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## NEW LIGHT FROM SOLAR ECLIPSES.

*New Light from Solar Eclipses; or Chronology corrected by the Rectification of Errors in the received Astronomical Tables.* By William M. Page. With an Introduction by the Rev. J. Brookes, D.D. (St. Louis: Barns Publishing Co., 1890.)

THIS is a book with a considerable portion of which we can have no concern, for it treats largely of theological matters of a disputed kind. It is the production, no doubt, of a devout and pious mind, but of one not scientifically trained. Indeed, we are informed, in an introduction by a St. Louis divine, that it is "written by a brother actively engaged in the ordinary pursuits of life," and an attempt is made to enlist our sympathies with the author on that account. This appeal would have been more effectual if the scientific conclusions at which the author has arrived, and for which he hopes to gain attention, were put forward either with more modesty on his own part, or with greater respect for recognized authorities.

But the contrary is the case. Our prejudices are not respected, and while the crudest statements are made on the smallest possible evidence, the work so bristles with errors that it is difficult to present typical examples. We should have been tempted to leave this volume to the obscurity it merits from a scientific point of view, but for two circumstances. One is, that this book will probably circulate largely among readers not qualified to judge of the rashness of statement and inaccuracy of detail that characterize its astronomical portion, and that consequently a very erroneous and exaggerated opinion may be formed of the character and amount of the errors that still exist in one of the most exact of sciences. The second inducement to look a little closely into its pages is this: that another and more instructed class of readers may imagine that on matters of chronology astronomy speaks with an uncertain sound, and consequently be led to undervalue the very substantial advantages that history has derived from astronomical sources.

The main object of the book is the arrangement of a system that shall bring the narrative contained in the Gospels into the chronological order conceived by the author as correct, and to render consistent, the facts recorded in sacred and secular history, with this system. How far this method and system will satisfy competent theological critics it is, as we have said, not our duty to inquire; we can only hope that the service rendered to religion is greater than that to science, for from the latter point of view we have no hesitation in saying that his theory is erroneous in its conception and unwarranted in its application.

The means employed to produce this chronological harmony is based on the assumption that the places of the sun and moon cannot be correctly computed for distant dates from the existing tables, and that consequently additional terms, empirically determined, must be introduced. This new theory had best be described in the author's own words, for fear we should not do it justice:—

"Our present lunation is too long by a fraction of a second, amounting in the course of a century, to about six minutes of time. In the same length of time, the sun's anomaly is too long by about seven minutes ten seconds of space, the moon's anomaly too long by eight minutes twenty seconds of space, and the sun's mean distance from the node is too short by about eight minutes thirty-five seconds of space."

After an attentive perusal we have not been able to discover any additional explanation or reason for the introduction of these terms. Neither have we discovered to what assumed values of the mean longitude, the mean anomaly, and the argument of latitude these corrections are to be applied. The only references to authorities are apparently those of Baily's "Tables" and Fergusson's "Astronomy," and the author does not appear to have had access or thought it worth while to examine more modern and trustworthy sources. We cannot be quite sure that we have described correctly the elements of the lunar and solar orbits to which these corrections are to be made, but it is asserted that, when introduced into the tables, all the eclipses recorded by the ancients can be represented correctly within a few minutes of time. It is much to be regretted that no rigorous comparison between the observed and computed times of all the ancient eclipses has been attempted, in order that a correct judgment might be formed of the value of this assertion. This was the more necessary as the few cases selected are, we think, very infelicitous, and the incapacity of modern tables to represent these eclipses is unjustifiably, but no doubt unintentionally, exaggerated.

It is curious to notice that the author does not recognize any other criterion of accuracy than the possibility of satisfying these ancient eclipses, the records of which are so imperfect, and the interpretation so doubtful, that they are gradually being discarded in the discussion of the one question for which they at one time seemed peculiarly fitted—namely, the determination of the amount of the secular acceleration of the moon's mean motion. The whole mass of modern observation is ignored. The careful records of eclipses made at Bagdad and Cairo in the ninth and tenth centuries share the same fate. It would seem that any observation made after the first half of the first century does not appear to the author to possess any value.

It will scarcely be believed that this is a correct description of the author's method. No one will imagine that any sane man would attempt to construct a lunar theory from ancient eclipses alone, and expect that the results at which he has arrived will be generally admitted, because, forsooth, he is able to represent a few facts by the introduction of nearly as many variables. It is true that the tables founded on this vicious reasoning do not appear in their integrity, and probably do not exist; but there are given many pages of computation, which are well calculated to mislead the uninstructed, and to give an air of accuracy to the results, to which they are not entitled. We can imagine nothing better adapted to bring astronomy into disrepute with thoughtful, but not mathematically trained minds, than the unwarranted conclusions presented in the slovenly manner in which they appear here.

