THURSDAY, JUNE 11, 1896.

ON BEHALF OF SELECTION.

Ueber Germinal-Selection; eine Quelle bestimmt gerichteter Variation. Von August Weismann. Pp. xi + 79. (Jena : Gustav Fischer, 1896.)

THE special purpose of the present treatise, the substance of which was given as an address at the International Congress of Zoologists at Leyden in 1895, is stated by the author to be the rehabilitation of the principle of selection. This principle, though many writers now seek to minimise or to dispense with it, still appears to him to be absolutely necessary for any scientific explanation of the problem of life. The only alternative would be to allow the existence of teleological contrivances, and this in science is inadmissible. The theory of natural selection, says Prof. Weismann, has been rated too highly, and is now suffering the effects of an inevitable reaction. It has not been overrated in the sense of having been credited with too wide a sphere of action, but in the sense that investigators have believed that they understood its whole method of operation, and had a clear conception of all its factors. This, however, is not the case. It has been generally left out of account that besides the individual or personal selection recognised by Darwin, there is a selective process always at work between the various parts of the individual organism (Roux), and even between the ultimate vital units within the germ itself. This conception had already been partly propounded by the author in his Romanes lecture delivered at Oxford in 1894, and in his last rejoinder to Herbert Spencer;[1] it is here stated with greater completeness, and brought into more intimate relation with the doctrine of selection as commonly understood. By its means he claims to have advanced a more satisfactory explanation of the origin of variations and their direction along appropriate lines of development than any as yet proposed.

It is quite impossible to do justice to the view here stated within the limits of a short notice such as this. Those interested in the evolution controversy must be referred to the treatise itself, where they will find the author's position fully explained and illustrated, and from which they will also be able to judge for themselves how far his new conclusions are borne out by the facts and reasoning at his command. The main heads of the argument may, however, be briefly sketched as follows.

The laws of variation provide the stones for the building, which are laid in place by selection. Our knowledge of the selection-value of variations is necessarily limited; we are able, however, to adduce many cases of transformation that can only be accounted for on principles of utility. One such instance is the distribution of colour in butterflies as between upper and under surface, and fore and hind wing. For example, while the upper side of *Protogonius* resembles a *Heliconius*, the under side is like a leaf; this *must* be a consequence of adaptation. So, too, must be the correspondence of the hind wing with the apex of the fore wing on the under surface of many butterflies. In view of the fact that the wing-areas so coloured accord with the usual posture of each species during rest, it is absurd to talk here of simple "correlation." Can mere "laws of development" account for the fact that all leaf-like butterflies are wood-haunting species? The case of *Kallima* by itself is decisive for adaptation.

But how have the suitable variations, which have culminated in such perfect adjustment to needs, originated in the right situations, and in correlation with the appropriate instincts? Herbert Spencer applies Lamarckian principles to the explanation of functional adjustments; but this will not meet the case of such parts as are purely passive in function. The current conception of selection (*i.e. individual* selection) is also inadequate to explain instances of this nature. The root of the process must lie deeper; the variations in question must be *determined in the germ*. This is also shown by the dwindling of disused organs, which disappear in a manner not to be explained by individual selection. Lamarckism (*pace* Lloyd Morgan) will not serve, even as a working hypothesis; and if this be the case, there must be, as Osborn says, a hitherto unrecognised factor in transformation; *i.e.* the direction taken by the variation of a part must be determined by utility. Known facts, as for instance those of artificial selection, will carry us a certain distance towards an explanation. In such a case as that of the long-tailed poultry of Japan, the variation must have been enhanced by selection, and the germ itself must have undergone progressive alteration. For further steps we must have recourse to hypothesis. Variations oscillate about a mean, and selection raises the mean to a higher point. This is satisfactorily accounted for by the theory of "determinants." The determinants are subject to the same conditions of nutrition as body-constituents of a higher degree, and will accordingly differ in size and strength. Hence the opportunity for the progressive raising of the mean by individual selection. But a more important principle is yet to be introduced. The phenomena of retrogression in a disused part show that, as the advocates of Lamarckism have rightly alleged, the simple raising or lowering of the mean by "personal" selection is not adequate to explain the facts. Panmixia will account for the degeneration of such a part up to a certain point, but not for a gradual and continued dwindling ending in complete disappearance.

The really efficient cause is *germinal selection*. This rests on Roux's conception of the "struggle of parts," a principle which must apply to the most minute units of life, not only in the somatic, but also in the germ cells; not, however, of course to "molecules" in the chemical sense. Panmixia starts the determinants of a dwindling organ on the inclined plane, down which they are impelled by intra-germinal selection to their final disappearance. The progressive increase, no less than the decrease of a part, must also be assisted by a like selective process taking place within the germ.

But it is necessary to show how simultaneous useful variations arise under the law of selection. This follows from the fact that the alterations of determinants in the germ, when they are once set going by individual selection, continue without needing the help of that

[1] "Neue Gedanken zur Vererbungsfrage," Jena, 1895. "Heredity once more," *Contemporary Review*, September, 1895.

principle as directed to one definite character alone. Individual selection must, however, step in from time to time, to check the other process when this latter exceeds the demands of utility. This is how so many different modifications can be set going at the same time. It is to be observed that qualitative no less than quantitative modification must be under the influence of the same principle. Selection must affect the "biophors" as much as the "determinants" which they compose. A *quantitative* alteration of constituent biophors appears to us as a *qualitative* modification of the corresponding determinants, and this enables us to understand how "units of variation" may play their part by either simultaneous or independent modification, as on the under side of a butterfly's hind wing. The phenomena of mimicry cannot be accounted for by accidental variations only, but must depend on variation definitely directed by utility. It is to be observed that the determinants and groups of determinants here postulated have nothing to do with Bonnet's preformation theory. The determination of the character of a developing ovum by its own constitution, instead of by the action of external forces, must be admitted by all those who do not, like O. Hertwig, confound the conditions of development with its causes.

The assumption seems inevitable that every heritable and independent variation in the soma depends on the variation of a definite part of the germ; not, as Spencer thinks, on that of *all* the units of the germ. The latter theory leads to needless complication. It is no valid objection to the determinant theory that it deals with invisible elements. The same is true of the chemical assumption of atoms and molecules. The theory justifies itself as such in that it can be used as a formula, to express, for example, the conditions of di- and poly-morphism. The "Hotspurs of biology" forget that all our knowledge is provisional. The assumption of biophors and determinants is parallel to such conceptions as "force," "atoms," and "ether-waves" in the domain of physics.

Epigenesis does not, as has been held, allow a simpler structure for the germ than the counter-theory, and germinal selection explains entirely the direction of variation by utility. It also disposes of the objection that selection cannot cause the variations with which it works. Given the numerical fluctuation of the units, selection will do the rest. Hence both the exactitude and simultaneity of useful variations, a simultaneity which may affect like parts, as in the development of eyes and limbs; or unlike, as in the production of complex mimetic patterns. The principle of selection reaches just so far as utility reaches, and translates, as we have seen, quantitative into qualitative modifications. Utility undoubtedly goes hand in hand with modification, but the dwindling of disused parts shows that the inheritance of characters actively acquired does not cover the whole ground, as the selection theory does; for how can the *disuse* of an organ affect the germ? The Lamarckians are right in pronouncing individual selection inadequate to account for the facts, and also in denying that panmixia could bring about the entire disappearance of a disused organ; they err, however, in attributing the results of Roux's "struggle of parts" to heredity.

Thus then the three stages of selection are (1) personal or individual (that of Darwin and Wallace); (2) histological, as maintained by Roux; and (3) germinal, as pointed out by Weismann. There is indeed another stage, that namely between races or stocks. Here individuals play the same part as organs in individual selection; the analogy, however, is not in all respects complete.

Everything in nature, says the author in conclusion, is purposeful; and this fact can only be accounted for by the theory of selection. What is obscure in the process is so from the imperfection of our methods, not of the principle. All kinds of knowledge ultimately resolve themselves into the hypothetical and unknowable. But doubt is the parent of progress; the veil is raised little by little; and what still remains dark in the explanation points, like the magic wand in the hands of the water-finder, to the hidden springs of truth, ready to yield themselves up to the persevering seeker.

The preface contains a forcible and dignified vindication of the use of hypothesis in scientific investigation; both generally and with special reference to the author's own theory of heredity. Appendices are added, in which several points raised by the paper receive more detailed treatment. The controversies that have centred round Prof. Weismann's former works are not likely to be hushed by the present treatise. We may safely venture to predict that the olive-branch held out to the neo-Lamarckians (p. 59) will not be accepted, though the admissions as to the inadequacy of individual selection will be welcomed by many as evidence of a change of view. The absence of all reference to amphimixis no doubt simplifies the argument greatly; it will, however, be probably used in some quarters to point the moral of the author's inconsistency. But, whatever the amount of acceptance which this latest development of the selection-hypothesis is destined to achieve, there can be no question that the present will rank among the most interesting and suggestive of the Freiburg professor's contributions to biological theory. F. A. DIXEY.

[ADDENDUM.—Since the above notice was written, an English translation of Prof. Weismann's treatise has been issued by the Open Court Publishing Company, Chicago.—F. A. D.]

RIVERSIDE LETTERS.

Riverside Letters; a continuation of "Letters to Marco." By George D. Leslie, R.A., author of "Our River." Pp. xvi + 251. (London: Macmillan and Co., Ltd., 1896.)

ALTHOUGH in his preface Mr. Leslie is careful to state that he cannot assert in the case of these Letters, as he did in the previous volume of his "Letters to Marco," that they were written wholly without view to publication, yet is there little or no change in subject-matter or in style. They are, like the former collection, genuine letters sent to his friend Mr. Marks, R.A., and the topics on which he writes are of mutual interest to the two friends who both, as he says, "love nature for her own sake, untrammelled by the prepossessions that not unfrequently accompany that love among the votaries of science or sport," and in publishing them he doubtless

hopes to find like sympathetic readers among the many who share that love with the two Royal Academicians. Nor do we think he hopes in vain. Admirers of nature are a companionable folk; they love to compare notes, to be asked to share each other's triumphs, to admire each other's finds, and among the topics on which Mr. Leslie dilates are many in which they will find an interest. They will be ready with their tribute of admiration for his *Iris susiana* and his *Cipripedium spectabile* (diverse triumphs), with their sympathetic sorrow at the loss of his old and faithful donkey, and will appreciate his avowal of the inexpressible pleasure he felt at the casual discovery of the exquisitely coloured berry of the lily of the valley. "You will, I dare say, laugh at me for my sentimentality," he writes. We cannot believe that his correspondent did, nor will the appreciative reader. It is the spirit of the true lover of nature, to whom such sights, the more that they come unexpectedly, can ever "bring thoughts that do lie too deep for tears."

Mr. Leslie confesses to a life-long fondness for gardening. He tells us that he had known the Jew's Mallow for more than fifty years before he learnt its botanical name of *Kerria japonica*. We doubt if he is happier for the knowledge. We, for our part, love to think of these old favourite flowers by their nicknames, so to speak, and not by the mongrel Latin names of the florists' catalogues. Among plants, as among men, the possession of a nickname is a sign of popularity, and it is the tender old-world associations that linger round them that give such a charm to some mere list of flowers in the poetry of the Elizabethan age. As regards the name of "Jew's Mallow," which, by the way, belongs to the rather numerous class of plants that cottagers seem to grow better than any one else, Mr. Leslie gives an explanation which is new to us, and which, though doubtless a true one, is far less interesting or suggestive than many a one which our imagination has tried to frame. While on the subject of names, surely Mr. Leslie is wrong in blaming (p. 75) English rose-growers for giving French names to the roses they introduce. In a list of more than 170 kinds we cannot find one case of such unpatriotic conduct, while such well-known instances as Captain Christy, Hon. Edith Gifford, and W. A. Richardson seem to point the other way.

The even tenor of Mr. Leslie's narrative is interrupted by two important events—the great flood of November 1894, and the long frost of the early part of 1895, from both of which visitations he escaped comparatively unscathed. In the case of the latter, he attributes his immunity to having such hardy and well-established plants in his garden; while in the former, the porous subsoil, chiefly gravel and sand, seems to have allowed the water to drain away, leaving only a little mud behind. We wonder, by the way, that Mr. Leslie found no fish stranded after the water subsided. We saw on that occasion hundreds of little ones, chiefly baby roach, left lamenting in a meadow near Marlow. But light as the visitation was, those who feel inclined to envy him the facilities to which he owes his Buck Bean and *Cipripedium spectabile*, will perhaps find some consolation in the sketch of his lawn tennis court on November 19, 1894, which, as he says, "was covered by four feet of water, and formed a lovely calm pool to boat on. I took the opportunity in my boat, of clipping the top of a hedge, which was rather too high to reach under ordinary circumstances." A quaint touch.

Like a true gardener, Mr. Leslie has his gird at the weather, anent the disastrous May frosts of two successive years, and at the devastating efforts of his paid staff, a gardener and a boy, in their attempts to help in the flower garden. In this we cordially sympathise with him. Work among the cabbages and potatoes seems to induce in the former official a breadth of handling quite inconsistent with the delicate stippling (we trust we do not misuse these technical terms) appropriate to the flower garden, while there is no weed, not even couch-grass or bindweed itself, that we would not rather see in our borders than "a boy" with a hoe.

With the many other topics touched upon by Mr. Leslie, we have here no space to deal. The book is pleasantly illustrated with drawings by the author. In the sketch of the Nuthatch, we cannot think that he is represented quite stoutly enough built. We have very frequent opportunities of seeing one at his work, and have been much struck not less with the great development of the muscles of his neck, than with the evident force with which he uses them, which latter is admirably indicated in this drawing.

To conclude, Mr. Leslie's book is not, and does not pretend to be, scientific or exhaustive, but it is eminently readable; and those whose lighter occupations lead them to find interest in the same field as Mr. Leslie, will derive much pleasure from the congenial gossip of "Riverside Letters."

MAN AND NATURE IN FINMARK.

Folk og Natur i Finmarken. By Hans Reusch, Ph.D. Pp. 176. 32 Illustrations. (Kristiania: T. O. Brögger, 1895.)

THE district treated of in this volume is one to which, at the present moment, the eyes of the astronomical world are turned with lively interest; for within its bleak borders the approaching eclipse of the sun will be observed if the atmospheric conditions be favourable. To astronomers, therefore, this book will be specially interesting and opportune; and not to them alone, but to every traveller who has visited the far north of Norway and sought the midnight sun, and even to the still more numerous class who are compelled to content themselves with acquiring a knowledge of lands and peoples solely from books. It is a model of what a book of travel should be; all insignificant details are ignored, but we have the observations and suggestions of one of the shrewdest of observers. Dr. Reusch is deeply interested in the commercial progress and social welfare of his fellow countrymen, and his book is full of valuable suggestions for the advancement of both; while at the same time he is not only just, but very generous in the views he expresses about other races, especially in regard to the Russians, whose territory forms the eastern boundary of Finmark. He describes in graphic and, at times, eloquent language the physical and geological features of the desolate interior of this northern province, which lies far within the Arctic circle, its storm-beaten coasts and its inhospitable, silent, stony deserts, where no tree will

grow, not even a shrub, and from which animal life is almost completely banished. Only in its valleys and its waters is there any abundance of animal life; and consequently its human inhabitants are confined mainly to the valleys and the coast. Finmark has a population of 18,000 Laps and 8000 Fins (the Norsk element is insignificant, being only 1 in 300); but these are actually increasing, the Laps having doubled, and the Fins more than doubled, between 1860 and 1887, in spite of the almost chronic condition of poverty in which they, especially the Laps, live, the frequent hunger from which they suffer, and the dirt which characterises their persons and miserable dwellings. They are, nevertheless, healthy as a whole, though the infant mortality is high; and, in spite of their wretched conditions, they are entirely free from those scourges of civilised life—consumption, cancer, calculus, dropsy and dysentery. The Laps are contented, honest (except as regards reindeer), unambitious, improvident and very drunken; their luxuries being brandy, coffee and tobacco. Imprisonment with bread and water is no hardship to a Lap who has been sent to the house of correction for reindeer stealing; he returns from Trondhjem with the air of a travelled man who has acquired distinction.

In discussing the question of the amelioration of the condition of the Laps, Dr. Reusch writes like a far-seeing statesman. He wishes to see them Norwegianised and civilised by the State, and by the mildest methods; he regards the school as the most effective agent, and recommends free education, free food and lodging for children far distant from their homes, and the compensation of the parents by the State for the loss of the services of the children. He admits that there may be individual cases of oppression on the part of Norwegians, which are never heard of, because the Laps cannot or do not write to the papers like the Danes in Schleswig, or the Germans in the Baltic provinces of Russia. In addition to his own observations, the author has availed himself of all trustworthy local information regarding ethnography, commerce, fisheries, industries, natural history, natural products, and mentions the Pasvig River as the only locality in Europe where diamonds are to be found. He enters very fully into the social condition of all the races in Finmark—Lap, Fin, Norwegian, and the Russian traders. The book is an exceedingly interesting one, and is well illustrated; but it is written in Norsk, a language with which, unfortunately, not many are familiar.

JAMES C. CHRISTIE.

OUR BOOK SHELF.

Weitere Ausführungen über den Bau der Cyanophyceen und Bacterien. By Prof. O. Bütschli. (Leipzig: Wilhelm Engelmann, 1896.)

SOME five years have elapsed since Prof. Bütschli first published his investigations on the structure of some of the sulphur bacteria: *Chromatium*, *Ophidomonas*, and Beggiatoa, and his views on this subject have been circulated and discussed far and wide. In the above work Prof. Bütschli has restated at greater length, and at the same time more precisely, the position which he has been led to assume with regard to this delicate question. We say "delicate question," because at present an opinion one way or another can only be based upon the degree of staining dexterity possessed by the investigator, and the results obtained are directly dependent upon the skill with which such operations are manipulated, whilst their interpretation is also subject to the individual intelligence or originality of the experimenter. Prof. Butschli's own words will best express the object which he has had in view in the publication of the present pamphlet. "Although I have made no fresh investigations in this direction during the years which have elapsed since I first published my views, it has appeared advisable to me for some time past to once more express myself on this question, and to support my opinion by the publication of micro-photographs. . . . I have, therefore, studied afresh during the past winter the greater number of the preparations I made in the years 1889–90, and I can only add that although some preparations have suffered in the interval, I have found everything exactly as I described it in 1890. . . . In the following exposition, which I have put together as briefly as possible, I have principally dealt with the doubts which have been thrown at, and attacks which have been made upon, my former statements." In taking up this essay the reader is, therefore, plunged into a keen scientific controversy, and for those who are concerned one way or the other, the subject-matter is replete with interest, and the scientific *littérateur* will gratefully accept the exhaustive bibliography bearing upon the question; whilst even the layman, who possibly feels but slender interest in the problems surrounding the structural character of these lowly forms of life, cannot but admire the beautiful plates with which the text is illustrated.

