 per cent. of the lecithin. In the authors' opinion, this is sufficient to explain the high death-rates through gastro-intestinal troubles in those towns where the sale of skimmed milk is allowed. It also accounts for some diseases in infants fed exclusively on sterilised milk.—On the physical geography of the Western Yaïla, Crimea, by M. E. Daniloff.

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