Some grounds must be given for the severe stricture here passed, and the only difficulty is to select the most fitting examples from so much worthless matter. On p. 18 the author says: "It is considered sufficiently near to the truth, if our calculations came within *a few hours* of the time and near enough to the quantity of the eclipse to identify it as being in all probability the obscuration mentioned by the historian in connection with a certain event." The italics are our own, and the statement to which they call attention is absolutely a misrepresentation. It is scarcely necessary to say in these columns that no astronomer of repute would be satisfied with a discrepancy of anything like this amount between history and computation in any case in which the phenomenon is clearly indicated and accurately described. In the annexed table is given the comparison of the computations of various astronomers of the times of historic eclipses with the recorded times. To keep the table to a moderate length it is confined to those dates between which the examples have been worked out by the writer. In estimating the accuracy of representation, there are two circumstances to be taken into account. One is that an eclipse, being a phenomenon the exact time of whose occurrence could not be accurately predicted by the observer or recorder, must have been in progress some time before detection, or, all observations of the first geometrical contact, the phase computed from the tables, would be observed too late; and though the error from this cause would not be so large in the observation of the end of the total phase, it is probable that this phenomenon would be recorded too soon. The other circumstance is that we cannot regard Ptolemy, from whose work the times here given have been taken, as a totally unprejudiced witness. He was anxious to establish a theory, and it is probable that he selected those instances which most nearly fitted his preconceived system. In other words he may have—what is not unknown in these days—rejected a discordant observation.

| Date. | Phase given in "Almagest." | Recorded Greenwich mean time. | Greenwich mean time computed by | | | |
|---|---|---|---|---|---|---|
| | | | Newcomb. | Zech. | Oppolzer. | Ginzel. |
| | | h. m. | h. m | h. m. | h. m. | h. m. |
| − 490, April 25 ... | Middle | 8 27 | 8 17 | 7 50 | 7 53 | 7 35 |
| − 382, Dec. 22 ... | Beginning | 15 35 | 15 52 | 16 19 | 16 15 | 16 7 |
| − 381, June 18 ... | Beginning | 5 8 | 4 25 | 4 54 | 5 9 | 4 40 |
| − 381, Dec. 12 ... | Beginning | 5 56 | 4 57 | 6 30 | 6 18 | 6 14 |
| − 200, Sept. 22 | Beginning | 3 23 | 2 57 | — | — | — |
| | End | 6 25 | 5 55 | 6 29 | 6 24 | 6 14 |
| − 199, Mar. 19 ... | Beginning | 9 29 | 8 51 | 9 22 | 9 20 | 9 9 |
| − 199, Sept. 11 ... | Middle | 12 22 | 12 3 | 12 34 | 12 28 | 12 18 |
| − 173, April 30 | Beginning | 10 48 | 10 4 | 10 36 | 10 16 | 10 24 |
| | End | 13 31 | 12 45 | 13 12 | 13 20 | 13 3 |
| − 140, Jan. 27 ... | Beginning | 8 7 | 6 44 | 7 8 | 7 6 | 7 5 |
| + 125, April 5 ... | Middle | 6 30 | 6 36 | 6 59 | 6 54 | 6 51 |

It is needless to point out there are no discrepancies of a few hours between the tabular and observed facts, and that the grave charge of the lack of accuracy is unsustained. The circumstances of two of these eclipses have been worked out by the author with some pretence of detail, employing his "new and corrected tables." For these two eclipses, − 382, Dec., and − 200, Sept., he gives the London mean times of the true full moon 15h. 56m. and 3h. 16m. respectively. There is no attempt to determine the exact phase observed, and it may be remarked that the longitude given for Babylon is grievously in error. These two eclipses have been selected with the particular purpose of demonstrating that no secular acceleration of the moon's motion exists. This selection, with this view, is unhappy. With regard to the earlier eclipse, it is very doubtful if it was really seen at Babylon. The account given in the "Almagest" ("Halma," p. 275) rather suggests that Athens, or one of the Ionic colonies, was the place of observation, since the description of the date is by means of the Greek calendar; and Hipparchus says that this eclipse with the two immediately following are added to the catalogue of the Babylonian eclipses as though they had been observed in that place (ὡς ἐκεῖ τετηρημένας γεγονέναι). This suggestion that the record of the eclipse was made elsewhere than at Babylon is strengthened by the addition of the note that "the moon set eclipsed." In an eclipse which commenced only half an hour before the setting of the moon, these words would have little meaning, but if the note was added by the observer at Athens, its purpose is intelligible, for the eclipse would be more than half over before the moon touched the horizon. It is very possible, therefore, that some allowance for longitude was made by Hipparchus, but with such a doubt overhanging the recorded time of observation, the selection of this eclipse from the long catalogue collected by Ptolemy gives a very doubtful support to any hypothesis. The second eclipse quoted was doubtless observed at Alexandria, but if Hipparchus is correctly rendered by Ptolemy, he is made to say that the eclipse began half an hour before the moon rose. The record, therefore, refers to a calculated, and not an observed, phenomenon, and on that ground alone should not have been selected.

But it is in solar eclipses, the total phase being confined to a comparatively narrow zone of country, that the feebleness of the author's method is most conspicuously exhibited. The eclipse known as that of Xerxes will serve for an example. To adequately explain the circumstances as recorded by Herodotus and Aristides has exercised the ingenuity, but baffled the efforts, of many experts. It offers no difficulties to Mr. Page, though we cannot think that his rendering will be generally appreciated. Herodotus's description runs, "The army having come out of their winter-quarters in the opening of spring." In the latitude of Sardis the opening of spring could hardly be put as late as April 18, but this is the date selected by Mr. Page, because on that day − 480 there was undoubtedly a total eclipse of the sun. The writer does not mention, what is equally the fact, that the shadow of the moon first touched the earth in the Indian Ocean, passed over the Himalayan peninsula, through China, and disappeared in the Pacific. Such a path is totally inadequate to explain the further description of Herodotus, that "night came on instead of day."

A still greater absurdity is introduced when the author wishes to prove that the death of Augustus happened in the year 13, by means of a solar eclipse which is said to have occurred just before the death of that Emperor. He finds that there was a solar eclipse on 13, April 28, and an attractive woodcut is given showing the track of the shadow passing over Rome. As a matter of fact, this eclipse began in the Pacific, touched the continent of America about Vancouver, and passed over Canada to the Atlantic: the whole of its path is confined to "regions Cæsar never knew." But the list of false deductions is too long and too uninteresting to pursue any further: exact astronomy can lend no support to the chronological system here developed. WILLIAM E. PLUMMER.