A Dictionary of the Names of Minerals, including their History and Etymology. By A. H. Chester. Pp. xv. + 320. (New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1896.)

THE study of mineral names by Prof. Chester was originally begun in the interest of Murray's New English Dictionary: the results of years of patient work and search are conveniently collected together in the volume now issued. In the case of each name a record is given of the name of its author, the year of the first publication, a reference to the work in which the name was announced, the derivation, the reason for the name, and a description of the mineral sufficient to indicate the one to which the name was intended to be applied. For many names the information has been already given in Dana's "Mineralogy"; Prof. Chester has gone to much trouble in the attempt to fill up the gaps which remain, but he gives a long list of names relative to which further information is still required. The book will be useful, not only to those who are interested in nomenclature, but to all who wish to have in a single small volume a brief statement of the chemical composition of the minerals to which names have at any time been given. It may be added that Prof. Chester appends a list of the authors of mineral names with the names for which each author is responsible.

L. F.

Principii della Teoria Matematica de Movimento dei Corpi. Gian Antonio Maggi, Professore ordinario della R. Università di Pisa. Pp. 503. (Milano: Ulrico Hoepli, 1896.)

BY omitting illustrations, examples and exercises, and diagrams, the author has managed to give a very compact treatise on all the ordinary formulas of Theoretical Dynamics, including a little Hydrostatics. The author has incorporated into his treatment the most modern ideas of Clifford and Mach; his analytical treatment is elegant and condensed; but a little geometrical and pictorial treatment would give some relief to the procession of equations.

G.

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.*]

Tidal Migrations of Limpets.

WHILE spending a few days, in March of this year, at the village of Matadona, situated on the south-east coast of British New Guinea, facing the China Straits and nearly opposite to the large island of Rogeia, I had the opportunity of making some observations on the habits of a species of limpets.

On the beach near Matadona there is a sort of rugged platform formed by massive eruptive rocks, extending seawards and presenting in some places a more or less vertical frontage, of some three feet in height, to the sea.

The rocky platform, covered at high tide, is quite exposed at low tide, the sea receding a considerable distance away from it.

Great numbers of limpets live on the sub-vertical front of the rocks, while the numerous small holes and crevices, with which it is riddled, are occupied by Chitons, several of which are often crowded together in a very limited space.

Several species of Patella inhabit these rocks at various points, but as a rule they occur as isolated individuals. One species, however, occurs in large herds of a hundred or so individuals, and it is to this gregarious Patella that the following notes refer.

At low tide these limpets are attached to the seaward face of the rock, quite at its base, adjoining the sand of the beach, and it may then be observed that the zone of limpets, as a general rule, occupies a lower level than that of the Chitons.

It may also be noted that many of the limpet shells are themselves coated with Nullipores and other marine plants.

I have several times observed, at the time of flood-tide, that at the approach of the surf, when the latter gets so close as to spray the rocks, the limpets commence to crawl slowly up the face of the rock, and as the tide rises higher so they climb higher, always keeping above the level of the surf.

It can often be observed that they progress in the form of a triangle, the leader at the apex.

From the time the procession commences until they reach the summit of the rocks, out of the reach of the violence of the surf, the slow movement is practically continuous, the whole company of limpets being found on close inspection to be in motion, and producing a unique effect.

The Chitons, sheltered in their nooks and crannies, undertake no such migration; so that, in general, the zone of limpets is above that of the Chitons at high tide.

When the ebb-tide sets in, the limpets start on their return journey; but I have not actually assisted at the downward procession. Between the tides they are stationary, but they produce no scar on the rocks, so that there can be no question as to their "homing" on the same spot.

On returning to the rocks on one occasion, after a stiff south-easterly breeze, I found the sand banked up to the depth of some two feet against the face of the rocks, approximately up to the level of the zone of Chitons, some of the latter being actually buried beneath the surface of the sand. Others again of the lower lying Chitons had shifted their positions in consequence of the inroad of sand.

None of the limpets were thus buried, and they occupied their usual relative position at the base of the available face of rock. The zones of limpets and Chitons then nearly coincided.

This tidal migration of limpets is interesting in comparison with the periodical phenomena in the lives of other marine organisms; while the elevation of the limpet zone through the formation of a sandbank, may perhaps suggest stratigraphical reflections.

ARTHUR WILLEY.

Sydney, April 22.

Butterflies and Hybernation.

IN connection with Mr. Pidgeon's communication, under the above heading, in NATURE of April 2, respecting the probable wintering of a tortoiseshell butterfly in a bath-room, I may state that the hybernation of butterflies is of well-established occurrence in at least certain portions of South Africa, where one species in particular, namely, *Precis sesamus*, Trimen, assembles in numbers at the end of the summer season for the purpose. This very distinct dingy blue and red insect is plentifully distributed in East Griqualand and Natal, especially affecting the road-cuttings between Ixopo and the Ingeli-Zuurberg mountain chain. As remarked in Mr. Roland Trimen's monograph on South African butterflies, it likes shady places under a roadside bank or rocks in a cutting; and Colonel Bowker—an enthusiastic and renowned South African lepidopterist—is quoted as having seen them congregated under rocks and in holes of dry banks, as many as twenty-nine being captured by placing the net over them. Their dark bronzy green under-colouring renders them, when thus massed, almost inconspicuous in association with withered fern, grass, &c., and it is only by startling them that one very often becomes aware of their presence. I particularly call to mind, while on one of my botanical rambles in the Lower Umzimkulu district of East Griqualand in 1885, accompanied by a younger son of Mr. Donald Strachan, unexpectedly flushing at least fifty of these butterflies in the cold frosty season of July, in a secluded glen of the Vubugas rivulet. Upon a little searching among the scrub and bush we discovered a boulder, under which there must have been as many again, if not more. These we roused out with branchlets, some being more torpid than others; but, as we retired from the spot, they all flitted back to their trysting-place. This was at the severest time of the season, and I never doubted, after having observed the massing of this butterfly at all times during the winter, that it emerged safe and strong in the ensuing spring. A description and coloured figure are given in Mr. Trimen's work, vol. i. p. 231, pl. iv. f. 3.

Cape Town, May 20. W. TYSON.

Becquerel's Colour Photographs.

I SEE that the photographs in colour, taken by Becquerel's plan, are said to be mainly due to interference. My own observations do not confirm this statement. A photograph of the spectrum in colours can be readily taken on silver chloride on a glass plate, and be examined both by reflected and transmitted light. The colours in the two cases are identical, which is contrary to the "interference" explanation.

W. DE W. ABNEY.

Bolton Gardens South, S.W.

Cannizzaro Memorial.

SINCE my return from Italy, I have been so frequently asked by friends and admirers of Prof. Cannizzaro what form it is proposed to give to this memorial, that I wish, through your valuable medium, to make it known that it is intended to present the Professor with a medal commemorative of the occasion, and to devote the balance of the sums subscribed to the creation of a Cannizzaro prize or medal to perpetuate his memory, the details of which will be left in his hands.

LUDWIG MOND.

Röntgen Ray Experiments.

IT has been generally noticed that when focus tubes become much blackened, presumably by volatilisation and deposition upon the glass of the platinum of the anode, they cease to be effective owing to the apparent increase in their internal resistance. This is generally attributed to increase in the vacuum due to the occlusion of the residual gas by the platinum black. This may in part be the true explanation, but another is to be found in a curious phenomenon discovered by Prof. Crookes, and described in his 1891 presidential address to the Institution of Electrical Engineers. He says: "It appears that the greater the phosphorescing power of the substance surrounding the poles, so much easier does the induction spark pass. Surround the poles with Bohemian glass or Yttria—two phosphorescent non-conductors of electricity—and the induction spark passes easily: immediately I surround the terminals with a non-phosphorescent conductor" [a film of deposited silver] "the current refuses to pass." Very possibly the deposited platinum in an old or overworked focus tube has a similar effect to the silver in Prof. Crookes' experiment. I have recently had experience with a tube of special form which was much blackened,

and which appeared to have an enormous internal resistance, though its blue appearance and other indications pointed to rather a low vacuum, which seems to show that this is the case.

A. A. C. SWINTON.

66 Victoria Street, S.W., June 8.

Dalton's Atomic Theory.

WITH reference to the communications from the authors and from the reviewer of the "New View of the Origin of Dalton's Atomic Theory," published in NATURE for May 14, I beg leave to offer the following remarks. The most serious difficulty which the reviewer advances against the new view, seems to be that Dalton, in his manuscript lecture to the Royal Institution in 1810, states that, as a consequence of an idea respecting elastic fluids which occurred to him in 1805, "it became an object to determine the relative *sizes* and *weights*, together with the relative *number* of atoms in a given volume"; whereas in one of his note-books, under date September 6, 1803, a table of atomic weights is given. The reviewer says:—"The authors notice this conflict of statement, but get rid of it by assuming 1805 to be a clerical error for 1803." In regard to these conflicting dates, I beg to draw attention to a passage which appears to have escaped the vigilance both of the authors and of the reviewer, and which seems to tell strongly in favour of the clerical error theory. In the preface to Part I. of Dalton's "New System of Chemical Philosophy" (1808), the author, writing of himself, says:—"In 1803, he was gradually led to those primary laws, which seem to obtain in regard to heat, and to chemical combinations, and which it is the object of the present work to exhibit and elucidate. A brief outline of them was first publicly given the ensuing winter in a course of lectures on natural philosophy, at the Royal Institution in London, and was left for publication in the journals of the Institution; but he is not informed whether that was done." I do not think there is any room for reasonable doubt that this passage refers, amongst other things, to the same idea as that stated in the manuscript lecture to have occurred to Dalton in 1805. In any case the date 1803 is definitely settled by the sentence referring to the lectures at the Royal Institution, since we know that Dalton's lectures were begun there on December 22, 1803 (compare Roscoe and Harden's "New View, &c.," p. 61). It ought to be possible to place this matter beyond all doubt if the notes stated by Dalton to have been left for publication in the journals of the Royal Institution are forthcoming.

LEONARD DOBBIN.

University of Edinburgh, May 15.

Halley's Chart of Magnetic Declinations.

I AM again able to add another reference to the list of publications of Halley's Chart of Magnetic Declinations (see NATURE, vol. lii. pp. 79, 106, 343).

The chart to which I now refer is one of the plates of Peter van Musschenbroek's work, entitled "Physicae Experimentales et Geometricae de Magnete, Tuborum Capillarium Vitreorumque Speculorum Attractione, Magnitudine Terrae, Coliaerentia Corporum Firmorum"; Lugundi Batavorum, MDCCXXIX. Its size is $19\frac{1}{8}$ inches × $7\frac{3}{4}$ inches, and it takes in the entire circumference of the globe. The title, in the upper left-hand corner, reads: "Tabula Totius Orbis Terrarum Exhibens Declinationes Magneticas, ad Annum 1700. Composita ab Edmundo Halleyo. Simul eum Inclinationibus a Poundio Observatis."

CHAS. L. CLARKE.

New York, May 28.

Professorial Qualifications.

I AM anxious to prepare myself for the appointment of professor or teacher in chemistry at one of the new technical schools held under the County Councils. Will you kindly inform me the best way to become competent for the post? My age is twenty-five, and I hold first-class certificates in advanced chemistry at South Kensington Science and Art examinations. Is it necessary to obtain the F.I.C. or some similar degree first? Any hints you could give me would be of great help to me.

I must add that at present I have had no experience in teaching.

STUDENT.

LEAP-YEARS AND THEIR OCCASIONAL OMISSION.

AFTER the present year there will be no leap-year, at any rate, in the many countries which now observe the Gregorian style, until 1904; in other words 1900, which would, by the Julian rule, have been a leap-year, will be a common year and have to content itself, like the three years preceding and the three years following it, with the ordinary number of three hundred and sixty-five days. Only once has a similar omission occurred before since the reformation of the calendar in England, viz. in 1800, a year remarkable enough in other respects. The change was originally made in 1582; but as centuries divisible by four hundred without remainder were to be considered leap or bissextile years by either reckoning, there was only occasion, in 1700, when a year was observed as such in England, which was a common year in southern Europe; for 1600 was, as 2000 will be, a leap-year by the Gregorian as well as by the Julian reckoning. Few persons seem to recollect that the change which was effected at Rome in 1582, and followed in this country in 1752, was twofold in its character. If it be desired to make the date in any year correspond exactly with the season of the year, this can of course be done for any future time by inserting or omitting certain intercalary days in the calendar in some such way as is directed by the Gregorian rule to which we are now accustomed, and which was devised by Clavius under the authority of Pope Gregory XIII. But if this had not been done in past ages through want of exact knowledge of the true length of the year, or from any other cause, the fact may either be accepted as inevitable and therefore regretfully disregarded, or we may, if we wish, so change the existing dates in the year from which we start, as to make the seasons correspond with what they were on these dates at some definite period in the past. This is what was actually done, the period selected being A.D. 325, the year of the first great Council of the Church held at Nicæa in the reign of Constantine the Great. At that time the vernal equinox fell on March 21; and as, in consequence of the observance of the Julian length of the year in the interim, it fell in 1582 on the 11th of that month, it was decreed that in the following autumn ten days should be struck out of the calendar, by calling the day after October 4 the 15th, so that in future the vernal equinox (and all the other seasons) should fall as they had done in 325. This arrangement involved another inconvenience besides the awkward enumeration of days in that year, viz. that the seasons were made to disagree appreciably with their dates in the years and centuries immediately preceding the time of the change. However, on the whole, it was thought to be the best arrangement, and it was gradually followed by most of the nations of Europe excepting Russia. In England the change was made in 1752, and the calendar in all respects assimilated to that of the New Style, adopting the Gregorian rules. As in accordance with these, 1700 had not been a leap-year, whereas in England by the Julian reckoning it had been, the two calendars now differed by eleven days; the Act of Parliament therefore, which ordered the change, enacted that the day after September 2, 1752, should be called the 14th.

In speaking of the erroneous length of the year assumed in the Julian calendar, we used the expression "through want of knowledge of the true length of the year, or from any other cause." This was intended as a reference to the fact that, although the exact length of the year was not known in the time of Julius Cæsar, it was certainly known that it fell several minutes short of $365\frac{1}{4}$ days. But it seems that he thought this was sufficiently near for all practical purposes; and a distinguished American astronomer of our own day, in the light of all our modern improved knowledge, is of that

opinion. "The change of calendar," says Prof. Newcomb, "met with much popular opposition, and it may hereafter be conceded that in this instance the common sense of the people was more nearly right than the wisdom of the learned. An additional complication was introduced into the reckoning of time without any other real object than that of making Easter come at the right time. As the end of the century approaches, the question of making 1900 a leap-year as usual, will no doubt be discussed, and it is possible that some concerted action may be taken on the part of leading nations looking to a return to the old mode of reckoning."[1] We are now several years nearer that time than when these words were written, but there is no proposition to return to the Julian reckoning, whilst it seems likely that Russia, which still observes it, will shortly adopt, either at once or by degrees, the Gregorian style, in which case all Christian nations will conform to its use. But it should never be forgotten that Cæsar's main object was to get rid of the previous Roman complication between a solar and a lunar year (endeavouring to keep them together by the insertion from time to time of an intercalary month), and substitute an entirely solar year with only an intercalary day every fourth year, making the length equal to its true amount within a few minutes.

But now comes the question, Is the so-called Gregorian year absolutely exact? Its length is unquestionably nearer that of the true typical year than the Julian year is. But a further modification is necessary if we really desire to make the date of the year correspond with the seasons for all time. The Gregorian rule amounts in fact to considering the year to contain 365·24250 days, whereas the typical year really consists of 365·24220 days, the difference being 0·00030 day, and the Gregorian year is too long by that amount. It in fact drops a leap-year not quite often enough, and a better rule would have been to drop one at the end of each successive period of 128 years. M. Auric has therefore recently suggested in the *Comptes rendus* of the French Academy a modification of the Gregorian rule, which would render it almost absolutely accurate, but which this generation need not, and in fact cannot, decide upon adopting. In 3200 years there are twenty-five periods of 128 years, so that there should be twenty-five omissions of leap-years. But by the Gregorian rule, only twenty-four leap-years are dropped in that interval, or one too few. His proposition then is to make an additional drop or omission of a leap-year in the year 3200 (which would, as the Gregorian rule now stands, be a leap-year), and at every succeeding period of 3200 years, A.D. 6400, 9600, being *not* leap-years. Strictly speaking, however, as the Gregorian calendar was arranged to start from A.D. 325, the first of these periods should expire more than three centuries later than A.D. 3200, and as A.D. 3500 will not be a leap-year by the Gregorian rule of dropping all divisible by 100 without remainder unless also divisible by 400, the nearest way to carry this proposal out practically would be to enact that A.D. 3600 should be an exception and not a leap-year; M. Auric's rule being afterwards applied at intervals of 3200 years, so that A.D. 6800 and A.D. 10000 would not be leap-years, although the Gregorian rule would make them so.

The present writer ventures to propound his own view that this same object would be carried out more straightforwardly by the natural course of dropping a leap-year at the end of each period of 128 years as it was completed, making unnecessary the Gregorian complication of an exception of an exception (*i.e.* the usual leap-year) now proposed to be increased by an exception of an exception of an exception. How exact this one exception would make the calendar (and M. Auric's suggestion would do precisely the same thing in a more roundabout way) may easily be shown. By dropping a leap-year (which usually occurs every fourth year) at the end of 128 years, we obtain in that period ninety-seven common years of 365 days, and thirty-one bissextile years of 366 days, or 46,751 days in all. Dividing this by 128, it is seen that this is equivalent to making each year contain 365·24219 days, the true length of the tropical year being (as above stated) 365·24220 days. It is agreed on all hands that 1900 is not to be a leap-year; and the effect of acting on this proposal would be that the next omission of a leap-year after that date would be in A.D. 2028.

W. T. LYNN.

[1] What Prof. Newcomb means here is making the vernal equinox which the paschal full moon followed, fall on the same date as it did at the time of the Nicæan council.

THE NICARAGUA CANAL.[1]

THE author of this book, though originally an engineer by profession, has become a traveller, a newspaper correspondent in Africa, the Far East, and Central America, and a writer about Eastern countries and problems. The book, accordingly, somewhat naturally reflects the two-fold experiences of the writer. Nicaragua is regarded, on the one hand, as the probable site of a gigantic engineering undertaking for connecting the Atlantic and Pacific, rivalling in commercial importance the Suez Canal; and the feasibility and prospects of the proposed canal are considered from an engineering standpoint, in combination with its commercial and political aspects, which cannot be disassociated from the more purely engineering problems involved. On the other hand, Nicaragua is described, in four chapters in the middle of the book, from the traveller's point of view; and details are given of the manners and customs of the population, the means of communication and resources of the country, with descriptions of the principal towns and other matters of interest noticed in the author's tour through the country. This portion of the book will possess attractions for readers of books of travel; but it appears to have been introduced rather with the object of recording the facts casually collected by the author, than as having any special bearing on the important problem of interoceanic communication. The main object of the book is unquestionably the Nicaragua Canal; and the Suez Canal has demonstrated that it is quite possible to construct a highway for navigation in a country devoid of natural resources, and that the physical conditions of the site selected, and the climate, are the main points which determine the feasibility of isthmian canals.

Several routes have been proposed for forming a water-way across the isthmus of Panama; but the only two which have been deemed capable of practical adoption are the line chosen for the Panama Canal, traversing a narrow portion of the isthmus between Colon and Panama, nearly following the course of the Panama Railway, and the more northerly Nicaragua route crossing a much wider part of the isthmus, in which, however, Lake Nicaragua provides a considerable length of natural water-way. The Paris Commission of 1879, presided over by M. de Lesseps, decided in favour of the Panama route in preference to all the others, including Nicaragua, mainly on the ground that it was essential that an interoceanic canal, with prospects of a very large traffic, should be an open water-way unimpeded by locks, like the Suez Canal; and Panama was the only route which could possibly fulfil this condition. When, however, owing to the treacherous nature of the soil under a tropical rainfall, the unhealthiness of the site when the surface vegetation was disturbed by the excavations, and the difficulties experienced in attempting to cope with the floods of the river Chagres, whose course frequently

[1] "The Key of the Pacific, the Nicaragua Canal." By A. R. Colquhoun. Pp. xiii + 443, with numerous illustrations, plans, and maps. (London: Archibald Constable and Co., 1895.)

crosses the line of the canal, it became imperative to introduce locks on the Panama Canal, in order to endeavour to complete the canal within a reasonable time and at a practicable cost, the special advantage of the Panama route disappeared. During the progress of the Panama Canal works, the Nicaragua scheme naturally remained

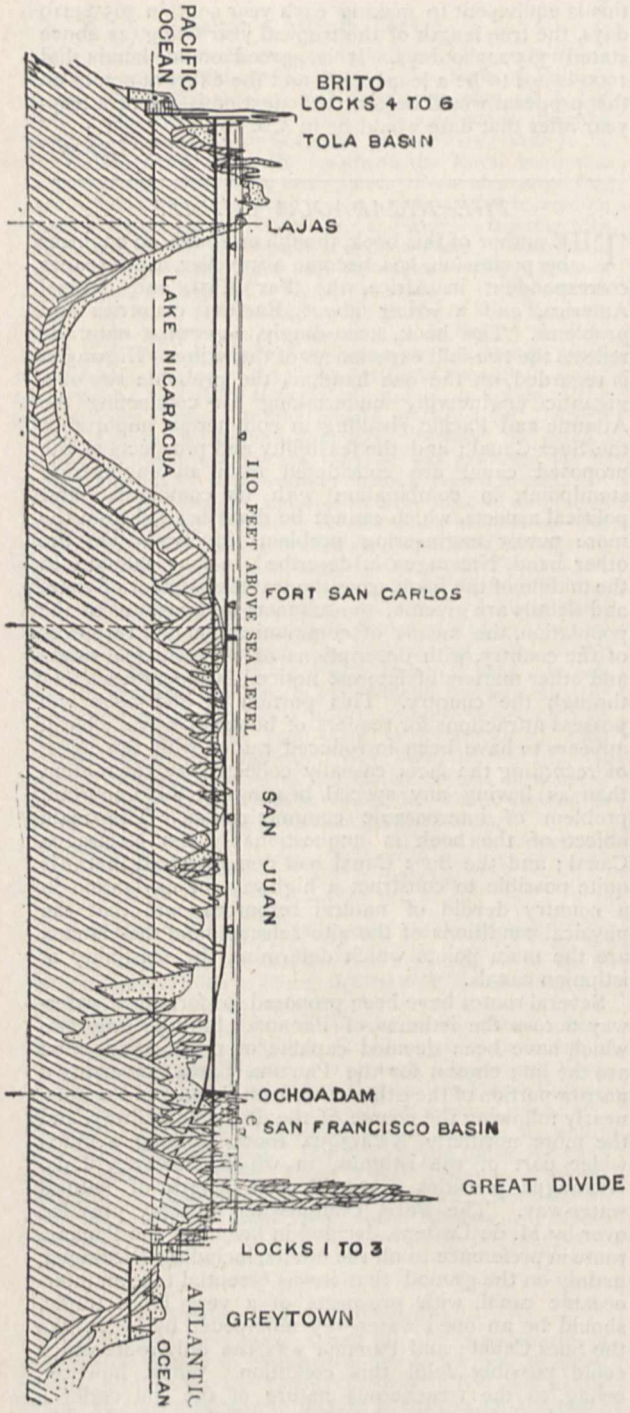

FIG. 1.—Nicaragua Canal (longitudinal section).

in abeyance ; but when the works at Panama came to a standstill for want of funds in 1889, and discredit fell upon the promoters, interest was again aroused in the Nicaragua Canal as the only alternative method of connecting the Atlantic and Pacific. The two routes across the isthmus, starting from points 280 miles apart on the Atlantic side, present a remarkable contrast in their natural configuration. The Panama route, starting from Colon in the Bay of Limon on the Atlantic side, and terminating near Panama in the Bay of Panama on the Pacific coast, has a length of 46⅓ miles ; and the ground rises on the Atlantic side with a fairly gentle slope to the central Culebra ridge, reaching a maximum elevation of about 317 feet above sea-level, and descends with a steeper slope to the Pacific. The canal, as originally designed, had to be formed in cutting throughout ; and a considerable portion of the excavations had been accomplished along the 27 miles of lower ground at the two ends before the cessation of the works, but comparatively little progress had been made in cutting through the main central ridge, 19 miles in width. The introduction of five locks on each slope has very greatly reduced the amount of excavation for carrying the canal through the central high ground ; but it has been estimated that nearly forty million cubic yards of excavation still remain to be effected, and that an expenditure of £36,000,000 is required for the completion of the canal with locks.

The Nicaragua Canal is designed to start from Greytown on the Atlantic side ; and after traversing about twelve miles of low marshy land, it is to rise by three locks to its summit-level (Fig. 1). This summit-level is to consist of dammed-up waters of the Deseado, San Francisco, and San Juan rivers on the Atlantic slope, Lake Nicaragua, from which the San Juan River issues, and the Tola basin formed by damming-up the waters of the Tola and Grande rivers on the Pacific slope. The canal is to descend by three locks from the Tola basin to the harbour which is to be constructed at Brito, by two converging breakwaters, at the Pacific end of the canal. The peculiar feature of the Nicaragua Canal is the long summit-level provided, about 110 feet above mean sea-level, by damming-up the rivers on each slope, in addition to the natural water-way across the lake, thereby greatly diminishing the excavation for forming a canal with a total length of 169½ miles between the two oceans, and substituting free navigation along 142½ miles of the route, in place of the restricted navigation of a narrow canal (Fig. 2). In spite, however, of the engineering skill exhibited in adapting the design so as to take advantage of the special physical conditions of the site, two high ridges have to be pierced near the two extremities of the summit-level, known respectively as the Eastern and Western Divides, involving, in the case of the Eastern Divide, a maximum depth of cutting of 328 feet, equalling in depth the Culebra cutting originally contemplated for a tide-level canal at Panama, through strata apparently not very dissimilar to the Culebra cutting, and exposed, as in that case, to an exceptionally heavy tropical rainfall and a very unhealthy climate. In addition to these unusually deep and formidable cuttings, a considerable amount of dredging will be necessary along the upper part of the San Juan River, to procure the requisite depth of 28 feet, together with the removal of rock from its channel at its exit from the lake and across some rapids in its course. The formation of the canal across the low-lying land between Greytown and the locks on the eastern slope, presents no engineering difficulty ; but the provision of a deep-water entrance between this portion of the canal and the Atlantic, and its maintenance, constitutes one of the most difficult problems of the undertaking. Greytown, the only place along that part of the coast, for a long distance, where deep water approaches the shore, is situated upon a lagoon which has gradually formed in front of the port, by the advance of the delta of the river San Juan under the influence of the waves raised by south-easterly winds ; and it is proposed to carry a breakwater out from the shore into deep water to arrest the littoral drift, under the shelter of which an approach channel is to be dredged. A dam

composed of a mound of loose rubble stone, is designed to be formed across the San Juan River at Ochoa, below the confluence of the river San Carlos, 44½ miles from the lake, in order to raise the water-level of the river to that of the lake along this distance, amounting to an elevation of 56 feet at the site of the dam; but, considering that it is proposed to place this dam on the unstable sandy bed of the river, and that the floods of the river will pass over its crest, the design has not been given adequate solidity. The dam at La Flor, for the Tola basin on the Pacific coast, is to be given a masonry core; and dams will have to be formed for retaining the water in the San Francisco and Deseado valleys; and upon the security of these dams, and the provision for the discharge of the surplus water of the rivers, will depend the safety of the canal. Mr. Menocal, the engineer of the Nicaragua Canal, estimated the cost of the works originally at £13,000,000; but, after revising the estimates, and making allowance for contingencies, the capital has been fixed at £20,000,000; though on this point Mr. Colquhoun remarks that, "taking into consideration all the circumstances—especially the climate, its debilitating character generally, and the excessive rainfall on the eastern side, the volcanic question, the difficulties as regards labour—I am inclined to think that £30,000,000 in genuine expenditure on the work will be found nearer the mark than the present estimate."

The sites of the two rival schemes for piercing the isthmus of Panama, though differing greatly in their general configuration, are very similar in respect of unhealthiness and excessive rainfall on the Atlantic slope and the nature of the strata to be traversed by the excavations; whilst, though a greater height has been adopted for the summit-level for the Panama Canal with locks, necessitating a larger number of locks than for the Nicaragua Canal, the excavation for the Panama Canal has been reduced considerably below the amount required at Nicaragua, and the maximum depth of the Culebra cutting is now about 150 feet less than that of the cutting through the Eastern Divide. The Panama scheme has a greater length of restricted water-way; but this will be compensated for by the much shorter length of the canal, and by the proposed damming-up of the river Chagres, providing free navigation along one or two of the reaches, as well as controlling its floods. The chief difficulty in the construction of the Panama Canal, as now designed, consists in the control of the discharge of the torrential Chagres, which has, however, been greatly minimised by the introduction of locks; whilst not less difficult problems confront the promoters of the Nicaragua Canal, in ensuring the stability of the dams for raising the water-level, the control of the floods of the rivers impounded to form the water-way, and the formation and maintenance of a deep-water entrance through the advancing sands encumbering the approach to Greytown. Nicaragua, moreover, is much nearer the zone of volcanic disturbances than Panama; and severe shocks from this cause would be fatal to the stability of the dams. The estimated cost of completing the Panama Canal is indeed greater than the highest estimate quoted for the Nicaragua Canal, and more searching investigations of the site are in progress, which may possibly lead to an increase in the estimates; but, on the other hand, the recent very adverse report of the United States Commission on the Nicaragua Canal, both as regards construction and cost, shows that no reliance can be placed on the estimates hitherto presented, and that the designs of the dams and other important works will have to be entirely remodelled. A considerable amount of interesting information about the Nicaragua Canal, and its prospects and probable influence on trade, is given in the first five and two last chapters out of the fourteen contained in the book, the description of the project being naturally largely derived from the reports by Mr. Menocal, the originator of the scheme, often in the very words of the promoter. In comparing, however, the Nicaragua Canal with the Panama Canal, it is evident that Mr. Colquhoun adopts the part of an interested advocate instead of an impartial critic. Thus, after alluding to the main points of the Panama Canal and

FIG. 2.—Nicaragua Canal.

Tehuantepec Ship Railway, he concludes the first chapter with the statement, that—

"The greatest obstacles met with in other localities are: (1) high elevations in the Cordillera separating the two oceans, requiring tunnelling; or (2) a high summit-

level requiring a large number of locks, for which an adequate water-supply is not obtainable; or (3) torrential streams whose control within economical limits defies the skill of the engineer."

"Nicaragua is free from all these obstacles."

It would naturally be supposed that Mr. Colquhoun was summing up the views he had arrived at after due deliberation; but in reality he is only acting as the mouthpiece of Mr. Menocal, for the statement is taken verbatim from this engineer's paper on "The Nicaragua Canal," read before the Water Commerce Congress of Chicago in 1893. Summing up the results of his visit to the Panama Canal, the author says:

"The general impression I gained from my visit was that a large amount of useful work remained accomplished. Still the Chagres river and the Culebra cut appeared to me to be obstacles which may be considered insurmountable"; whereas, in reference to the Nicaragua Canal, he says: "The only serious difficulties are (*a*) the Ochoa dam, (*b*) the Great Divide, (*c*) the Greytown Harbour, none of them, however, insurmountable."

In fact, Mr. Colquhoun exhibits a disposition to minimise the obstacles to the construction of the Nicaragua Canal, and to exaggerate those of the Panama Canal, which occasionally leads him to make contradictory statements in different parts of the book. Thus on p. 116, he says:

"While the lake region and Pacific slope are healthy and superior to Panama, the country embraced between Ochoa and Greytown, in my opinion, presents much the same climatic difficulties. Here occurs the dredging of the channel through the stagnant swamps of the San Juan delta, as well as the cut in the 'Great Divide' and the Deseado and San Francisco basins through dense tropical jungle with a rich (but rotten) surface soil. The past history of the Panama Canal and Panama Railway, with their enormous expenditures of life, makes it imperative to treat very seriously this question, and to take every possible precaution. The climates of both Colon and Panama have greatly improved since the canal days."

Later on, however, in contrasting the two schemes on page 142, he remarks:

"The advantages over Panama are these:—It is a fresh-water canal, with an admirable natural reservoir—the lake; it passes through a region offering prospects of great development, free from the marshy soil, the overpowering heat, and the unhealthy climate of Panama; there is no Chagres River problem, and the 'Divide' stands in a different category to that of the Culebra at Panama."

Again on page 317, he states:

"The Panama isthmus, in addition to being very unhealthy, is a region of floods with very poor local resources; the Suez Canal runs through a sandy desert. Nicaragua stands in marked contrast to both these projects. It has a climate immensely superior to that of Panama, a fertile soil, and internal intercommunication, with great resources both vegetable and mineral."

It may be observed, with regard to these last two extracts, that the Panama Canal with locks would be a fresh-water canal, amply supplied by the Chagres, Obispo, and other rivers; it is curious to call the Suez Canal a project; and the desert traversed by the Suez Canal has proved no bar to its unprecedented financial success.

In justice to English engineers, we must draw attention to a misstatement made by the author on page 138, where he says, with regard to the Suez Canal: "The report of other engineers was equally unfavourable." If Mr. Colquhoun had referred to the report he alludes to, he would have found that the Commission which reported was an international one, that the report was eminently favourable and formed the basis of the subsequent canal works, and that, in addition to the foreign members, three English engineers signed the report.

The Nicaragua Canal has naturally been preferred by the United States, as being nearer, and therefore more convenient for the trade of North America; and we agree with Mr. Colquhoun in considering that the simplest solution of the difficulty of connecting the Atlantic and Pacific Oceans, would be for the Government of the United States to construct the canal, which would be of incalculable benefit to the trade of that country. If, however, the United States is deterred from embarking upon this work by the very unfavourable report of the Government Commission, there appear to be no insuperable obstacles to the completion of the Panama Canal with locks, provided the necessary capital can be raised in France and elsewhere.

IN THE HEART OF A CONTINENT.[1]

THE small size of this record of ten years' travel is in keeping with the character of the author, as revealed in his pages. It is rare to meet a man so simple, brave, and kind-hearted as Captain Younghusband, and rarer still to find a book of travel so straightforward, concise, and modest as this. Many volumes have been written by travellers who have spent fewer months than Captain Younghusband has spent years in Central Asia, and without them it would perhaps have been difficult for us to estimate the magnitude of the difficulties, the overcoming of which the author so quietly relates. But this book differs from those by an entire absence of "padding," of hearsay statements, and of rash speculation. There are chapters indeed which are not purely descriptive, dealing in fact with the opinions formed and the thoughts suggested by ten years largely spent in the most remote and desolate regions of the earth. These thoughts and opinions are perhaps the most striking part of the book, showing in a remarkable manner the power of travel and the contemplation (rather than the study) of nature in educating an appreciative mind. To read the following extract from the five chapters of "Impressions of Travel," one would hardly suspect the author of being a young soldier:—

"No one, indeed, who has been alone with nature in her purest aspects, and seen her in so many different forms, can help pondering over her meanings, and though, in the strain and stress of travel, her deepest messages may not have reached my ear, now, in the after-calm, when I have all the varied scenes as vividly before me as on the day I saw them, and have, moreover, leisure to appreciate them and feel their fullest influence, I can realise something of her grandeur, the mighty scale on which she works, and the infinite beauty of all she does. These impressions, as I stand now at the close of my narrative, with the many scenes which the writing of it has brought back to my mind full before my eyes, crowd upon me, and I long to be able to record them as clearly as I feel them, for the benefit of those who have not had the leisure or the opportunity to visit the jealously-guarded regions of the earth, where nature reveals herself most clearly."