## THE EVOLUTION OF SEX.

*The Evolution of Sex.* By Prof. Patrick Geddes and J. Arthur Thomson. With 104 Illustrations. (London: Walter Scott, 1889.)

THIS book, say the authors in the preface, has "the difficult task of inviting the criticism of the biological student, although primarily addressing itself to the general reader or beginner." In attempting to meet these two interests the authors have aimed high: they have aimed at producing a classic. They have brought to the task—as indeed their names guarantee—a wealth of knowledge, a lucid and attractive method of treatment, and a rich vein of picturesque language. The illustrations are pertinent, and sometimes very good. The index and table of contents are copious, and the summaries and references to literature at the end of each chapter are most useful. In matters of history they are especially good, and advanced biological students will find the abstracts of the views of Eimer, Weismann, Brooks, Hertwig, Haeckel, Wallace, Spencer, Geddes, and many others exceedingly useful. But as writers for the general public the authors have serious if not prohibitive disadvantages.

General readers demand, with right, that those who speak to them with the voice of authority shall give them the authoritative views. Controversial matter they are only remotely interested in, and when it cannot be avoided they must have it carefully distinguished from matter beyond controversy. These authors are controversialists from the first page of their book to the last: they are partisan controversialists offering their wares and their wisdom as accredited doctrine and determined result. This is no quarrel with the views of the authors. Prof. Geddes and Mr. Thomson are workers well able to command the attention of biologists for their contributions to any controversy. It is a quarrel with the offering of personal views, generalizations, and theories as final, in a series "designed to bring within the reach of the English-speaking public the best that is known and thought in all departments of modern scientific research."

As is the fashion with neo-Lamarckians, the authors delight in obtruding their misconceptions of Darwin. Take, for instance, the following statements:—

"Arguing from the bad effects of close-breeding among higher animals, Darwin and others have called attention to the numerous contrivances among plants which are said to render self-fertilization impossible. It must again be said that this survival of a very old way of explaining facts—in terms of their final advantage—is not really a causal explanation at all" (p. 74).

Or, again, on p. 27:—

"As a special case of natural selection Darwin's minor theory (*i.e.* sexual selection) is open to the objection of being teleological, *i.e.* of accounting for structures in terms of a final advantage. It is quite open to the logical critic to urge, as a few have done, that the structures to be explained have to be accounted for before, as well as after, the stage when they were developed enough to be useful. The origin, or in other words, the fundamental physiological import, of the structures, must be explained before we have a complete or adequate theory of organic evolution."

Now there can be no doubt of the question here at issue. Readers of NATURE may remember that some time ago (NATURE, December 12, 1889, p. 129) Prof. Ray Lankester *à propos* of Cope's supposed contribution to the theory of natural selection,[1] asked: "How can Mr. Cope presume to tell us this? Who has ignored it? When? and where?" It is clear that Prof. Geddes and Mr. Thomson imagine that Darwin has ignored this, and that he has done so in his theory of sexual selection, and in his accounts of contrivances in plants to prevent self-fertilization. In a set of works the definite and reiterated purpose of which is to show (1) that variations do occur, (2) that from these, by selection, varieties, species, organs are elaborated and adapted, it is fortunately easy to find chapter and verse conclusive against the view that Darwin could have imagined that selection teleologically causes the variations that give it scope. Will Prof. Geddes and Mr. Thomson refer to the "Descent of Man" (the writer has the second edition before him)? On p. 240 it is written:—

"Not only are the laws of inheritance extremely complex, but so are the causes which induce and govern variability. The variations thus induced are preserved and accumulated by sexual selection."

Will Prof. Geddes and Mr. Thomson refer to the "Fertilization of Orchids" (also second edition)? On p. 284 it is written:—

"Thus throughout nature almost every part of each living being has probably served in a slightly modified condition for diverse purposes, and has acted in the living machinery of many ancient and distinct specific forms."

Or, again, on the same page:—

"This change" (labellum assuming its normal position) "it is obvious might be simply effected by the continual selection of varieties which had their ovaries less and less twisted; but if the plant only afforded varieties with the ovarium more twisted, the same end could be attained by the selection of such variations until the flower was turned completely round on its axis."

Can there be the faintest suspicion that the man who wrote these sentences did not distinguish between the material for selection and the causes producing that material? One more quotation from the authors to show how they misunderstand Darwin's spirit and writings:—

"The first of these is the still curiously prevalent opinion that, when you have explained the utility or the advantage of a fact, you have accounted for the fact, *an opinion which the theory of natural selection has done more to foster than to rebuff. Darwin was indeed himself characteristically silent* in regard to the origin of sex as well as of many other 'big lifts' in the organic series" (p. 126).

[1] The key-note of Cope's imagined contribution was, "Selection cannot explain the origin of anything."

What do the authors mean? Their erudite and careful statements of the position of many foreign writers emphasize their failure to represent the position of the author of the "Origin of Species."

The authors think that the problems and questions relating to sex, problems and questions carefully and ingeniously analyzed by them, "are in final synthesis all answerable in a sentence." Morphological questions are at base, they say, physiological; and physiological questions are ultimately referable to the metabolism of protoplasm, as Prof. Burdon-Sanderson pointed out last autumn. This metabolism is double: it consists on the one hand of anabolic, constructive, elaborative processes—processes attended with the storage of energy; and on the other hand of katabolic, destructive, disintegrating processes—processes attended with the liberation of energy. These processes are complementary; in living protoplasm they seem for the most part coincident. Losing sight of the coincidence the authors have seized on the antithesis; the idea has grown upon them till they see a rhythm of anabolism and katabolism swinging through organic nature and producing—well, producing nearly everything.