It is rare now-a-days to have the magnitude of the earth, the vastness of distances intervening between places, the month-long silence of desert and mountain forcibly brought before one, and it is startling to reflect how little the resources of modern applied science have done to facilitate journeys in really remote regions. Except for some articles of food and the means of defence, men must travel in Central Asia now just as they travelled in the days of Marco Polo, or even of Alexander.

A sketch of those journeys which have won for Captain Younghusband the gold medal of the Royal Geographical

[1] "The Heart of a Continent." A narrative of travels in Manchuria, across the Gobi Desert through the Himalayas, the Pamirs, and Chitral, 1884-1894. By Captain Frank E. Younghusband, C.I.E. (London: John Murray, 1896.)

Society, will prepare the reader for considering the opinions he was led to form on some important questions regarding men and things. In 1884, at the age of twenty-one, Younghusband was invited by Mr. James to accompany him into Manchuria. Never was invitation more eagerly accepted, and once released of his military duties in India, he threw his whole being into travel. Starting from Newchwang on the Yellow Sea, they pushed northward, visiting the Ever-white Mountain, and describing for the first time the wonderful crater lake on its summit, 8000 feet above the sea, whence flows the river Sungari. Thence the journey continued down the Sungari to Kirin, and north-westward into Mongolia, eastward again, and southward through thriving colonies of strong, self-reliant, diligent Chinamen, to the Russian fort of Nova-Kievsk, south of Vladivostok. Thence they went back to Newchwang and Peking, experiencing all the severity of a Siberian winter, and observing amongst many objects of interest the curious phenomenon of a frozen mist, the particles of ice being so small that the whole air glittered in the sunlight. At Peking, Captain Younghusband was fortunate enough to get permission to return to India overland; and in the spring of 1887 he set out alone with a small party of Chinamen to find his way across the Gobi Desert to Kashgar (Fig. 1), and thence over the Karakoram Mountains into India by a route never previously taken by Europeans. The journey was full of incident, if not of adventure, as far as Hami, 2000 miles from Peking, which was reached in three months, at the end of July. The scenery of the Gobi Desert is powerfully described, and the singular character of the gravel-covered valleys, the cliffs, and the sand-dunes very clearly explained. It is a region of æolian formations where erosion by the alternation of heat and cold and the furious blasts of the prevailing winds has its full course unchecked and unassisted by water or ice. Several instances are recorded of heavy showers of rain, not one drop of which reached the parched ground, so rapidly did evaporation proceed in the hot lower air. Thence the route lay along the edge of the Tian-Shan Mountains to Kashgar, where the glory of the vegetation and the comforts of the Oriental city-life were fully appreciated after the weary crossing of the desert. From Kashgar he proceeded to Yarkand, and thence, with Balti guides, plunged into the sea of mountains with the object of reaching India by a new route. Few enterprises in modern mountaineering have been more daring or more successful than Younghusband's rediscovery and crossing of the Mustagh Pass, inexperienced as he was in the ice-craft of alpine climbers, and solely dependent on native guides, who had themselves never passed that way before. To an experienced and well-equipped alpinist the danger would perhaps be inconsiderable, but the high specialist's point of view is not that from which to judge the work of a traveller, unused to mountains, arriving worn from the desert with no mountaineering outfit.

The next journey recorded is one of remarkable interest, bearing as it does on the political condition of the Indian frontier. It was a reconnaissance of the passes across the great mountain barrier from the north, and a visit to the almost-unknown valley of Hunza in 1889. On this occasion Captain Younghusband was accompanied by a small detachment of Gurkhas, the native Indian troops, whose praises as mountaineers and good companions have been sounded by every European who has had occasion to do difficult work in their company. The description of the primitive little State is so attractive, that the reader feels relieved when he is assured that since its subjection to the Indian Government local autonomy has been maintained, and only the raids of the mountaineers on their lowland neighbours have been checked.

FIG. 1.—Kashgar.

In 1890 commenced a longer and more important journey, which led Captain Younghusband back to Yarkand and Kashgar, where he spent a winter studying the curious cosmopolitan population of the capital of Chinese Turkestan, and doubtless collecting information which, not concerning the general public, is not

referred to in the volume. An interesting contrast is noted between the dreamy philosophical indifference of the Chinese to all questions of geography and natural science, their absolute and voluntary ignorance of other countries, and the quick intelligence of the Turki and Indian merchants who travel far, observe keenly, and hold surprisingly clear views on the difficult political questions which the convergence of the domains of the three dominating powers of Asia brings to a focus in Kashgar. At length Captain Younghusband was ordered back to India, making an exploring expedition through the Pamirs on the way, and it is almost amusing to notice how little he speaks of the sport of that famous region; indeed, the killing of *Ovis poli* seemed to interest him less than the observation of the wolves which weed the herds of the old rams when the weight of years and horns makes their removal a benefit to their species. On the Pamirs there were great political problems in course of development, and such information as the reader gleans of Captain Younghusband's intercourse with Russian officers, only whets his desire for the full history of all that went on. At one time the officers of both nations were drinking the health of their sovereigns, and imparting useful hints as to dealing with exacting natives; the next day the Englishman was informed by his Russian friend that he must quit the Pamirs instantly for Turkestan, and sign an undertaking not to cross into India by any known pass. This was done; but instead of returning to the northern plain, Captain Younghusband set to work to discover an unknown pass, and so fulfilled his mission without breaking his word.

The remaining journeys were of less value as exploration, being carried out in the course of military and political duty in Hunza and Chitral, duty which gave to Captain Younghusband a unique knowledge of the intrepid mountaineers whose misguided rulers precipitated the recent war with the Indian Government. For the details of that war we are referred to the special book in which the author narrates his experience as correspondent of the *Times*.

Captain Younghusband gives in his preface one of the most powerful reasons for the inclusion of natural science in ordinary education. He says: "It has been a ceaseless cause of regret to me that I had never undergone a scientific training before undertaking my journeys. During the last year or two I have done what I can by myself to supply this deficiency; but amongst the Himalaya Mountains, in the desert of Gobi, and amid the forests of Manchuria, how much would I not have given to be able to exchange that smattering of Greek and Latin, which I had drilled into me at school, for a little knowledge of the great forces of nature which I saw at work around me."

With one more quotation we must close this notice. Captain Younghusband has been considering the universality of the law of evolution, and proceeds to apply it to the human species with somewhat remarkable results.

"The traveller," he says, "frequently associates with men who are little more than beasts of burden, and on his return he meets with statesmen, men of science, and men of letters of the first rank in the most civilised countries of the world. He sees every step of the ladder of human progress. And, so far as I have been able to make use of my opportunities of observation, I have not been impressed with any great mental superiority of the most highly-developed races of Europe over lower races with whom I have been brought in contact. In mere brain-power and intellectual capacity there seems no great difference between the civilised European and, say, the rough hill tribesmen of the Himalayas; and, in regard to the Chinaman, I should even say that the advantage lay on his side."

It is to the moral superiority of the European races that Captain Younghusband attributes their power over all the races of the East. The illustrations are comparatively few but good and well-chosen, as the specimen on p. 131 shows, while the maps are sufficient as regards number and scale, and show the routes very clearly.

HUGH ROBERT MILL.

PROFESSOR DAUBRÉE.

ONE of the brightest lights in the geological department of French science has been extinguished by the death of Prof. Daubrée, who has passed away at the ripe old age of eight-two years. Born at Metz on June 25, 1814, he early devoted himself to minerals and rocks, and from the École Polytechnique passed in 1834 into the Corps des Mines. In these early years he paid visits to the mining districts of different parts of Europe, and communicated papers on his observations to the Geological Society of France, the *Annales des Mines*, and the *Comptes rendus* of the Academy of Sciences. He already began to display that breath of view and width of sympathy which distinguished his career, for, while studying minutely the mineral districts of Scandinavia, he devoted much time and thought to the erratic formations then beginning to attract attention, and published his views regarding them. Gradually his attention was more and more directed to the experimental side of his favourite science. He studied the artificial production of various minerals, and entered upon a course of profound investigation in which he became the great leader, and did more than any other observer to advance that department of the science.

With a deep admiration for Sir James Hall, the true founder of experimental research in geological inquiry, he threw himself with especial ardour into the investigation of the influence of water-vapour on minerals and rocks when exposed to high temperatures and under great pressure. The difficult problems of metamorphism had a peculiar fascination for him, and he devoted himself with admirable patience to the task of trying to solve some of them by actual experiment. Every geologist who has studied these questions will feel that by the death of Daubrée, the great pioneer who first lighted up for us some of the darkest pathways of the subject has passed away. The various researches collected in his "Études Synthétiques de Géologie Expérimentale" have taken their place among the classics of modern science.

Nor were his investigations confined to the earth. He took special interest in meteorites, and besides diligently gathering specimens, studied their composition and structure, and carried on a series of experiments in order to reproduce their characters artificially, and thus to throw light on the chemistry of extra-terrestrial space. His last important volumes discussed in ample detail the phenomena of underground water, and traced the various solutions and changes which water is now producing and has formerly effected within the crust of the earth.

M. Daubrée spent the greater part of his scientific life in Paris, where he occupied official posts in the École des Mines and Muséum d'Histoire Naturelle. He retired from office two or three years ago, but continued to interest himself actively in scientific research. He was an indefatigable worker, and, like most busy men, found time for more than his own professional duties. He was one of the most regular attendants of the Académie des Sciences, and one of the most influential members of that distinguished body, serving on many of its Committees, and taking an active part in all its concerns. At its meeting last week, the Academy, after some eulogistic words from the President, at once rose in token of its respect. Daubrée was likewise a member of the Council of the Legion of Honour until the whole body resigned some time ago.

The death of his wife last year was a blow to him, from which he never seemed quite to recover. Yet at the Centenary of the Institute of France, last October, he took his part in the various functions, save those that required evening attendance. He accompanied the excursionists to Chantilly, and was welcomed there by the Duc d'Aumale as an old colleague and personal friend. He began to be somewhat ailing before Easter, and though for a time he appeared to rally, and hopes were entertained that his life might still be prolonged, he died peacefully on May 29, at his house in the Boulevard St. Germain.

A courteous and polished gentleman of the old school, M. Daubrée was everywhere a favourite. There was a certain gentle timidity of manner which gave him a peculiar charm. To those privileged with his friendship he was a warm-hearted kindly benefactor who never spared himself trouble to do a kind act, and to give proofs of the depth of his affectionate nature. A. G.

NOTES.

AT the annual meeting of the Royal Society for the election of Fellows, held on Thursday last, in the Society's rooms in Burlington House, the following gentlemen were elected into the Society:—Lieut.-Colonel Sir George Sydenham Clarke, R.E., Dr. J. Norman Collie, Dr. Arthur Matthew Weld Downing, Dr. Francis Elgar, Prof. Andrew Gray, Dr. George Jennings Hinde, Prof. Henry Alexander Miers, Dr. Frederick Walker Mott, Dr. John Murray, Prof. Karl Pearson, Rev. Thomas Roscoe Rede Stebbing, Prof. Charles Stewart, Mr. William E. Wilson, Mr. Horace Bolingbroke Woodward, and Dr. William Palmer Wynne. The investigations made by each of the new Fellows are set forth in the certificates printed in our issue of May 7.

A DISTINGUISHED philosopher, a wonderful orator, and a mind that was always on the side of advancement in science, art and literature, has been lost to France by the death of M. Jules Simon. He was a great educational reformer, and his voice and pen were always ready to support those things which make for the peace and progress of the world. At the celebration of the Centenary of the Institute of France, last October, he delivered a remarkable discourse, which was printed in full in these columns. His concluding words reflect the broadness of his mind so well, that they may be appropriately repeated now. "Associés et correspondants de l'Institut de France, vous n'emporterez pas seulement d'ici le souvenir des chaleureuses sympathies qui vous ont accueillis. Nous emporterons tous, de cette réunion fraternelle, un redoublement d'amour pour la paix, pour les sciences qui la fécondent et pour les arts qui l'embellissent; et nous travaillerons, chacun dans notre coin préféré de l'atelier universel, à la prospérité de la maison, c'est-à-dire au bonheur de l'humanité." The French Chamber has shown its appreciation of Jules Simon's services in the interests of humanity by voting ten thousand francs for a public funeral, and this has been unanimously agreed to by the Senate.

DR. ROUX has been elected an associate of the Academy of Medicine, in the room of the late M. Pasteur.

SIR GEORGE STOKES and Dr. Carl L. Griesbach, Director of the Geological Survey of India, have been elected honorary members of the Austrian Academy of Sciences.

THE annual conversazione of the Institution of Electrical Engineers will be held in the Galleries of the Royal Institute of Painters in Water Colours, Piccadilly, on the evening of Thursday, June 25.

AN agricultural bacteriological laboratory will shortly be opened at St. Petersburg, under the Ministry of Agriculture and State's Domains. Its chief purpose will be the study of the micro-organisms which are harmful to agriculture, and the pursuit of scientific studies in bacteriology. The laboratory is endowed with a yearly grant of 10,000 roubles (£1000) from the Treasury of the State.

THE members of M. Andrée's balloon expedition to the North Pole left Gothenburg on Sunday, June 7, on board the steamer *Virgo*, bound for Spitzbergen.

OWING to some difficulty in connection with the preparations for his new expedition to Greenland, Lieutenant Peary will be unable to come to England as he intended. The meeting of the Royal Geographical Society on Tuesday, June 16, at which he was to read a paper, will, therefore, not be held.

THE steam yacht *Windward* left St. Katharine's Docks on Tuesday with a very large supply of provisions, a number of sledges, and two additional members for the Franz-Josef Land party of the Jackson-Harmsworth Expedition. It is hoped that she will communicate with the explorers at Cape Flora, Franz-Josef Land, on or about July 20. As soon as the *Windward* has discharged her cargo, she will leave Franz-Josef Land with news of the doings of the explorers, and she may be expected in England by the end of September. About this time next year, if all has gone well, the ship will leave London again to bring the explorers home.

WE regret to record the death of Sir George Johnson, F.R.S., at the age of seventy-eight. He obtained his medical education in King's College Medical School, with which institution his life's work is intimately associated; for at different times he there filled the posts of medical tutor, professor of materia medica and therapeutics, professor of the principles and practice of medicine, and professor of clinical medicine. He was the author of numerous works and papers on medical subjects, the best-remembered of which will probably be those on cholera, epidemic diarrhœa, and Bright's disease. A melancholy interest is attached to the fact that his last work, on "The Pathology of the Contracted Granular Kidney," was published the day before his death. He was elected a Fellow of the University of London in 1862, and was admitted into the Royal Society ten years later.

TOWARDS the end of a long and highly appreciative notice of the life and works of the late Sir J. Russell Reynolds, whose death we briefly recorded last week, the *British Medical Journal* thus refers to the scholarly address which he delivered as president of the successful meeting of the British Medical Association held in 1895:—"His presidential address, as the last important public utterance of a distinguished man, has now a double interest. As we reperuse it we seem to read the departing words of a veteran to whom the sunset of life had already given mystical lore, and whose admonitions to those who shortly will reign in his room have assumed oracular force. At the end of a span of years greater than is usually allotted to men of our calling, he looks with calm survey over a period the most pregnant with scientific progress the world has ever yet known. In a series of terse, closely reasoned passages he points out the vast changes that have occurred in the entire theory and method of physic since he first set foot in a hospital ward, rejoicing in the advances made, warning his successors against the errors and defects that those very advances may beget. Science is great, wisdom is greater; the ampler the armament

of knowledge, the more need to strengthen and train the mind by which it must be carried, the judgment by which it must be exercised; such is the constant moral of Sir Russell Reynolds's final utterance to the medical world. Was it in a spirit of prophecy that he warned the subject-ridden student of to-day of the danger of becoming entangled in the net of an ill-considered and misunderstood technical phraseology, and of juggling with words when he ought to be dealing with concrete things? It was at least the warning of a man, rarer among us as the generations proceed, who had seen both sides of the intellectual shield; who was at once a scholar and a scientific physician."

THE Royal Medals and other awards made by the Royal Geographical Society for the encouragment of geographical science and discovery have, reports the *Geographical Magazine*, been assigned as follows:—The founder's medal, to Sir William Macgregor, for his long-continued services to geography in British New Guinea, in exploring and mapping both the interior and the coast-line, and in giving information on the natives; the patron's medal, to Mr. St. George R. Littledale, for his three important journeys in the Pamirs and Central Asia; the Murchison grant, to Yusuf Sharif Khan Bahadur, Native Indian Surveyor, for his work in Persian Baluchistan and elsewhere; the Gill memorial, to Mr. A. P. Low (of the Canadian Survey), for his five explorations in Labrador; the Back grant, to Mr. J. Burr Tyrrell (of the Canadian Survey), for his two expeditions in the Barren Ground of North-East Canada; and the Cuthbert Peek grant, to Mr. Alfred Sharpe, for his journeys during several years in Central Africa. The following geographers have been elected honorary corresponding members of the Society: M. P. de Semenoff, Vice-President of the Russian Geographical Society; Prof. Dr. Karl von den Steinen, President of the Berlin Geographical Society; Prof. Dr. G. Neumayer, Director of the Naval Observatory, Hamburg; Prof. A. de Lapparent, late President of Council of the Paris Geographical Society; Dr. Albrecht Penck, Professor of Geography in Vienna University; Prof. Dr. Otto Petterson, of Stockholm, the distinguished oceanographer; Prof. Dr. Kan, President of the Dutch Geographical Society; Sr. D. Ernesto do Canto, of São Miguel, Azores, who has edited a series of the Archives of the Azores; Prof. H. Pittier, Director of the National Physico-Geographical Institute of Costa Rica.