Take, for instance, secondary sexual characters. Males are frequently lithe, active, aggressive, gorgeously coloured and decorated. Females are often sluggish, vegetative, passive, and soberly coloured. These characters, according to Geddes and Thomson, occur because males have a male or katabolic diathesis, because females have a female or anabolic diathesis.

"Brilliancy of colour, exuberance of hair and feathers, activity of scent glands, and even the development of weapons, are not and cannot be (except teleologically) explained by sexual selection, but in origin and continued development are outcrops of a male as opposed to a female constitution" (p. 22).

It is impossible to follow in detail and state the innumerable objections to this explanation. Do the authors suppose a male diathesis explains the ascending series of horn and antler development? Can it in any way account for "interference" colours, which play so large a part in the adorning of males? Are women less female when they have radiant complexions and abundant tresses? What physiological reason is there for believing that skeletal weapons and scent glands, or the crystals in anthers, are due to the katabolism of "exuberant maleness," while menstruation and lactation are means of getting rid of "anabolic surplus?"

Parthenogenesis occurs in groups of animals where the anabolic rhythm is dominant. Sex itself appears when katabolic conditions preponderate. And this is why flowers so often are situated at the end of the vegetative axis; this is furthest from the source of nutrition; the flower occupies a katabolic position, and is often the plant's dying effort (p. 226). Alternation of generations is a special example of the rhythm. Thus, but the authors do not cite this example in this connection, the tiny sexless and spore-bearing stalk parasitic on the moss-plant is the anabolic vegetative generation, while the conspicuous moss-plant is the sexual or katabolic generation—the generation peculiarly connected with starvation! It is obvious that the authors are nothing if not original. But the real value of the book must not be lost sight of in quotations from it. The chapters on the "Determination of Sex," on "Sex Elements," and on "Growth and Reproduction," are very suggestive. But indeed, to biologists the greater part of the book and its theories must be useful and suggestive. It is only the general public that must be warned off.

It is very much to be regretted that the authors have included a discussion of certain social and ethical problems absolutely unconnected with the title of their book. If such matters are to be discussed *coram populo*, it is only fair that explicit information should appear on the title-page.

P. C. M.

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## *THE QUICKSILVER DEPOSITS OF THE PACIFIC SLOPE.*

*Geology of the Quicksilver Deposits of the Pacific Slope.* By G. F. Becker. Pp. 486, and Atlas of xiv. folio Plates. (Washington: Government Printing Office, 1888.)

AMONG the numerous mineral treasures of California none are of more interest than the deposits of mercury ore which occur at intervals along the greater part of the Coast Range from the Mexican boundary to Clear Lake, in lat. 39° N., a distance of more than 200 miles. This region, together with the district of Steamboat Springs in Nevada, has been carefully examined by the division of the United States Geological Survey under the charge of Mr. G. F. Becker, and the results are now presented in another of the handsome quarto series of monographs published by Major Powell, the head of the Survey.

The discovery of mercury in California preceded that of gold; the most productive locality, New Almaden, near San José, at the south end of the Bay of San Francisco, having been known for about 65 years, while the actual mining was commenced under a grant from the Mexican Government shortly before the cession of the country to the United States. In its earlier years the mine was extremely profitable, and the long judicial controversy that ensued before the title was satisfactorily established occupies a prominent place among the records of American mining litigation. The maximum production of 47,194 flasks of 76½ pounds each was realized in 1865, but in 1886 it was reduced to 18,000 flasks, the total for the period 1850-86 being 853,259 flasks, or about two-thirds of the produce of the Spanish Almaden. The total produce of the Californian mines, which was about 80,000 flasks in 1877, declined to 30,000 in 1886.

The second mine in point of importance, known as New Idria, is about 70 miles in a south-easterly direction from New Almaden, the ore, cinnabar, occurring under conditions similar to those in the latter mine—namely, in very irregular groups of fissures in metamorphic strata, which pass into others containing Neocomian fossils of the genus *Aucella*. These were succeeded by other Cretaceous and Tertiary formations up to the Miocene, the close of the latter period being marked by an upheaval and the commencement of volcanic activity. The ore deposits are closely related to the latter, and are probably nearly all, if not entirely, of post-Pliocene origin.

In the Clear Lake region, in lat. 39° N., which adjoins the group of volcanic cones known as Mount

Konocte (or Uncle Sam) hot springs and solfataras are abundant in a small area of basalt of comparatively recent origin. The most important of these, known as the Sulphur Bank, was at first worked for sulphur, but, on getting below the surface, cinnabar was found in the decomposed basalt, and for some years it produced large quantities of mercury, up to 11,152 flasks in 1881; but latterly the yield has fallen off, being only 1449 flasks in 1886.

The Redington Mine, adjoining Knoxville, about 25 miles south-east of Clear Lake, was discovered in making a cutting for a road, and has been worked since 1862, and has produced nearly 100,000 flasks of mercury, a quantity which has only been exceeded by the mines of New Almaden and New Idria. In 1886 the yield had fallen to 409 flasks, the immense irregular body of ore at the surface having changed in depth to some narrow veins following fissures in the metamorphic Neocomian strata. These are to a large extent converted into serpentine; and a black opal, known as quicksilver rock, accompanied the ore, which was remarkable as consisting largely, in the upper workings at least, of amorphous black sulphide of mercury, or meta-cinnabar, a mineral that was there recognized in quantity for the first time. This deposit is considered to be the result of the action of hot springs in connection with an adjacent mass of basalt—springs which are now dormant except in so far that sulphur gases are given off and sulphur crystals are deposited in the old workings, where a comparatively high temperature, exceeding 100° F., prevails.