THE preliminary announcement of the Local Committee of the American Association for the Advancement of Science for the forty-fifth meeting, being the fourth Buffalo meeting, has just been issued. The meeting of the Association itself will be held August 24-28, and affiliated societies will begin their meetings on August 20, and will continue till September 1. On Monday morning, August 24, the retiring President, Prof. Edward W. Morley, will introduce the President-elect, Prof. Edward D. Cope. On Monday afternoon the several Vice-Presidents will deliver their annual addresses as follows:—Carl Leo Mees, before the section of physics, on "Electrolysis and some outstanding Problems in Molecular Dynamics"; Alice C. Fletcher, before the section of anthropology, on "Emblematic Use of the Tree in the Dakotan Group"; Ben. K. Emerson, before the geological section, on "Geological Myths"; Wm. E. Story, before the section of mathematics and astronomy, on "Intuitive Methods in Mathematics"; William R. Lazenby, before the section of social and economic science, on "Horticulture and Health"; Theodore N. Gill, before the section of zoology, on "Animals as Chronometers for Geology"; Wm. A. Noyes, before the section of chemistry, on "The Achievements of Physical Chemistry"; Nathaniel L. Britton, before the botanical section, on "Botanical Gardens"; Frank O. Marvin, before the section of mechanical science and engineering, on "The Artistic Element in Engineering." Prof. F. W. Putman is Permanent Secretary of the Association, and Eben P. Dorr, of Buffalo, is the Local Secretary for this meeting.

THE Geological Society of America will have a series of excursions before the meeting of the American Association, and will hold a business meeting on Saturday evening, August 22, at which papers will be presented by title, which are to be read and discussed in the geological section in the following week. This is a departure from the custom of previous years, when papers read before this Society detracted from the material presented to the geological section. Prof. Joseph Le Conte is President. Other affiliated societies, which meet two or three days before the General Association, are the American Chemical Society (Dr. Charles B. Dudley, President), Society for the Promotion of Agricultural Science (Prof. Wm. R. Lazenby, President), Association of Economic Entomologists (Prof. C. H. Fernald, President), Botanical Society of America (Prof. Charles E. Bessey, President), Society for the Promotion of Engineering Education (Prof. Mansfield Merriman, President). A meeting of the American Mathematical Society will be held after the close of the Association meeting.

FROM a circular recently distributed we learn that Mr. W. Garstang, Fellow of Lincoln College, Oxford, will again conduct a vacation course of study in marine biology at the Plymouth laboratory during the ensuing summer, from July 23 to August 22, inclusive. Students who may desire to join the class should apply to Mr. Garstang before the end of the current month.

IN a contribution to the current number of the *Biologisches Centralblatt*, Dr. Imhof records some observations upon the effects of introducing eels into certain Alpine lakes which seem to him to discredit the generally received opinion that the fresh-water eel spawns only in the sea. The reproduction of the eel is a mystery which has hitherto baffled all attempts at solution; and naturalists may perhaps find some clue to the successful elucidation of the problem in Dr. Imhof's communication. It appears that eels were first introduced into three small Alpine lakes in canton Graubünden in the year 1882. In two of the ponds the fish apparently died; but in the Caumasee they flourished. Extensive additions were made to the stock in the lake in 1887. The eels still thrive well there and attain a length of 1·3 metres. No additions have been made to the stock since 1887, so that all the original eels must be at least eight or nine years old at the present time. Nevertheless, it was discovered last year that young eels were present in the lake; and the knowledge that both sexes are represented there, combined with this discovery, has led Dr. Imhof to the conclusion that the eels introduced into the Caumasee have multiplied in the lake itself. It should be mentioned that the Caumasee is 1000 metres above sea-level, has no apparent outlet, and is fed almost exclusively by subterranean springs. It seems improbable that the presence of the young eels can be due to natural immigration.

AT the recent annual meeting of the Selborne Society, Sir William Flower delivered an interesting address, which is printed in the June number of *Nature Notes*. In the course of his remarks he traced the rise and fall of local museums, and pointed a moral which cannot be too widely known. He said:—"A museum is started or established in some country town, a building is appropriated, various things are brought together, and the people who have done this think they have done a great thing towards cultivating a love for natural history. But in twenty or thirty years when you go again to that place, you will see the building and most of the specimens, but in such a condition that you might well think that the inscription 'Rubbish may be shot here' should be over the doorway. There are a few exceptions here and there, of course, but the

principal reason is that when people start a museum they forget one thing. If you were starting a school the first thing you would think of would be the schoolmaster. A church is of no use without a minister; a garden is of no good without a gardener. None of these things are expected to take care of themselves, yet that is what *is* expected of nearly all the museums in the country. They are set up and the exhibits are arranged, but the last thing anybody seems to think anything about is the curator. A curator is the heart and soul of a museum, and yet we have museums going to decay because nobody thought of the expense that is needful to keep a curator and his staff going. If the thousands, aye, tens of thousands, which have been spent on so-called technical education had only been spent in founding really good local museums—places where any one wishing to know about any bird, or stone, or plant, might go and see for themselves—for I maintain that a museum in its proper sense should be a place of instruction, not merely showing things stuffed and dried like miserable mummies, but giving instruction as to its nature and habit, and any other we might wish to know—what an immense store of useful information would have been gained."

PITHECANTHROPUS is still to the fore. Early this year the Royal Dublin Society published the paper Dr. Dubois read before that Society (*cf.* NATURE, No. 1362, vol. liii., 1895, p. 115), and now he has published a further communication in the *Anatom. Anzeiger* (vol. xii. p. 1), with several illustrations, in which he reiterates his conclusions. A table is given of nineteen anatomists who are classed according to whether they believe Pithecanthropus to be a simian, human, or transitional form; but we imagine that some may object to be tabulated in this form. It is a pity that the ideal reconstruction of the cranium on p. 15, should require to be corrected in two points. Dr. R. Martin has also published a small pamphlet on "further remarks on the Pithecanthropus question," in which he quotes the opinion of a large number of writers on the subject, and particularly lays himself out to attack Virchow; he believes that it is "a low variety of the species *homo*." M. L. Manouvrier concludes in the current number of the *Bull. Soc. d'Anthrop. Paris* (vi. 4e sér. fasc. 6) his erudite "Deuxième étude sur le *Pithecanthropus erectus* comme précurseur présumé de l'homme." This is the most searching scrutiny to which the remains have been subjected, and it forms the most important contribution to the general discussion. It will be remembered that the Javan femur is very human in its characters, the only non-typical differences (putting aside the pathological bony outgrowth) being in the popliteal region. M. Manouvrier has thoroughly discussed this point after having examined several hundred femora, and he finds that the femur of Pithecanthropus fits in a series with normal human femora, and it is not more simian than human; the peculiar variation of the Javan femur is associated with a weak musculature, and the latter may possibly be partly due to the pathological condition already noted; when another femur is discovered, it may be yet more human than this one. In his discussion on the skull, M. Manouvrier gives three alternative ideal restorations and several other comparative diagrams, and he comes to the conclusion that "the Trinil race has arisen from a race of species of very short stature." This is very important from a theoretical point of view; and, with the evidence now to hand, there seem to be grounds for believing that in the evolution of man the femur assumed its human characters in advance of the skull. M. Manouvrier denies that this is a case of microcephaly, and believes that the "missing link" has been found.

REPRODUCTIONS of the decorative artistic efforts of primitive folk are always of great value provided they are perfectly accurately copied. Mr. R. L. Jack, the Government Geologist of Queensland, has recently published a plate or reproductions of aboriginal cave-drawings from the Palmer Gold Field (*Proc. Roy. Soc. Queensland*, xi.), and though we welcome all signs of interest taken in native matters, we cannot but feel some suspicion in the present instance, as there are discrepancies between the figures and the text in certain details. Reproductions of aboriginal drawings lose almost the whole of their value unless the strictest accuracy is preserved. We hope that our colonial scientific societies will publish as many exact transcriptions of native art as they can obtain from travellers, before it is too late.

PROF. R. SEMON, of Jena, whose brilliant investigations on the development of Ceratodus and the Monotremes has already been referred to in these pages, has also turned his attention to the Anthropology of Australia. We cull from our contemporary *Die Natur* (1896, No. 20) the conclusions to which Dr. Semon has arrived respecting the vexed question of the origin of this people. As to culture grade the Australians are ranked above the Veddas, and slightly below the African Pigmies and the Bushmen; the Fuegans are of about the same grade, but the natives of Brazil and the Eskimo are higher. The Australians and Dravidians of India belong to one of the main stems of humanity. The Veddas of Ceylon, judging from the investigations of the Sarasins, belong to a small Pre-Dravidian branch; these arose at a low-culture grade, and have not made any progress since. Other early branches of the primitive Dravido-Australian stem seem to be the curious Ainus of Japan, and the Khmers and Chams of Cambodja. The White Race ("Caucasian") probably came from the Dravidian branch, and thus we Europeans are related to the low savages of Australia; very distantly, it is true, but these are nearer to us than are the Negroes, Malays, or Mongols. It may be noted that these conclusions of Prof. Semon's agree pretty closely with opinions expressed by several English anthropologists.

DR. WESLEY MILLS, Professor of Physiology in McGill University, Montreal, has recently published in the *Transactions* of the Royal Society of Canada (second series, section iv. vol. i. pp. 191-252) a series of papers on the psychic development of young animals. A year earlier, Dr. Mills published the first paper of the series dealing with the psychic development of the dog (St. Bernard and Bridlington terrier). This is now supplemented by observations on the cat, mongrel dog, rabbit, and guinea-pig, and, among birds, the pigeon and the chick. The records are in the form of diaries, from which comparisons and conclusions are then drawn. There is so little systematic record of observations on the instincts and habits of young mammals, that Dr. Wesley Mills' papers are especially welcome. Dr. Mills has also contributed to a discussion on instinct in the correspondence columns of *Science* during the last few weeks, in which Prof. Mark Baldwin also took part. Prof. Baldwin's letters (March 20 and April 10) and Dr. Mills' criticism (May 22) should be read by those interested in the interpretation of the phenomena of instinct in the light of modern theories of heredity.

DURING the last six or seven years, the observation of the pulsations from distant earthquakes has been facilitated by the invention of delicate instruments, such as the horizontal and bifilar pendulums and the long vertical pendulums used in Italy. The investigation of these interesting phenomena suffers, however, from two or three serious disadvantages, which can hardly be removed except by some form of combined action. The instruments employed are of several different types, and they are very unequally scattered over the earth's surface. Many pulsations, again, are recorded which, though of the usual seismic character, cannot be traced to any known earthquake, there

being many countries where no regular organisation exists for the study of these disturbances. We are therefore glad to draw attention to a circular issued by Prof. Gerland, of Strassburg, and signed by nearly all the leading seismologists. Starting from Japan, which possesses the most complete organisation for the study of earthquakes, they suggest a number of stations at which it is desirable that observations should be made. These stations are distributed as uniformly as possible over the earth's surface, and the following places are indicated as especially suitable:—Shanghai, Hongkong, Calcutta, Sydney, Rome, Tacubaya (Mexico), Port Natal, Cape of Good Hope, Santiago (Chili), and Rio de Janeiro. The horizontal pendulum of von Rebeur-Paschwitz is, in the first place, recommended for adoption. As a necessary supplement, it is proposed to form a centre for the collection and publication of reports on the earthquakes of the whole world. These are to be issued as supplements to Gerland's "Beiträge zur Geophysik." They will contain accounts of all earthquakes strong enough to damage well-built houses, and will give in each case the most exact details that can be obtained with reference to the position of the epicentre and the time-records at places adjoining it. Lists are also to be published of all earthquake pulsations registered by the horizontal and other pendulums. The scheme, for which we are chiefly indebted to the late Dr. E. von Rebeur-Paschwitz, can hardly fail to add greatly to our knowledge of earthquakes and their nature, even if it should have to be carried out on a scale less extensive than that now planned.

AN interesting series of experiments on the transparency of liquids is described by M. W. Spring in the *Bulletin* of the Royal Academy of Belgium. The first of M. Spring's papers deals with the colours of the alcohols as compared with water. None of the alcohols observed were colourless when the thickness of fluid was 26 metres; methyl alcohol appeared greenish blue, ethyl alcohol the same, but of a less warm colour, and amyl alcohol greenish yellow. The pure blue colour observed in water becomes thus modified by the admixture of more and more yellow as we pass from one term of the homologous series of compounds to the next. The absorbing powers of the various liquids for ordinary light were also observed, and it was found that these formed a descending series, the simplest substance, water, offering the greatest resistance to the passage of light seen by the eye. In a second contribution, the same writer discusses the temperature at which the connection currents begin to produce opacity in a column of water of given length. Where the length is 26 metres the smallest difference of temperature that will suffice is about 0°·57, and is comparable with that which doubtless exists in lakes and seas. The author concludes that we have here an explanation of the varied colours so often seen on water. These result from the differences of temperature caused by sunshine, on the one hand, and by the cooling action of wind blowing on the surface, on the other.

IN NATURE of June 4, reference was made to a report from Missouri bearing on the question, "Do Röntgen rays exercise any influence on bacteria?" This question forms the title of a paper by Prof. G. Sormani (*Rendiconti del Reale Istituto Lombardo*), in which are described experiments made on sixteen different species of bacteria, both in cultures and when inoculated into living animals. As a result of these experiments, the author has to admit that Röntgen rays do not exercise any sensible action on the cultural and pathogenic properties of the bacteria on which he has experimented.

M. GASPAR SCHMITZ (*Bulletin de l'Académie Royale de Bélgigue*) describes, with diagrams, a fine group of thirty-two upright tree trunks which were discovered in November last on the top of the coal-bearing strata in the Liège basin. There are two theories to account for the existence of these trunks, viz. growth on the spot, or transportation from a distance; and from the evidence derived from careful examination of the surroundings, M. Schmitz appears, however, to incline to the latter theory.

THE Deutsche Seewarte has issued the tenth yearly series of Daily Synoptic Weather Charts for the North Atlantic Ocean, prepared in conjunction with the Danish Meteorological Institute. The charts are drawn for each morning from December 1, 1890, to November 30, 1891, and embrace a large portion of the adjoining continents of Europe and America. The explanatory text, issued in separate quarterly parts, shows (1) the paths of all barometric minima, or areas of low pressure, with indications of the intensity of the depressions; (2) the positions and the changes of locality of the barometric maxima, or areas of high pressure; (3) the mean position of the isobar of 765 mm. (30·1 inches) for certain definite periods. We have before expressed our opinion that the value of this and similar laborious undertakings for the purpose of investigating the laws which underlie our weather changes, most of which reach us from the Atlantic, can hardly be over-estimated.

THE Hydrographic Office of the United States continues the publication and wide distribution of its monthly Pilot Charts for the North Pacific Ocean. These charts contain much information of especial value to seamen, and show the mean average conditions of atmospheric pressure, winds and storms, the positions of areas of high and low barometer, and the principal sailing routes over that ocean. The chart for May last contains the track and log of the American schooner *Aida*, which recently made the passage from Shanghai to Port Townsend, Washington State, in the remarkably short period of twenty-seven days. This passage is an excellent example of what may be accomplished by a captain who takes advantage of existing meteorological conditions and of the information afforded by the Pilot Charts. In the case in point the conditions were certainly favourable, but not exceptionally so.

LIMITS of space prevent us from reviewing, or even enumerating, the whole of the articles in several bulky volumes recently received; all we can do is to direct attention to their publication. The annual of the Bergen Museum—"Bergen's Museums Aarbog"—for 1894–95 contains numerous papers on physical and natural science, archæology and history, printed in Norsk, German, and French. Among the subjects of the papers are:—Results of cross-fertilisation of fishes, the systematic ennumeration of the marine polyzoa of Norway, the geology of the glacier of Hardanger, the geology and archæology of the plateau of Hardanger, ichthyological notices, foraminifera collected near Bergen during 1894, the decomposition of albuminoids in the human organism, echinoderm fauna in the western fiords, mosses of the Sandefiord region, a certain differential equation, and algæ of the western coast of Norway. The volume also contains reports of the collections and work of the Museum during 1894 and 1895. The "Sitz. der königl. bohmischen Gesellschaft der Wissenschaften at Prague," for 1895, comes to us in two volumes, each filled with papers of scientific value, and many well illustrated. There are altogether fifty-three papers and forty-five plates. Unfortunately for scientific readers having only a limited acquaintance with foreign languages, many of the papers are printed in Chech. Among the subjects dealt with are the Arachnida of Bohemia and Moravia, by Prof. A. Nosek; the chalk formation in the neighbourhood of Ripu, by Prof. V. Zahálka; the palæontology of the older palæozoic formations in Central Bohemia, by Dr. F. Katzer; new descriptions of Tubellaria, by Prof. F. Vejdovski; anemometer observations at Prague, by Dr. J. Frejlach; a contribution to the electromagnetic theory of light, by Prof. F. Koláček; monograph of the fossil flora of Rossitz, Moravia, by

Dr. F. Katzer; some curious geological effects produced by wind-borne sand, by Prof. J. N. Woldřich; the anatomy and development of the brain of vertebrates, by F. K. Studnička; the development of Stylomatophora, by J. F. Babor; determination of the altitude of the celestial pole by means of photography, by Prof. V. Láska; on *Baculus elongatus* (Lubbock) and *Lernæa branchialis*, a contribution to the anatomy of Lernæadæ, by A. Mrázek; studies of isopoda, by B. Němec; on electrolytic superoxide of silver, by Dr. O. Šulc; studies of the Coccidæ, by K. Šulc (this paper is summarised in English); the histology and histogenesis of the spinal cord, by Dr. F. K. Studnička; and new vertebrates from the Permian formation of Bohemia, by Prof. A. Fritsch.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus*, ♀) from India, presented by Mrs. Bouveri; two Slow Lorises (*Nycticebus tardigradus*), a —— Toad (*Bufo asper*) from Penang, a Roseate Cockatoo (*Cacatua roseicapilla*) from Australia, a Lesser Sulphur-crested Cockatoo (*Cacatua sulphurea*) from Moluccas, two Spinose Land Emys (*Geomyda spinosa*), a Black-spotted Toad (*Bufo melanostictus*) from Singapore, presented by Mr. Stanley S. Flower; two Hairy Armadillos (*Dasypus villosus*) from Uruguay, presented by Messrs. FitzHerbert, Bros.; a Coati (*Nasua rufa*) from South America, presented by Mr. Ernest Brocklehurst; two Herring Gulls (*Larus argentatus*), two Black-headed Gulls (*Larus ridibundus*) British, presented by Baron Ferdinand de Rothschild; a Javan Porcupine (*Hystrix javanica*, white var.) from Java, a Leopard Tortoise (*Testudo pardalis*), a Natal Python (*Python sebæ*, var. *natalensis*) from South Africa, a Cunningham's Skink (*Egernia cunninghami*) from Australia, deposited; a Japanese Deer (*Cervus sika*, ♂), a Red Deer (*Cervus elaphus*, ♀), two Thars (*Capra jemlaica*, ♀ ♀), a Huanaco (*Lama huanacos*, ♂), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

OCCULTATION OF JUPITER.—On the evening of June 14 there will be an occultation of Jupiter and his satellites. The planet will disappear at 9h. 52m. G.M.T. at an angle of 113° from the north point towards the east, and reappear at 10h. 43m. at the position angle 293°. The moon will be about three and a half days old, but as it will set at 10h. 56m. the reappearance will occur under unfavourable conditions of observation. The sun will pass below the horizon of Greenwich at 8h. 16m. on the 14th.