The Steamboat Springs in Nevada, near the Comstock lode, have been also studied by the author. These, although presenting no deposits of commercial value, are interesting from the light they cast upon the phenomena of the formation of mineral veins, and have therefore been carefully investigated by several observers, including the late Mr. J. A. Phillips, F.R.S., and M. Laur, of the École des Mines. The author considers that the main source of the ore in the Comstock lode is the diabase forming the hanging wall, and that the mineral contents were extracted from this pre-Tertiary eruptive mass by intensely heated waters charged with alkaline carbonates and sulphides rising from great depths, and that a similar origin may properly be attributed to all the cinnabar, pyrites, and gold found in the mercury-mines of the Pacific slope, having been brought in as solutions as double sulphides of metal and alkalies. The original source must have been either the fundamental granite of the country, or some *infra*-granitic mass, it being extremely improbable that they were extracted from any volcanic rock at or near the surface. In connection with this subject, the author has made a series of interesting experiments on the relations of the sulphide of mercury to that of sodium, which show that mercuric sulphide is freely soluble in aqueous solutions of sodium sulphide, although the contrary has repeatedly been asserted. Mercuric sulphide may be precipitated from sulpho-salt solutions in many ways, particularly by excess of sulphuretted hydrogen, by borax and other mineral salts; by cooling, especially in the presence of ammonia, and by dilution. In the latter case, a certain quantity of metallic mercury separates as well as the sulphide, indicating one of the methods by which the native metal has been produced in Nature.

In addition to the mines specially described, the author has extended his study of the subject to a consideration of the principal mercury-mines other than those of America, partly from personal investigation in Spain and Italy, and partly with the help of other observers and published accounts. He expresses a very decided opinion against the supposed substitution origin of the Almaden deposits, considering them to be essentially of a vein-like character, the cinnabar being deposited in fissures or interstitial cavities in sandstone previously existing. This latter conclusion is substantially similar to that arrived at by the late Mr. J. A. Phillips and the present writer, in a microscopic study of the Almaden ores made some years since. The details of the foreign deposits have been very carefully collected, the comparatively new discoveries of Avala in Servia, and Bakmuth in Southern European Russia, being included. The latter mine, which, at the time the book was completed, was not at work, has since become of considerable importance. The ore, cinnabar, occurs as an impregnation of a bed of carboniferous sandstone from 14 to 17 feet thick, with an average yield of 154 pounds per ton—about 7 per cent.—and the reduction works have a productive capacity of about 10,000 flasks annually.

In conclusion, it is scarcely necessary to state that the whole of the details illustrating the subject have been worked out with the care and fulness which have characterized the author's former monograph on the Comstock lode. Whether mercury-mining in California may be in a declining state, or destined to a revival of its former prosperity at a future time, there can be no question of the high value of the record of the results hitherto obtained, which is contained in the volume it has been our pleasant task to notice.

H. B.

## OUR BOOK SHELF.

*Illustrations of some of the Grasses of the Southern Punjab, being Photo-lithographs of some of the Principal Grasses found at Hissar.* By William Coldstream, B.A., Bengal Civil Service. With 38 Plates and 8 pages of Introduction. (London: Thacker and Co. Calcutta: Thacker and Spink. 1889.)

THIS work contains a series of thirty-eight photo-lithographs of the grasses used for agricultural purposes in the southern portion of the Punjab. The tract of country to which it relates lies to the west of Delhi, between the Jumna on the east and the Sutlej on the west. It constituted till recently the civil district of Hissar, which has now been broken up. It has an area of 8500 square miles, and a population of a million and a half. Except along the streams and canals the soil is sterile and sandy, and the crops depend upon the periodical rains. The staple cereals are *Sorghum vulgare* and *Penicillaria spicata*. In its centre is situated the great Government cattle-farm of Hissar, where for many years cattle of the finest Indian breeds have been reared by Government, principally for the supply of the ordnance and transport departments, but also to some extent for distribution through the country, with the aim of improving the commoner indigenous kinds. The *Bir*, or grass-lands, of this great farm are of very wide extent, and in the rainy season a large number of grasses, of more or less value as fodder, grow luxuriantly over its vast parks. The farm has altogether an area of above sixty square miles, and it is mainly from this that the species figured by Mr. Coldstream are taken.

The book is modelled upon the "Fodder-grasses of India," published not long ago, in two volumes, by Mr. Duthie, the director of the botanical department of Northern India, and to Mr. Duthie the author is indebted for the botanical determination of the species. He gives the native name of each plant, and a short account of the extent and manner in which it is used, and as most of them have a wide dispersion, this will be found useful in other dry sub-tropical regions. Out of thirty-seven species, the two great tropical tribes are represented, *Paniceæ* by twelve species, and *Andropogoneæ* by ten, and only three species fall under *Festuceæ*, the tribe to which most of our North European pasture grasses belong. The plates are lithographed from photographs, and do not contain any dissections. Plate III., called *Panicum Crusgalli*, is clearly not that species, but a form of *P. colonum*, another variety of which is figured on Plate II. Mr. Coldstream also has got entirely wrong with his two species of *Cyperus*, figured on p. 38. The left-hand figure, called *Cyperus species*, is evidently *Cyperus Ivia*, Linn., a common weed throughout India in rice-fields. The left-hand figure, labelled *Cyperus Tria*, is not in flower. There is no such plant known to botany; *Tria* is doubtless a mistake for *Ivia*. The figure is quite unrecognizable, but from the native name appended, "Motha," it is most likely *Cyperus rotundus*.