COMET SWIFT.—The following elements for comet Swift, 1896, have been derived by F. Bidschof (*Ast. Nach.*, No. 3356).

T = 1896 April 17·68237 (Berlin M.T.)

$$\left.\begin{array}{rl} \omega = & 1\ 43\ 55\cdot3 \\ \Omega = & 178\ 15\ 28\cdot1 \\ i = & 55\ 33\ 42\cdot8 \end{array}\right\} 1896{\cdot}0$$

$$\log q = 9{\cdot}753076$$

The following is a short ephemeris, the unit of brightness being that on April 19:—

	R.A. h. m. s.	Decl. ° ′	Brightness.
June 11	22 17 17	+72 43	0·05
15	21 52 31	72 21	0·05
19	21 29 5	71 46	0·04
23	21 7 20	70 57	0·03
27	20 47 29	69 57	0·03
July 1	20 29 38	+68 45	0·03

The last published observation is that of Dr. Engelhardt on May 11 (*Ast. Nach.*, No. 3353), when the comet was reported "faint."

SPOTS AND MARKINGS ON JUPITER.—During the past seventeen years Prof. Hough, of the Dearborn Observatory, has made an almost unbroken series of observations of the markings of Jupiter, with the special aim of studying the phenomena by means of micrometrical measures of size and position, rather than by sketches. He considers that for the proper interpretation of the changes taking place, such measurements, extending over a long period of time, are absolutely necessary, while the study of latitude variations is likely to lead to results as important as those of rotation period (*Ast. Nach.*, No. 3354). Photographs have been regarded as capable of giving results as accurate as micrometric measures in the telescope, but long experience has led Prof. Hough to doubt this conclusion. Notwithstanding its varying visibility, the size and shape of the great red spot have changed very little since 1879, though during recent years it was possibly 1″ shorter than when it was most conspicuous. The very slight change in the latitude of the spot during the last seventeen years seems to indicate that this object is the most stable of any of the markings. The average length of the spot, reduced to mean distance, has been 11″·61 or 37°·2. Measures of the equatorial belt and of several spots are also given, and it is worth noting that there are many advantages in Prof. Hough's method of expressing latitudes in direct measures of angular distance. A very suggestive observation was made on February 13, 1895. The third satellite was then observed in transit, at first as a black spot, but afterwards as a white disc; "after emersion, when the distance from the limb of the planet was 0″·4, the outline was sharply defined, and there was an absence of glow around the disc as though the satellite was immersed in a medium which absorbed some of its light."

COMET PERRINE-LAMP (1896 I.), which attracted considerable attention in the early part of the year, has probably now passed out of reach of even the largest telescopes. M. Schulhof has computed hyperbolic elements for this comet; but while the hyperbolic character of the orbit is still uncertain, it is established that the comet is not one of short period.

THE RELATIVE LENGTHS OF POST-GLACIAL TIME IN THE TWO HEMISPHERES.

SOME interesting observations on underground temperature have recently been made at Cremorne, near Port Jackson, in New South Wales.[1] The bore is 2939 feet deep, the mean temperature at the surface is 63° F., and the temperature at the depth of 2733 feet was found to be 97° F. The observations having been made with great care, the resulting gradient of 1° F. per 80 feet would appear to be "a good approximation to the truth." The rocks of the district down to a depth of about 3000 feet consist of sandstones, shales and conglomerates, and therefore, so far as conductivity is concerned, seem to be not unlike the rocks penetrated by the shafts of coal-mines in the north of England, or those in which Forbes' rock-thermometers were sunk in the neighbourhood of Edinburgh.

The estimates of the relative lengths of post-Glacial time in the two hemispheres, given on p. 138, are based on the following assumptions, the first three of which, it is needless to say, are only rough approximations to the truth. It is supposed (1) that in each hemisphere the gradient beneath the ice-sheet at the close of the Glacial period was the same[2]; (2) that the gradient at the surface may now be taken as equal to the average gradient over the whole boring; (3) that when the ice-sheet disappeared, the mean temperature of the district rose *suddenly* to its present value; and (4) that, previously to its disappearance, the temperature of the ground at the base of the ice-sheet was that of the freezing-point of water due to the pressure of the ice above, say 30°·5 F.[3]

The change in the gradient near the surface after a lapse of t years, due to a rise of b degrees in mean surface temperature, is $b/\sqrt{(\pi\kappa t)}$, where κ is the conductivity of rock expressed in terms of its own capacity for heat.[4] Now, the mean temperature over England averages 49°·5 F., so that b is here 19°, and the temperature gradient in the north of England is 1° per 49 feet.[5] Hence,

$$\frac{19}{\sqrt{t}} = \sqrt{(\pi\kappa)}\left(\frac{1}{x} - \frac{1}{49}\right),$$

[1] Report of B. A. Underground Temperature Committee, 1895.

[2] This implies that the Glacial period was of the same—or, if not, of very great—length in each hemisphere.

[3] See a paper "On the Effect of the Glacial Period in changing the Underground Temperature Gradient" (*Geol. Mag.*, vol. ii., 1895, pp. 356-360).

[4] Rev. O. Fisher, *Phil. Mag.*, vol. xxxiv., 1892, p. 339.

[5] Sir J. Prestwich, "Controverted Questions of Geology," p. 203.

where 1° per x feet is the unknown gradient at the end of the Glacial period. At Port Jackson, b is 32°·5, and the gradient 1° per 80 feet. If t' be the corresponding value of t, we have

$$\frac{32{\cdot}5}{\sqrt{t'}} = \sqrt{(\pi\kappa)}\left(\frac{1}{x} - \frac{1}{80}\right),$$

and therefore

$$\frac{32{\cdot}5}{\sqrt{t'}} - \frac{19}{\sqrt{t}} = \sqrt{(\pi\kappa)}\left(\frac{1}{49} - \frac{1}{80}\right).$$

Lord Kelvin, making use of Forbes' observations, finds κ to be 400, so that the last equation reduces to

$$\frac{65}{\sqrt{t'}} - \frac{38}{\sqrt{t}} = 0{\cdot}56.$$

This is satisfied if t and t' are both 2325 years, but so small a length of post-Glacial time is of course inadmissible. But, if t be increased beyond this value by any amount, it may be shown that t' is increased by a smaller amount; that is to say, the length of post-Glacial time must be greater in the north of England than at Port Jackson.

The following table contains some numerical estimates of the relative lengths of post-Glacial time in these districts, calculated from the last equation :—

North of England. Years.	Port Jackson. Years.
10,000	4,800
20,000	6,100
30,000	6,900
40,000	7,500
50,000	7,900
100,000	9,100

Too much stress should not of course be laid on these figures. The second and third, especially, of the assumptions on which they are based, must certainly be far from true. But, at any rate, it seems clear that the ice must have left the neighbourhood of Port Jackson much more recently than it left the north of England.

Whether this conclusion points to an alternation of the Glacial periods in the two hemispheres, and so furnishes an argument in favour of Croll's theory, is perhaps doubtful. But it shows, I think, how important it is, from a geological point of view, that further temperature observations should be made in the coal-mines and other borings of Australia, New Zealand, and South Africa.

C. DAVISON.

PLANT-BREEDING.

WE are most of us now-a-days so much accustomed to see our gardens or our houses bedecked with flowers, and our tables supplied with vegetables and fruit, that we take these things for granted, and do not trouble to inquire whence they come or how they are produced. But if we look back even a few years, we shall see how much larger a share plants have now in our lives than they had then. We shall see, moreover, that while there has been enormous numerical increase, there has also been in many cases continued progression in form and other attributes. We are not concerned here with the introductions from foreign countries, important though they are; our business for the moment lies with the changes resulting from the natural processes of variation as controlled by the art of the gardener. The garden roses of to-day, for instance, are not the roses of a dozen years ago, and as to the sorts that were grown by our fathers and grandfathers, they have, with some few exceptions, utterly gone. It is the same with peas and potatoes, and with most other plants that are grown on a large scale. True, there are some exceptions; there are some "good old sorts," which seem to show by their persistence that they are the fittest to survive under existing conditions. The black Hambro' grape is an illustration, the old double white Camellia is another; but these plants are not reproduced by seed, and therefore do not invalidate the rule, that each succeeding generation of plants differs in some degree from its predecessor. At first the differences are slight, and it may be imperceptible to all but the trained expert; but they become more accentuated as time goes on, till at length they eventuate in forms so different from that from which they sprang, that they would undoubtedly be considered of specific, if not of generic, rank, were not their history known. The Jackman Clematis and its near allies may be cited as cases in point, and still more remarkable are the tuberous Begonias, which, like the Clematis just mentioned, have been created, so to speak, within the last quarter of a century, and which are so different from anything previously known amongst Begonias, that they have actually been raised to the dignity of a genus by M. Fournier, a French botanist. Pansies and Auriculas—garden productions both—are now, morphologically speaking, as good species as are most of the groups of individuals to which this rank is assigned by naturalists. Of their seedlings a large proportion comes true—that is, the parental characteristics are so far reproduced that there is no greater amount of variation among the offspring of many of these artificially-made species than there is in the progeny of natural species. If, as is the case in some Auriculas and the gold-laced Polyanthus, we find little change has occurred during the last few years, may not this relative invariability be the result of the gradual assumption of a degree of stability which we usually associate with the idea of a species? Again, it often happens that these high-bred, close-fertilised plants become sterile, so that their continuance can only be ensured by cuttings, or some means of vegetative propagation. Is not this analogous to the retrogression and ultimate extinction which occur in natural species? It is not necessary here to cite more illustrations; our concern lies rather with the way in which these changes are brought about. This leads us to what is called the improvement of plants, or plant-breeding. There seems to be a growing tendency to make use of the latter term; but if it is to be adopted, it must be taken in a broad sense, and not limited to the results of sexual propagation.

The two methods, made use of by gardeners and plant-raisers for the improvement of plants, are selection and cross-breeding—the latter, as far as results are concerned, only a modification of selection. The natural capacity for variation of the plant furnishes the basis on which the breeder has to work, and this capacity varies greatly in degree in different plants, so that some are much more amenable and pliant than others. The trial-grounds of our great seedsmen furnish object-lessons of this kind on a vast scale. Very large areas are devoted to the cultivation of particular sorts of cabbage, of turnips, of peas, of wheat, or whatever it may be. The object is two-fold—primarily to secure a "pure stock," and secondarily to pick out and to perpetuate any apparently desirable variation that may make itself manifest.

The two processes are antagonistic—on the one hand, every care is taken to "preserve the breed," and to neutralise variation as far as possible, so that the seed may "come true"; on the other hand, when the variation does occur, the observation of the grower marks the change, and he either rejects the plant manifesting it as a "rogue," if the change is undesirable, or takes care of it for further trial, if the variation holds out promise of novelty or improvement. It is remarkable to note how keen the growers are to observe the slightest change in the appearance of the plants, and to eliminate those which do not come up to the required standard, or which are not "true." Where the flowers lend themselves freely to cross-fertilisation by means of insects, as is the case with the species and varieties of Brassica, it is essential, in order to maintain the purity of the offspring, to grow the several varieties at a very wide distance apart. In passing along the rows or "quarters," the plant-breeder not only eliminates the "rogues," and retains what he thinks may be desirable variations, as we have said, but he specially marks those plants which most conspicuously show the characteristic features of the particular variety he desires to increase, and he takes care to obtain seed from the plants so marked. The variety thus becomes "fixed," but it is obvious that that word is only used relatively; really, there is a constant change, which may be either in a retrograde direction, or which may be looked on as an amelioration. Thus, in the seedsmen's advertisements we see announcements of this character: "So-and-so's *Improved* Superlative Cucumber" or whatever it may be. This "improvement," when it exists, is the result of the careful scrutiny, elimination, and selection exercised by the raiser. These are repeated season after season, till a degree of fixity is attained and a good "strain" is produced.

Fierce competition and trade rivalry forbid the growers to relax their efforts, and thus it happens that the pea or the potato of to-day is not the same, even though it may be called by the same name as its predecessors. To the untrained eye, the primordial differences noted are often very slight; even the botanist, unless his attention be specially directed to the matter

fails to see minute differences which are perceptible enough to the raiser or his workmen. Nor must it be thought that these variations, difficult as they are to recognise in the beginning, are unimportant. On the contrary, they are interesting, physiologically, as the potential origin of new species, and very often they are commercially valuable also. These apparently trifling morphological differences are often associated with physiological variations which render some varieties, say of wheat, much better enabled to resist mildew and disease generally than others. Some, again, prove to be better adapted for certain soils or for some climates than others; some are less liable to injury from predatory birds than others, and so on. These co-relations, then, are matters of the greatest importance to the biologist intent upon the study of progressive modification, and to the merchant and the cultivator for practical reasons.

So far we have been alluding to variations in the plant as grown from seed, but similar changes are observable in the ordinary buds, and gardeners are not slow to take advantage of these variations. The buds taken from the base of a plant not unfrequently differ from those which are developed higher up, and these differences are perpetuated by propagation by means of cuttings or grafts. An interesting illustration of the variability in flower-buds is furnished by the gigantic Chrysanthemums which attract so much attention in late autumn. Without entering into technical details, it may be briefly stated that the cultivator selects certain buds, or one bud occupying a special position, and pinches off and rejects most or all the others. The result is not only a flower-head of large size, such as we might expect under the circumstances, but also, in very many cases, one which presents different characteristics to those which are manifested by the other buds when allowed to develop themselves. "As like as two peas in a pod" is, therefore, a motto which has not the significance it had before we had observed that the peas are mostly different, sometimes very much so, and the same thing happens, as has been shown, in the ordinary leaf- and flower-buds; doubtless each cell has its peculiarity, which only awaits a Röntgen ray or some other means to become visible.

Before we leave the subject of buds, some mention may be made of that form of bud-variation which the gardeners speak of as "sporting." Sports are bud-variations which occur suddenly, without assignable cause, and often simultaneously in different regions widely separate. Thus we get peaches and nectarines on the same bough, black and white grapes on the same shoot, or even in the same bunch, finely-cut leaves on a branch that normally produces broad or entire leaves, and so on. The gardener who is on the alert takes care to remove such buds, and to propagate them by cuttings or grafts. If raised from cuttings or layers, the duration of the sport is indefinite; if propagated by grafting, their duration is naturally conditioned by the life of the stock. The problems afforded by sports are of great interest, and are by no means fully solved. Many of them may arise from atavism, or a reversion to an ancestral condition; but of this there is no proof, neither can we appreciate the reason why such reversion should take place. Some may be the result of the dissociation of previously mixed characteristics. Of this we frequently see unmistakable evidence. Thus hybrid berberries frequently show on the same plant an un-mixing or separation of the characters belonging to the two parent-forms.

This brings us to the subject of cross-breeding as a means of obtaining new or improved varieties. Cross-breeding may occur in all degrees from the case where the pollen of one flower is transferred, by insect or other agency, to the stigma of another on the same branch, to that in which the pollen is transferred to the flower on a plant of a different species. Watch a bee travelling over the great disc of a sun-flower, and it will become obvious that (always provided the stigmas be in a receptive condition) cross-fertilisation of neighbouring flowers must take place.

There are endless adaptations which ensure cross-fertilisation, and on the other hand there are very numerous structural arrangements which necessitate close fertilisation, or the fertilisation of a flower's ovules by pollen produced in the same blossom. In view of the copious literature on this matter, it is not necessary here to enter into further detail. It is enough to say that some of the most astonishing results of the gardener's art are due to this practice of repeated cross-fertilisation. When the cross is effected between plants of two different species the term "hybridisation" is made use of, but it is obvious that there is only a difference of degree between the fertilisation of different flowers on the same plant and that of flowers belonging to different species, or even genera.

The tuberous Begonias, before alluded to, are the results of the successive intercrossing or hybridisation of several species, and the result is the production, within little more than a quarter of a century, of a race or garden-group, not to be matched in nature, and so distinct as to have been thought worthy not merely of specific but of generic rank.

Many recognised genera, we might even say most, are not so sharply differentiated as are these Begonias from others of the same family. These extreme crosses apparently are not effected under natural conditions, and some botanists even hesitate to admit the occurrence of hybrids in nature except under very exceptional circumstances. The gardeners and cultivators, however, have long considered certain forms to be of hybrid origin, and one of the most interesting things in this connection of late years is the positive evidence which cultivators have been able to bring forward as to the existence and the parentage of natural hybrids. Certain orchids, now rather numerous, were, from the appearances they presented, assumed to be "natural hybrids" between certain species. That such assumptions were correct has now been proved by the production in our orchid houses of forms indistinguishable from those met with in a wild condition, as the direct consequence of the designed fertilisation of one flower by the pollen of another.

Fairchild, a nurseryman at Hoxton, and the founder of the Flower-sermon, was the first on record to raise a hybrid Pink. Indeed, this is the first artificial hybrid of any kind on record, and it dates from 1719. From that time to this gardeners have gone on selecting, cross-breeding, hybridising. At one time some good folk looked askance at such operations as an interference with the laws of Providence. So much was this the case, that one eminent firm of nurserymen in the early part of the century led their customers to believe that certain heaths (Ericas), which they had for sale, were imported direct from the Cape of Good Hope, instead of having been raised by cross-fertilisation in their own nurseries at Tooting!

Gardeners for the most part pursue their experiments with no scientific aim. The names of Philip Miller, Thomas Andrew Knight, and of Dean Herbert, amongst others, suffice to show that some gardeners appreciate the deep scientific value of these every-day procedures. From the labours of these men and their successors it is made obvious that the cultivator, by availing himself of natural tendencies and natural agencies, and by his power of eliminating conflicting or unpropitious elements, does actually bring about, in a relatively very short period, the same results that occur under natural conditions only after the lapse of a prolonged period. Do not these facts show the desirability for our own biologists to study carefully the results obtained by the gardener, and better still to enter, as their great leader Darwin did, the field themselves as experimenters.

There can be few departments in which greater promise of important results can be held out.

MAXWELL T. MASTERS.

THE ROYAL OBSERVATORY, GREENWICH.

ON Saturday last, the Astronomer Royal presented his annual report to the Board of Visitors of the Royal Observatory, Greenwich. Following the usual custom, a number of astronomers and other men of science were invited to inspect the buildings and instruments of the observatory. The subjoined extracts from the report give a general idea of progress made in some departments since the middle of May last year.

Work with Equatorials.

The new equatorial with photographic telescope of 26 inches, presented by Sir Henry Thompson, is now nearly finished and ready for inspection at Sir Howard Grubb's works. Sir Henry Thompson has completed his valuable gift by the addition of a Cassegrain reflecting telescope of 30 inches aperture, to be carried in place of the counterpoise at the other end of the declination axis.

The 28-inch refractor has been in constant use for micrometric observations during the year, and for spectroscopic observations till November last year.

The measures of the dimensions of Saturn and his rings,

begun last year, were continued on nine nights, and the results communicated to the Royal Astronomical Society in November. The diameters of Jupiter were measured on nineteen nights with the filar micrometer and, for comparison, with the double-image micrometer; the results were communicated to the Royal Astronomical Society in May. The weather during the opposition of Jupiter and Neptune made it impossible for any systematic search to be made for Jupiter's fifth satellite, and the position of Neptune's satellite was only observed on one night.

The Photographic Chart and Catalogue.

With the Astrographic Equatorial 502 plates, with a total of 1224 exposures, have been taken on 123 nights in the year ending May 10, 1895. Of these, 135 have been rejected for various reasons.

The following statement shows the progress made with the photographic mapping of the heavens between May 11, 1895, and May 10, 1896:—

	For the Chart (Exposure 40 m.).	For the Catalogue (Exposures 6 m., 3 m., and 20 s.).
Number of photographs taken	118	353
,, successful plates	89	247
,, fields photographed successfully	79	223
Total number of fields photographed successfully since the commencement of the work	490	732

The question of the utilisation of the photographs taken for the Astrographic Chart, and the formation of a catalogue of stars down to the eleventh magnitude by means of photography, has occupied much attention during the past year, and a satisfactory working scheme for the measurement of the photographic plates and determination of the positions of the stars on them has been brought into operation. It is estimated that if no unforeseen difficulties arise the measures and calculations for the Greenwich Astrographic Catalogue of Stars down to the eleventh magnitude, from Dec. 64° N. to the Pole, will be completed in about seven years, and that the positions of about 120,000 stars will be determined with a degree of accuracy at least twice as great as that of the Astronomische Gesellschaft Catalogues from meridian observations. When it is considered that the Greenwich Astrographic Catalogue will contain about ten times as many stars as the catalogues of the Astronomische Gesellschaft for the corresponding zones, and that the Astrographic Catalogue for the whole heavens will give the positions of from two to three million stars with an accuracy hitherto unattained, and at a relatively small expenditure of labour, the great advantage resulting from the application of photography to the mapping of the heavens will be sufficiently evident.

Spectroscopic and Heliographic Observations.

Since the date of the last report, 189 measures have been made of the displacement of the F line in the spectra of 17 stars, as well as 33 measures of the F line in the spectrum of the moon for comparison.

The spot activity of the sun has steadily declined from the date of the last report. The mean daily spotted area of the sun was decidedly smaller in 1895 than in 1894, but a greater number of small spots was observed.

Magnetic Observations.

The variations of magnetic declination, horizontal force and vertical force, and of earth currents have been registered photographically, and accompanying eye observations of absolute declination, horizontal force and dip, have been made as in former years.

The principal results for the magnetic elements for 1895 are as follows:—

Mean declination	16° 57′·4 West.
Mean horizontal force	3·9739 (in British units). 1·8323 (in Metric units).
Mean dip (3 months, January to March)	67° 15′·3 (by 9-inch needles). 67° 14′·8 (by 6-inch needles). 67° 16′·6 (by 3-inch needles).
Mean dip (4 months, September to December)	67° 10′·7 (by 9-inch needles). 67° 11′·8 (by 6-inch needles). 67° 12′·4 (by 3-inch needles).

Uncertainty attaches to the results for mean horizontal force, owing to the permanent effect of the iron in the new Altazimuth Pavilion.

From April to August 1895, during the progress of the building work on the new Altazimuth, the observations of magnetic dip were subject to great uncertainty on account of the masses of iron for the building being stored near the north end of the New Library in immediate proximity to the dip instrument. And after the completion of the building—that is to say, since September 1895—the results of magnetic dip are affected to the extent of about 3′ or 4′ by the permanent iron in the building and instrument. An independent determination at a place sufficiently removed from the Altazimuth building is urgently required. The question, however, has necessarily been deferred, pending the settlement of the site for the new Magnetic Pavilion, which is to be built in Greenwich Park.

The magnetic disturbances during the year 1895 have been comparatively trifling. There were no days of great magnetic disturbance, and sixteen days of lesser disturbance. Tracings of the photographic curves for these days, selected in concert with M. Mascart, will be published in the annual volume as usual. The calculation of diurnal inequalities from five typical quiet days in each month has been continued.

Meteorological Observations.

The mean temperature of the year 1895 was 49°·3, being 0°·1 below the average for the 50 years 1841–1890.

During the twelve months ending April 30, 1896, the highest daily temperature recorded was 87°·3 on September 24. On May 30 a temperature of 86°·2 was recorded. The temperature rose above 80° on 26 days in 1895 as compared with seven days in the preceding year. The monthly mean temperatures were all in excess of the average values with the exception of the month of October, which was in defect. The mean for September was in excess to the amount of 4°·7; that for November in excess by 4°·2, and that for March 1896 by 4°. The mean temperature for the twelve months May 1895 to April 1896 was 51°·1, being 1°·7 above the 50 years' average.

The characteristics of the fine and hot month of September require to be examined in detail. It has been mentioned that the highest temperature of the year (87°·3) occurred on September 24, a temperature greatly exceeding all temperatures previously recorded at this advanced period of the year during the 54 years 1841–1894. Only two instances of higher temperature, both in the earlier part of the month, have been experienced in September, viz. 92°·1 on September 7, 1868, and 87°·7 on September 1, 1886.

The winter of 1895-96 was very mild, and there were only 19 days on which the temperature of the air fell to or below the freezing-point. The lowest winter temperature was 24°·3 on February 25, 1896.

The mean daily horizontal movement of the air in the twelve months ending April 30, 1896, was 275 miles, which is 6 miles below the average for the preceding 28 years. The greatest recorded movement was 1002 miles on December 5, and the least 70 miles on October 20. The greatest recorded pressure of the wind was 27·5 lb. on the square foot on March 16, with an extreme hourly velocity of 49 miles.

The number of hours of bright sunshine recorded during the twelve months ending April 30, 1896, by the Campbell-Stokes instrument was 1176 out of the 4465 hours during which the sun was above the horizon, so that the mean proportion of sunshine for the year was 0·263, constant sunshine being represented by 1. In the corresponding period for 1894–95 the number of hours of sunshine was 928, and the mean proportion 0·208.

The rainfall for the year ending April 30, 1896, was 19·76 inches, being 4·78 below the 50 years' average. This is the smallest rainfall since the year 1884–85, when the fall was 19·61 inches. In 1864–65 the rainfall was 17·71 inches, and in 1858–59 it was 17·38 inches. The number of rainy days in the twelve months was 151.

Re-organisation of the Staff.

The scheme for the re-organisation of the staff, referred to in last two reports, has now been sanctioned. With a view to strengthening the supervising power and increasing the permanent subordinate staff, an additional chief assistant is appointed, and the five second-class assistants of the old staff are to be replaced by eight established computers, two of these to be of a higher grade, the number of temporary computers being correspondingly reduced. The future staff will be thus constituted:—

Upper staff, two chief assistants and five assistants; lower staff, two higher grade established computers and six established computers; temporary staff, non-established computers.

Mr. P. H. Cowell was appointed the additional chief assistant on April 20, and it is hoped that the appointments of the established computers will very shortly be made. Mr. Criswick has retired on pension after a useful and honourable service of forty-one years at the Observatory, and Mr. Hollis has been promoted to fill the vacancy thus occasioned in the staff of first class assistants.

THE ROYAL SOCIETY OF CANADA.

THE annual meeting of the Royal Society of Canada was held at Ottawa on May 18, and the three following days. In addition to the papers read before the literary sections of the Society, a large number of important papers were presented in the two Science Sections.

In Section III. (Mathematical, Physical and Chemical Sciences), Profs. Cox and Callendar presented the results of recent investigations carried on by them in the physical laboratories of McGill University, in which they have succeeded in demonstrating that Röntgen rays are not unaffected by magnetic attraction, as Röntgen states, but on the contrary are affected in a marked manner when tested experimentally under favourable conditions, the approach of the magnet causing a marked deviation of the kathode rays within the tube in one direction, and at the same time a corresponding deviation of the Röntgen rays without the tube in the opposite direction. These observations are of especial importance as bearing on the question of the relation of Röntgen rays to the kathode-rays, Röntgen having considered the former as differing from the latter in that they were not influenced by magnetism.

In the same Section, papers were also read by Messrs. Alex. R. Mellanby and John T. Farmer, Royal Commissioners' Scholars, on investigations carried out in the laboratories of McGill University; the former, "on an investigation as to the thermal and plant efficiencies of compound, triple and quadruple expansion engines," and the latter, "on the efficiency of ½-inch jets from circular orifices, impinging upon surfaces of different forms."—Prof. Bovey communicated the results of a series of experiments on the strengths of the woods of the hemlock, red pine, and white pine.—Mr. Howard Barnes presented the results of a series of very accurate measurements of the temperature of the waters of the St. Lawrence, opposite Montreal, during the coldest part of last winter. It was shown that the greatest variation in temperature did not exceed $\frac{1}{100}$ of a degree Centigrade. The measurements were carried out with a view to ascertaining whether the formation of frazil ice was accompanied by any considerable changes in temperature, such as have been described by some observers. It was found that as the river does not vary throughout its depth by so much as one-hundredth of a degreee from the freezing point, the formation of frazil does not depend on any considerable lowering of the temperature of the water. The formation of fine needles of ice all through the water of the river is probably aided by fine particles of sand and other suspended material acting as nuclei, since earthy matter is found embedded in the frazil attached to the under side of the surface ice.

In Section IV. (Geological and Biological Sciences), Sir William Dawson read a paper on fossil sponges and other organic remains from the rocks of the Quebec Group at Little Metis.—Prof. D. P. Penhallow read a paper which embodied his final deductions on the generic characters of the North American Coniferæ as exemplified in the microscopic structure of the woods.—Prof. Ramsay Wright gave the results of his studies of a great number of minute forms of life obtained from certain of the Canadian fresh-water lakes by means of a very fine tow-net, among which he describes a number of new species, and compares others with closely allied forms already recognised in the lakes of Scandinavia and other parts of Europe. He also communicated a paper by Mr. E. C. Jeffery, on the morphological nature of the medullate stellar structures of certain plants.—Dr. George M. Dawson, in a communication on secular climatic changes in British Columbia, showed from a study of the rainfall of the Province, as evidenced by the varying height of lakes without outlet, that the last few years have been more humid than any preceding them in a period of about fifty years.

Other papers were read by Prof. Edward E. Prince, Dr. A. R. C. Selwyn, Dr. William Saunders, and others.

The usual public lecture was delivered by Prof. Prince, Dominion Commissioner of Fisheries, on the fishery industries and resources of Canada.

The Society decided to petition the Dominion Government to establish a marine biological station at some point on the Atlantic Coast of Canada, as soon as possible, as recommended in a recent report of the Dominion Commissioner of Fisheries.

Prof. Ruttan and Prof. Adams, of McGill University, and Mr. W. Bell Dawson, of the Hydrographic Service, were elected Fellows of the Society, to fill three vacancies recently caused by death.

The meeting was well attended, and was successful in all respects. At the conclusion of the meeting the Fellows of the Society were entertained at a garden party, by their Excellencies the Earl and Countess of Aberdeen, at Rideau Hall.

THE CIRCULATION OF ORGANIC MATTER.

AT the evening meeting of the Royal Institution on Friday, April 24, Dr. G. V. Poore gave a discourse on the circulation of organic matter. Without attempting to define "organic matter," Dr. Poore began by saying that all organic matter was combustible, and that all our combustibles were of organic origin. A comparison was made between combustion in a furnace and the combustion of food in the body of an animal, and it was shown that whereas in the furnace the fuel was used up and furnace wore out, in the animal there was increase of size, while its droppings stimulate the soil to an increased production of food. This apparent increase was probably due to the holding in suspension by the extra growth of plants of both water and soluble salts, which otherwise would percolate the soil and find their way to the sea. Recent experiments made it certain, also, that some of the atmospheric nitrogen was appropriated by microbes in the soil. The animal was a true regenerative furnace, and led to the increase of the herbage at the expense of the sea on the one hand, and the atmosphere on the other. It was impossible to imagine an increase in one direction without some compensating decrease in another direction. When organic matter collected under water, fermentations were set up, and the organic matter was reduced instead of being oxidised. The tendency of organic matter, when thus treated, to form combustible bodies was very remarkable. The inflammable gases which sometimes formed in cesspools, and the marsh gas evolved by mud in ponds and rivers, were familiar examples, as were also the alcohols formed by the fermentation of carbohydrates. Our immense stores of coal and peat were due to the silting up of marsh plants in past ages and in recent times, and so-called mineral oils were certainly of organic origin, as were also the nitrates which were so much used in the manufacture of explosives. If we were to judge what *has been* by what *is*, it was impossible not to come to the conclusion that life must have preceded combustion in this world. This biological theory of the cosmogony made the world subject, like all other things, to the processes of development, evolution and decay, and he believed that such a theory had fewer drawbacks than might at first sight appear.

Organic matter was our capital in this world, and the more frequently we could make it circulate the greater would be our increase of material wealth. If we burnt it or threw it into the sea, we thereby spent money for dissipating our capital; but if we placed it on the land, we increased our capital and earned frequent dividends. The *rôle* of microbes in the soil, in bringing about the humification and nitrification of organic matter, was next dealt with. It was shown that farming without frequent additions of organic matter to the soil, must end in ultimate failure. We found everywhere that vegetable organisms co-operated with animals in the destruction and circulation of organic matter, and it appeared to be probable that the correlation of the biological forces was not less rigid than the correlation of the physical forces.

Allusion was made to the observations of M. Megnin on the destruction of animal bodies by successive squadrons of insects and microbes, and many facts were brought forward to show that the comparatively new doctrine of symbiosis was probably of universal application. The intestines of every animal swarmed with microbes which were essential for digestion, during life, and at death were active in starting the dead body upon the cycle of events which led to its ultimate circulation and re-

appearance in plant form. There were no less than 628 species of fungi which flourished in excrement, and of these no less than 402 were peculiar to certain animals. There could be no doubt the excrement often contained the organisms which led to its dissolution and circulation.

The proper course to pursue with organic matter was to place it near to the surface of well-tilled ground, and such a course seemed to be both profitable and safe. By mixing it with water we had all the evils of putrefaction, while our capital was thrown into the sea, and our water-supplies were poisoned by leakage. Our methods of sanitation inevitably lead to overcrowding, and farmers were often taxed to provide expensive apparatus, which merely deprived them of organic matter which otherwise might fertilise the land instead of involving them in a ruinous expense.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Some friends of the late Prof. Sir T. F. Wade have offered to the University, by way of memorial, a sum of £100 for the construction of a catalogue of the Chinese books in the University Library. These books were his own gift, and during his lifetime he held the post of Honorary Curator of the collection.

Mr. J. E. Gray, and Mr. S. D. Scott, of King's College, have been appointed to work at the University's table in the Zoological Station of Naples and Plymouth respectively.

Sir Walter Gilbey has offered to the University a fund sufficient to provide an income of £25 a year for twenty-one years as an endowment for a Lecturer in the History and Economics of Agriculture. The Council of the Senate recommend that the benefaction should be gratefully accepted, and propose suitable regulations for the foundation of a "Gilbey Lectureship."

The Library Syndicate propose that the new class of "Advanced Students" should have the same privileges as Bachelors of Arts in respect of borrowing books from the Library.

The discussion by the Senate of the proposal to expend £27,000 in acquiring sites adjoining the congested area occupied by the New Museums was unusually full and detailed. The price is generally held to be high, but the importance of the ground in question for the extension of the scientific and other departments was strongly urged. The question is to be decided by a vote to-day.

In the Mathematical Tripos, Part I., all but one of the candidates have obtained honours. Fourteen women are among the successful. The class list will be published on June 16.

The Deputy-Professor of Pathology, Dr. A. A. Kanthack, announces four courses of instruction in different branches of his subject, including bacteriology, during the ensuing Long Vacation (July and August).

Honorary degrees are to be conferred on June 18 on a number of foreign men of letters, and upon Prof. Carl Gegenbaur, of Heidelberg, Prof. Felix Klein, of Göttingen, and Prof. Simon Newcomb, of Johns Hopkins University, Baltimore.

Mr. Charles Smith, Master of Sidney Sussex College, has been re-elected Vice-Chancellor.

"THE College of New Jersey," universally known as "Princeton," has just changed its corporate name to Princeton University. An attempt will be made to raise 2,000,000 dols. in connection with its approaching sesqui-centennial celebration this fall. John I. Blair has contributed 150,000 dols. for a dormitory to be known as Blair's Hall, and another friend has contributed 100,000 dols.