J. G. B.

*Elementary Dynamics of Particles and Solids.* By W. M. Hicks, M.A., F.R.S. (London: Macmillan and Co., 1890.)

IN this excellent treatise, extending over nearly 400 pages, the author introduces to the student the principles of dynamics. Although the book is issued under the latter title, it will be found to differ considerably in its treatment from the majority of text-books on the same subject. For instance, the two subjects of statics and kinetics have been considered together, the former being regarded as a special case of the latter. Again, the discussion of force is reserved until an attempt has been made to give an idea of mass and its measurement; thus a preliminary study of momentum finds an early place.

Although the mathematical acquirements of the student of these pages may be limited to a knowledge of the elements of algebra and geometry, he will be able to readily follow the methods adopted in establishing the various results. This the author has kept in view throughout his work, except in a few cases where, in the hope of rendering it useful to a larger circle of readers, he has had recourse to the trigonometrical ratios for examples which he has worked out.

The volume is divided into three portions (1) rectilinear motion of a particle; (2) forces in one plane; (3) plane motion of a rigid body.

One cannot read the first few chapters without observing the care taken by the writer in trying to impart to the student a correct and precise idea of the fundamental units. That this is a very important matter all will agree who have had any experience in teaching or testing students. The most deplorable state of ignorance sometimes exhibited by them, in giving their results in all manner of absurd units, should encourage both teacher and author to make a special effort when dealing with the question of units, fundamental or otherwise.

As the subject of statics is included, an opportunity has been taken of introducing the method of drawing stress diagrams for loaded framework; this will be valuable to engineering students.

Notwithstanding that the writer has forbidden himself the use of the integral calculus, he has been able to establish (in some cases very neatly) many useful results in the two chapters on centre of gravity and moment of inertia, which should be read with care.

Neatness in method characterizes the book throughout and an unusually large number of examples will be found at the end of each chapter.

The work is based on a series of lectures delivered by the author at the Firth College, Sheffield, and many details for which time can generally be found at the lecture table have in this case found their way into the book.

These will help to lessen the individual difficulties of students, and their views of the subject will be enlarged thereby. There can be little doubt that the text-book will have a deservedly favourable reception.

G. A. B.

*Catalogue of the Fossil Reptilia and Amphibia in the British Museum (Natural History).* Part III., containing the Order *Chelonia*. By Richard Lydekker, B.A., F.G.S., &c. (London: Printed by Order of the Trustees, 1889.)

MR. LYDEKKER is to be congratulated on having added one more to the valuable series of catalogues of the palæontological collections in the British Museum which he has compiled during the last few years. Like his previous catalogues, the present work indicates an enormous amount of careful and accurate work, which, however, is of such a special kind that it cannot easily be summarized in a short review.

The extreme difficulty of correlating the fossil forms of Chelonia with the recent, on account of the fragmentary character of many of the remains, is indicated by the fact that, out of the 52 genera and 131 species or varieties described, the author has only been able to place with certainty 18 genera and 10 species amongst existing forms. The classification adopted is to a great extent that followed by Mr. Boulenger in his catalogue of recent Chelonians. The work is illustrated by 53 woodcuts, and abundant references to the bibliography of the group are given. It must be added, as stated in the preface, that "the collection which forms the subject of this Catalogue is particularly rich in Chelonians from the Purbeck Beds of Swanage, the Cretaceous of England and Holland, the Eocene Tertiaries of Warwick, Sheppey, Hampshire, the Isle of Wight, and the older Pliocene of the Siwaliks of India." The last-named beds have yielded the largest tortoise known (*Testudo* [*Colossochelys*] *atlas* of Falconer), the carapace of which measures about six feet in length.

## 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.*]

### Systems of "Russian Transliteration."

As one who takes an interest in the Russian tongue, quite apart from the value of the scientific papers published in that language, I may perhaps be allowed to express my regret that the author of "A Uniform System of Russian Transliteration," published in your issue of February 27 (p. 397), has departed in almost every point where it is possible to do so from the system of transliteration which has been in use in England for about a century, and which has, moreover, the advantage of being almost identical with that current in France.

A system of transliteration may be founded on one of two bases—namely, the *empirical*, in which little or no account is taken of the sound of the letters in the foreign language, and the *rational;* in the latter the letters of the foreign language are, where possible, represented by letters or groups of letters which have as nearly as may be the same sound as the original. For instance, Б in Russian would be represented by *B* in English, these two having the same sound. It seems to me that the latter is the most convenient system, and the one which ought to be generally adopted; the author of this new "uniform system," however, has chosen the other course.

If the author of the "uniform system" had been contented with tabulating the system of transliteration which has been so long in use, he would have earned the gratitude of those devoted to literature, as well as of those who cultivate science. As it is, I am afraid he has merely given the world of art and letters an opportunity for gibes at what they are sometimes pleased to call the narrowmindedness and pedantry of scientific men.