THE Council of Firth College and the Committees of the Medical School and Technical School, Sheffield, have each passed resolutions in favour of a joint application for a charter of incorporation with the Victoria University, Manchester. A meeting of representatives from these educational establishments has been held, at which the form of the proposed charter was finally agreed upon, and a small Committee appointed to bring it before the proper authorities.

A RESOLUTION was moved at the last meeting of the Technical Instruction Committee of the Glamorganshire County Council to the effect that funds should be allocated to the establishment of five musical scholarships, each of the value of £40 per annum, tenable at the University College, Cardiff. The resolution was not seconded. It was decided to defer the matter until the next meeting. The two issues which are here raised, (1) whether the funds for technical instruction can rightly be devoted to musical education, and (2) whether it is desirable to encourage such instruction at a University College, certainly require some time for consideration.

SCIENTIFIC SERIALS.

The Quarterly Journal of Microscopical Science for May 1896 (vol. xxxix. part 1) contains:—On the blood of Magelona, by Dr. W. Blaxland Benham (pl. 1). The blood of *Magelona papillicornis* is totally different in structure from that of any other known Chætopod, in that it consists mainly of very small madder rose-coloured, non-nucleated globules, embedded (rather than floating) in a very small amount of colourless plasma; amongst the corpuscles occur isolated nuclei. It was originally demonstrated by Lankester that nuclei occur in the red fluid of the common earthworm, and this observation has been extended to sundry other Annelids by various observers. In these cases, as in Megalona, the nucleus is surrounded by very little, if any, protoplasm, and floats freely in the perfectly liquid plasma, which is coloured red by hæmoglobin, or in a few cases green by chlorocruorin or chlorochromin; while in some Oligochætes the plasma is colourless. The so-called "corpuscles" or coloured globules of Magelona differ from those observed in other Annelids, not only in position, viz. within blood-vessels instead of in the cœlom, but also in structure and in their behaviour to chemicals. These globules "stand, as it were, midway between the coloured liquid plasma of Annelids generally and the coloured corpuscles of mammalian blood." The colouring matter showed no absorption bands, when spectroscopically analysed.—Fission in Nemertines, by Dr. W. Blaxland Benham (pls. 2 and 3). The fact that many Nemertines break up into pieces when irritated is well known, but the phenomenon has received but little attention, nor does it seem to have been definitely ascertained whether it is a normal occurrence. From these researches it seems, however, proved that these pieces are gonads, thrown off from the male and female worms, about the time the sexual elements are mature. The species examined belonged to the genus Carinella, and was probably *C. linearis*, Montagu.—Studies on the nervous system of Crustacea, by Edgar J. Allen (pl. 4). IV. Further observations on the nerve elements of the embryonic lobster.—Notes on Oligochætes, with the description of a new species, by Edwin S. Goodrich (pls. 5 and 6). The author first describes a new species of Enchytræus, found in a garden at Weymouth, also near Oxford and London (*E. hortensis*); it is, when full grown, about 15 mm. in length, and milky white in colour, the anterior end being sometimes yellowish. The chetæ are in bundles of from three to four, generally three in the dorsal and four in the ventral bundle; they have a straight shaft and a hooked inner end; a small dorsal head-pore is found between the pro-stomium and the first segment. In a favourable light the cuticle is seen to be covered throughout with fine hair-like processes, similar to those described by the author in *Vermiculus pilosus*. Three kinds of cœlomic corpuscles are described as very characteristic of this worm: (*a*) amœboid; (*b*) oval corpuscles of the type so frequently met with in the Enchytræidæ, nearly twice as large as the amœboid, flattened oval in form, and filled with refringent granules; and (*c*) a third type of a discoid form, but the refringent granules, when they escape by rupture of the corpuscle wall, form a long thread of transparent homogeneous substance, closely coiled. These threads are possibly of an albuminoid nature.—On the development of *Lichenopora verrucaria*, Fabr., by Sidney F. Harmer (pls. 7–10). The author in a previous volume of this journal, from a study of Crisia, had suggested that embryonic fission would be found to be characteristic of the whole group of cyclostomatous Polyzoa. A chance discovery of large numbers of the colonies of *Lichenopora verrucaria*, Fabr., in all stages of development, has enabled him not only to show that this fission occurs here in an equally marked manner as in Crisia, but to discover some previously unsuspected phenomena in the life-history of *Lichenopora verrucaria*. Among these is the restriction of the production of an embryo to one or two of the oldest Zoœcia in the normal development.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 21.—"Helium and Argon. Part III. Experiments which show the Inactivity of these Elements." By Prof. William Ramsay, F.R.S., and Dr. J. Norman Collie.

To chronicle a list of failures is not an agreeable task; and yet it is sometimes necessary, in order that the record of the behaviour of newly-discovered substances may be a complete one. It is with this object that we place on record an account of a number of experiments made to test the possibility of forming compounds of helium and argon.

It will be remembered that in their memoir on Argon (*Phil. Trans.*, vol. clxxxvi., A), Lord Rayleigh and Prof. Ramsay described numerous experiments, made in the hope of inducing argon to combine, all of which yielded negative results. Two further experiments have been since made—again without success.

(1) The electric arc was maintained for several hours in an atmosphere of argon. A slow expansion took place. The resulting gas was treated with caustic soda and with a solution of ammoniacal cuprous chloride, and, on transference to a vacuum-tube, it showed the spectrum of argon along with a spectrum resembling that of hydrocarbons. Having to leave off work at this stage, a short note was sent to the *Chemical News* on "A Possible Compound of Argon." On resuming work after the holidays, the gas was again investigated, and, on sparking with oxygen, carbon dioxide was produced. But it was thought right again to treat the gas with cuprous chloride in presence of ammonia, and it now appeared that when left for a sufficient time in contact with a strong solution, considerable contraction took place, carbonic oxide being removed. There can, therefore, be no doubt that, although apparently all gas had been removed from the carbon electrodes before admitting argon, some carbon dioxide must have been still occluded, probably in the upper part of the electrodes, and that the prolonged heating due to the arc had expelled this gas and converted it into monoxide. It appears, therefore, certain that argon and carbon do not combine, even at the high temperature of the arc, where any product would have a chance of escaping decomposition by removing itself from the source of heat. It is hardly necessary to point out that such a process lends itself to the formation of endothermic compounds such as acetylene, and it was to be supposed that if argon is capable of combination at all, the resulting compound must be produced by an endothermic reaction.

(2) A product rich in barium cyanide was made by the action of producer gas on a mixture of barium carbonate and carbon at the intense temperature of the arc. This product was treated by Dumas' process so as to recover all nitrogen; and, as argon might also have entered into combination, the nitrogen was absorbed by sparking. All the nitrogen entered into combination with oxygen and soda, leaving no residue. Hence it may be concluded that no argon enters into combination.

(3) A mixture of argon with the vapour of carbon tetrachloride was exposed for several hours to a silent discharge from a very powerful induction coil. The apparatus was connected with a gauge which registered the pressure of the vapour of the tetrachloride and of the argon of which it was mixed. Careful measurement of the pressure was made before commencing the experiment, and after its completion. Although a considerable amount of other chlorides of carbon was produced, no alteration of pressure was noticeable; the liberated chlorine having been absorbed by the mercury present. Here again the argon did not enter into the reaction, but it was recovered without loss of volume.

The remaining experiments relate to attempts to produce compounds of helium. The plan of operation was to circulate helium over the reagent at a bright red heat, and to observe whether any alteration in volume occurred—an absorption of a few c.c. could have been observed—or whether any marked change was produced in the reagent employed. As a rule, after the reagent had been allowed to cool in the gas, all helium was removed with the pump, and the reagent was again heated to redness, so as, if a compound had been formed, to decompose it and expel the helium. Every experiment gave negative results; in no case was there any reason to suspect that helium had entered into combination.

A short catalogue of the substances tried may be given, none of which gave any signs of combination.

(4) Sodium.
(5) Silicon.
(6) Beryllium.
(7) Zinc.
(8) Cadmium.
(9) Boron.
(10) Yttrium.
(11) Thallium.
(12) Titanium.
(13) Thorium.
(14) Tin.
(15) Lead.
(16) Phosphorus.
(17) Arsenic.
(18) Antimony.
(19) Bismuth.
(20) Sulphur.
(21) Selenium.

(22) Uranium oxide, mixed with magnesium dust, was heated to bright redness in helium. No change, except the reduction of the oxide, took place. The mixture was allowed to cool slowly in the current, and the helium was removed with the pump till a phosphorescent vacuum was produced in a vacuum tube communicating with the circuit. The mixture was reheated, and no helium was evolved, not even enough to show a spectrum. The vacuum remained unimpaired.

It had been hoped that elements with high atomic weight, such as thallium, lead, bismuth, thorium, and uranium might have effected combination, but the hope was vain.

(23) A mixture of helium with its own volume of chlorine was exposed to a silent discharge for several hours. The chlorine was contained in a reservoir, sealed on to the little apparatus which had the form of an ozone apparatus. No change in level of the sulphuric acid confining the chlorine was detected after the temperature, raised by the discharge, had again become the same as that of the room. Hence helium and chlorine do not combine.

(24) Metallic cobalt in powder does not absorb helium at a red heat.

(25) Platinum black does not occlude it.

(26) It is not caused to combine by passage over a mixture of soda-lime and potassium nitrate heated to bright redness. This was hardly to be expected, for it resists the action of oxygen in presence of caustic soda, even when heated by the sparks which traverse it.

(27) A mixture of soda-lime and sulphur consisting of polysulphides causes no change of volume in a current of helium passed over it at a bright red heat.

(28) Induction sparks in an ozone apparatus passed through a mixture of helium with benzene vapour in presence of liquid benzene for many hours, gave no change of volume. The benzene was, of course, altered, but the sum of the pressures of the helium and the benzene-vapour remained as at first. Had helium been removed, contraction would have occurred.

This ends the catalogue of negative experiments. Any compound of helium capable of existence would probably be endothermic, and the two methods of producing endothermic compounds, where no simultaneous exothermic reaction is possible, are exposure to a high temperature, at which endothermic compounds show greater stability, and the influence of the silent electric discharge. These methods have been tried, so far in vain. There is, therefore, every reason to believe that the elements, helium and argon, are non-valent, that is, are incapable of forming compounds.

Chemical Society, May 21.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read. The diphenylbenzenes, I. Metadiphenylbenzene, by F. D. Chattaway and R. C. T. Evans. Metadiphenylbenzene may be prepared by the action of melted sodium on a boiling xylene solution of metadichlorobenzene and chlorobenzene; it melts at 84°.—Derivatives of camphoric acid, by F. S. Kipping. A lactonic monocarboxylic acid, $C_{10}H_{14}O_4$, which the author terms trans-π-camphanic acid, is obtained by boiling sodium π-bromocamphorate with water; its cis-isomeride can only be prepared as a salt. On oxidising trans-π-camphanic acid, transcamphotricarboxylic acid $C_{10}H_{14}O_6$ is obtained; on fusion with potash it yields the isomeric ciscamphotricarboxylic acid.—On some substances which exhibit rotatory power both in the liquid and crystalline states, by W. J. Pope. Cis-π-camphanic acid and transcamphotricarboxylic acid possess the power of circularly polarising light, both in the dissolved and crystalline state; in the former case the circular polarisation in the crystalline state is a specific property of the crystalline structure, but in the latter it is due to complicated twinning of the crystals.—Dimethoxydiphenylmethane and some of its homologues, by J. E. Mackenzie. Dimethoxydiphenylmethane, and the corresponding diethoxy- and dibenzoxy-compounds, may be prepared by the interaction of benzophenone chloride and the sodio-derivative of methylic, ethylic or benzylic alcohol respectively.

Zoological Society, June 2.—F. DuCane Godman, F.R.S., Vice-President, in the chair.—Mr. Sclater exhibited the skin of an African Monkey of the genus *Cercopithecus*, originally received alive from Mombasa, which he believed to be referable to Stairs's Monkey (*C. stairsi*).—Mr. Sclater also exhibited a series of water-colour drawings of African antelopes by Mr. Caldwell, and a photograph of the gorilla now living in the Society's Gardens, by Mr. Henry Scherren.—A communication was read from Mr. Henry J. Elwes and Mr. Edwards, containing a revision of the European and Asiatic butterflies of the family Hesperiidæ. The species treated of in this paper were about 450 in number and were divided into about 100 genera.—Mr. Charles Davies Sherborn gave an explanation of the plan he had adopted in his "Index Generum et Specierum Animalium." Mr. Sherborn stated that the absence of any trustworthy lists of the species of particular genera had led him to commence the compilation of an "Index Generum et Specierum Animalium" in 1890. Since that time 130,000 generic and specific names had been recorded in a manuscript which was stored at the British Museum (Natural History). Mr. Sherborn explained in detail the method and plan adopted for the compilation of the work.—Mr. G. A. Boulenger, F.R.S., read a paper on the dentition of snakes, and added remarks on the evolution of the poison-fangs in this order of reptiles.

PARIS.

Academy of Sciences, June 1.—M. A. Cornu in the chair.—The President announced the loss sustained by the Academy by the death of M. Paul Daubrée, Member of the Section of Mineralogy. A letter from M. Des Cloizeaux, giving a brief account of M. Daubrée's contributions to science, was read by the Secretary.—Note on the observed passages of Mercury across the disc of the sun, and on the question of the existence of inequalities of long period in the mean longitude of the moon, of which the cause is still unknown, and in the rotation of the earth upon its axis, by M. S. Newcomb.—On the laws of induction. Reply to the note of M. Marcel Deprez, by M. A. Potier.—Action of acetylene upon iron, nickel, and cobalt reduced by hydrogen, by MM. H. Moissan and Ch. Moureu. If acetylene, which has been allowed to suddenly impinge upon pyrophoric iron which has been reduced by hydrogen at the lowest possible temperature, the gas is decomposed with incandescence into its constituents. At the same time, owing to the high temperature, condensation takes place, and a liquid hydrocarbon, rich in benzene, is produced. The same phenomenon is produced by pyrophoric nickel and cobalt, and also by platinum black. No compound containing metal can be isolated, and the decomposition appears to be due to physical causes.—Respiratory exchanges, in the case of muscular contractions provoked electrically in animals either fasting, or fed with a diet rich in carbohydrates, by MM. A. Chauveau and F. Laulanie. The experimental results with dogs and rabbits were identical with those already obtained with men.—New experiments on the distribution of velocities in tubes, by M. Bazin. No single expression can be given which will accurately represent the velocity of an air current at any point between the centre and circumference of the tube, the law being very complicated. At a distance from the centre equal to three-fourths of the radius of the tube the velocity was equal to the mean for the whole tube.—On a musical register, by M. A. Rivoire. Description of an instrument for automatically recording the notes struck on a piano.—Density of variable stars of the Algol type, by M. Mériau. Starting with the hypothesis that the variations in the brightness of stars of the Algol type are due to eclipses produced by dark satellites, a formula is developed giving the density in terms of constants that can be experimentally determined.—On entire functions, by M. Hadamard.—On systems in involution of equations of the second order, by M. E. Goursat.—On a differential equation of the first order, by M. Michel Petrovitch.—On the rotation of a variable body, by M. L. Picart.—On the anomaly in the acceleration of gravity at Bordeaux, by M. J. Collet.—On the theory of turbines, pumps, and centrifugal fans, by M. A. Rateau.—On molybdenite and the preparation of molybdenum, by M. M. Guichard. Metallic molybdenum free from sulphur can be obtained by subjecting the mineral molybdenite in a carbon tube to the electric furnace (900 amperes, at 50 volts) for five minutes. The ingot contained about 92 per cent. of molybdenum, 2 per cent. of iron, and 7 per cent. of carbon.—On the methylamines, by M. Delépine. As a means of distinguishing the three methylamines rapidly and with certainty, the formation of the picrates is recommended, the salts from mono-, di-, and trimethylamine melting respectively at 207°, 156°, and 216°, and differing also in colour and solubility.—On the reaction between aldehydes and phenylhydrazine, by M. H. Causse. Compounds are obtained with acetaldehyde and benzaldehyde which appear to contain one molecule of aldehyde to two of phenylhydrazine, and to be formed without any condensation.—On a new building material from glass refuse, by M. Garchey.—On the influence of certain pathological agents on the bactericidal properties of the blood, by M. E. S. London.—On the slowness of the normal coagulation of the blood in birds, by M. C. Delezenne. Contrary to the generally accepted view, if the blood of birds is taken under experimental conditions similar to those in general use for mammals, the coagulation always takes place with extreme slowness, frequently not commencing until four to six hours after its removal from the artery.—On a new audiometer, and on the general relation between the intensity of the sound and the successive degrees of sensation, by M. Charles Henry.

BOOKS RECEIVED.

BOOKS.—Crystallography for Beginners: C. J. Woodward (Simpkin).—Crystals and Apparatus for use with ditto (Simpkin).—Chemistry in Daily Life: Dr. Lassar-Cohn, translated by M. M. P. Muir (Grevel).—The Spas and Mineral Waters of Europe: Dr. H. and F. P. Weber (Smith, Elder).—The Antichrist Legend: W. Bousset, translated by A. H. Keane (Hutchinson).—Lloyd's Natural History. British Birds: R. B. Sharpe, Part 1 (Lloyd).—Théorie Nouvelle de la Vie: Dr. F. Le Dantec (Paris, Alcan).—Stuttering and how to cure it: L. Klindworth (Glasgow, Bauermeister).—A Manual of Botany: Prof. J. R. Green, Vol. 2 (Churchill).—The Pathology of the Contracted Granular Kidney: Sir G. Johnson (Churchill).—Animals at Work and Play: C. J. Cornish (Seeley).—Physikalisch-Chemische Propaedeutik, Zweite Hälfte, 1 Liefg. (Leipzig, Engelmann).—Lehrbuch der Vergleichenden Mikroskopischen Anatomie der Wirbeltiere: Dr. A. Oppel. 1 Teil. Der Magen (Jena, Fischer).—Geological Sketch Map of South Africa, and Notes on the Geological Formation of South Africa and its Mineral Resources: F. P. T. Struben (Stanford).

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