I may, perhaps, be permitted to give a few examples of the defects of the new system; Г in Russian has three sounds, one nearly resembling the English *g*, another very like *h*, and a third guttural sound, to which there is nothing analogous in our tongue. The author proposes to get over this by transliterating Г by *gh!!* The eminent chemist Hemilian thus becomes masked as Ghemilian, whilst Gustavson appears as Ghustavson, and a well-known political character, Gortchakoff, is altered to Ghorchakov'. For comparison, I give these names, and a few others, as transliterated in accordance with the two systems:—

| Present system, | New system. |
| --- | --- |
| Hemilian | Ghemilian. |
| Gustavson | Ghustavson'. |
| Gortchakoff | Ghorchakov'. |
| Alexéeff | Aleksyeev'. |
| Gregoreff | Ghrighor'ev'. |
| Ogloblin | Oghloblin. |
| Mendeléeff | Mendelyeev'. |
| Chroushtchoff | Khrushchov'. |
| Michael | Mikhail. |
| Joukovsky | Zhukovskiĭ. |

Geographical names are even more weird; for example, it becomes somewhat difficult to recognize under the disguise of Nizhniĭ Novghorod and Volgha, the town of Nijni Novgorod and the River Volga. Such words as "Journal" and "Chemie," when occurring in titles, can be at once recognized; this can scarcely be said of them if the new system of transliteration is used, as they become "zhurnal" and "Khimiĭ" respectively.

It is much to be regretted that the Royal Society, the Linnean Society, and the Geological Society should have pledged themselves to adopt this novel "system of transliteration," instead of adhering to the one which has been so long in use. As a Fellow of the Royal Society, I feel very great regret that the Council are going to adopt this system in their publications, as it will seriously detract from the value of their supplementary "Catalogue of Scientific Papers" now in the press, at all events as far as Russian literature is concerned.

No protest of mine, however, can be half so forcible as the unconscious sarcasm of the author himself, in his paper, where he says that "an expression of grateful thanks is due" to two Russians "who have assisted in the arrangement of the system." The names of the Russians are then given, and if my readers will take the trouble to study them by the light of the table for transliteration by the new system, he will see how they express their appreciation of the author's labours by *carefully avoiding* every one of the novelties he has introduced.

CHARLES E. GROVES,
Editor of the *Journal of the Chemical Society.*
Burlington House, March 17.

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HAVING in view the increasing importance of Russian to literary and scientific men, it becomes very desirable to have a uniform system of transliteration, such as that recently proposed in your columns.

But, in order to be useful, everyone must agree to conform to it, nor should any such system be adopted off-hand without full discussion of any points which may seem susceptible of improvement.

It seems to me objectionable to indicate the semi-vowels (ъ and ь) by a simple ', and to omit them altogether at the end of a word. They really correspond, to a certain extent, to our *e* (mute); and I would suggest that it would be better to indicate them by a full letter—perhaps *ĕ* for one and *ê* for the other.

March 11. W. F. KIRBY.

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ONE or two points in the criticisms on this subject call for some notice before the publication of a more detailed account of the system.

As regards Mr. Kirby's suggestion, the transliteration of the semi-vowels was discussed, but it was not thought advisable to exaggerate their importance by using two letters for them, especially as their use is becoming discontinued in Russia.

When recommending a uniform system, we did not imagine that Mr. Groves or anyone else would infer that this was intended to limit the right of Russians who dwell in England or who write in English to spell their names as they please; we have not asked Messrs. Kelly to apply it to all Russian names in the Post Office Directory or the Court Guide; we should never think of altering such names in ordinary correspondence. Even in catalogues and records, for which this system is intended, the familiar form should of course be quoted with a cross reference, as recommended by us in the clause dealing with proper names.

Mr. Groves asks why we have not tabulated "the system which has been in use in England for about a century." Our efforts began with an attempt to discover such a system, and resulted in the tabulation of a large number of systems, including that employed by Mr. Groves in the *Journal of the Chemical Society;* since, however, no two authors agree in the English symbols intended to represent either the sounds or letters of Russian words, we endeavoured to frame a system combining as far as possible the features of those already in use in England and America.

We are much obliged to Mr. Groves for supplying further illustrations of the desirability of using *gh* for Г; the letter has, of course, more than the three sounds to which he limits it.

The uniformity of "the system which has been so long in use" may be illustrated by the following examples, in which we confine ourselves to the names of chemists, and to the words quoted by Mr. Groves:—

Consulting the "Imperial Gazetteer," Lippincott's "Gazetteer," and Keith Johnston's "Atlas" alone, we find Nijni, Nijnei, Nishnii, Nizhnee, Nijnii, and Nischnii-Novgorod.

One journal is given in Bolton's "Catalogue of Chemical Journals" as

*Zhurnal russkova khimicheskova i fizicheskova;*

in the *Geological Record* as

*Jurnal rosskoi chimitcheskago i phizitcheskago;*

and in Scudder's "Catalogue of Serials" as

*Zhurnal; russkoye khimitcheskoye i fizitcheskoye.*

Hence it is difficult to see why Nizhniĭ and Zhurnal should be unintelligible.

In the Royal Society Catalogue, the *Geological Record*, and Chemical Society's Journal, the same name is spelt Jeremejew, Jeremejeff, Jereméeff. Which of these words represents the pronunciation?

In the Chemical Society's Journal, Wroblewski and Flawitzky correspond to the Wroblevsky and Flavitzsky of Armstrong and Groves' "Organic Chemistry."

The same journal frequently quotes the name Markownikoff where the same Russian letter (and sound) is denoted both by *w* and *ff*, while in the examples of Mr. Groves it is also represented by *v*; here, of course, and in similar cases, the name comes through a German channel.

Mr. Groves transliterates a few names; since, however, in his "rational" system one Russian letter has more than one English equivalent (*v*, *ff*), and one English letter (*e*) has more than one Russian equivalent, while the sound is not correctly represented (*e*, *é*), it is obvious that this is neither "rational" nor a system (it does not profess to be "empirical"; perhaps Mr. Groves will now call it the "graphic method").

Since, moreover, the system recommended by Mr. Groves is not used by him in the Chemical Society's Journal, we hope that he may yet see his way to adopting the one which has now been accepted by so many of the leading English Societies.

H. A. M.
J. W. G.

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### "Like to Like"—a Fundamental Principle in Bionomics.

THE following letter has been intrusted to me for seeing through the press, and therefore I deem it desirable to state that it does not constitute the writer's reply to Mr. Wallace's criticism of his paper on "Divergent Evolution." This reply, as previously stated (NATURE, vol. xl. p. 645), will be published by him on some future occasion.

I cannot allow the present communication to appear in these columns without again recording my conviction that the writer is the most profound of living thinkers upon Darwinian topics, and that the generalizations which have been reached by his twenty years of thought are of more importance to the theory of evolution than any that have been published during the post-Darwinian period. GEORGE J. ROMANES.

London, March 10.

I FOLLOW Prof. Lankester in the use of bionomics to designate the science treating of the relations of species to species. If the theory of evolution is true, bionomics should treat of the origin, not only of species, but of genera, and the higher groups in which the organic world now exists.

In his very suggestive review of "Darwinism," by Mr. A. R. Wallace, in NATURE of October 10, 1889 (p. 566), Prof. Lankester refers to "his (Mr. Wallace's) theory of the importance of the principle of 'like to like' in the segregation of varieties, and the consequent development of new species." Prof. Lankester has here alluded to a principle which I consider more fundamental than natural selection, in that it not only explains whatever influence natural selection has in the formation of new species, but also indicates combinations of causes that may produce new species without the aid of diversity of natural selection. The form of like to like which Mr. Wallace discusses is "the constant preference of animals for their like, even in the case of slightly different varieties of the same species," which is considered not as an independent cause of divergence, but as producing isolation which facilitates the action of natural selection. If he had recognized this principle, which he calls selective association, as capable of producing in one phase of its action sexual and social segregation, and in another phase sexual and social selection, he would perhaps have seen that its power to produce divergence does not depend on its being aided by natural selection.

Mr. Wallace's view is very clearly expressed in the following passages, though I find other passages which lead me to think that the chief reason he does not recognize segregation as the fundamental principle in divergence is that he has not observed its relations to the principle of like to like. He says :—"A great body of facts on the one hand, and some weighty arguments on the other, alike prove that specific characters have been, and could only have been, developed and fixed by natural selection because of their utility" ("Darwinism," p. 142). "Most writers on the subject consider the isolation of a portion of a species a very important factor in the formation of new species, while others maintain it to be absolutely essential. This latter view has arisen from an exaggerated opinion as to the power of intercrossing to keep down any variety or incipient species, and merge it in the parent stock" ("Darwinism," p. 144).

I think we shall reach a more consistent and complete apprehension of the subject by starting with the fundamental laws of heredity, and refusing to admit any assumption that is opposed to these principles, till sufficient reasons have been given. Laws which have been established by thousands of years of experiment in domesticating plants and animals, should be, it seems to me, consistently applied to the general theory of evolution. For example, if in the case of domesticated animals, "it is only by isolation and pure breeding that any specially desired qualities can be increased by selection" (see "Darwinism," p. 99), why is not the same condition equally essential in the formation of natural varieties and species? If in our experiments we find that careful *selection* of divergent variations of one stock does not result in increasingly divergent varieties *unless free crossing between the varieties is prevented*, why should it be considered an exaggeration to hold that in wild species "the power of intercrossing to keep down any variety or incipient species, and merge it in the parent stock," is the same. Experience shows that *segregation, which is the bringing of like to like in groups that are prevented from crossing*, is the fundamental principle in the divergence of the various forms of a given stock, rather than *selection, which is like to like through the prevention of certain forms from propagating;* and I think we introduce confusion, perplexity, and a network of inconsistencies into our exposition of the subject, whenever we assume that the latter is the fundamental factor, and especially when we assume that it can produce divergence without the co-operation of any cause of *segregation* dividing the forms that propagate into two or more groups of similars, or when we assume that segregation and divergence cannot be produced without the aid of diverse forms of selection in the different groups. The theory of divergence through segregation states the principle through which natural selection becomes a factor promoting sometimes the stability and sometimes the transformation of types, but never producing *divergent* transformation except as it co-operates with some form of isolation in producing segregation ; and it maintains that, whenever variations whose ancestors have freely intergenerated are from any combination of causes subjected to persistent and cumulative forms of segregation, divergence more or less pronounced must be the result. The laws of heredity on which this principle rests may be given in the three following statements :—

(1) Unlike to unlike, or the removal of segregating influences, is a principle that results either in extinction through failure to propagate, or in the breaking down of divergences through free crossing.

(2) Like to like, when the individuals of each intergenerating group represent the average character of the group, is a principle through which the stability of existing types is promoted.

(3) Like to like, when the individuals of each group represent other than the average character of the group, is a principle through which the transformation of types is effected.

In my paper on "Divergent Evolution" (Linn. Soc. Journ., Zoology, vol. xx. pp. 189–274), I pointed out that sexual and social instincts often conspire together to bring like to like in groups that do not cross, and that in such cases there will be divergence even when there is no diversity of natural selection in the different groups, as, for example, when the different groups occupy the same area, and are guided by the same habits in their use of the environment. There is reason to believe that under such circumstances divergence often arises somewhat in the following way. Local segregation of a partial nature results in some diversity of colour or in some peculiar development of accessory plumes, and through the principle of social segregation, which leads animals to prefer to associate with those whose appearance has become familiar to them, the variation is prevented from being submerged by intercrossing. There next arises a double process of sexual and social selection, whereby both the peculiar external character and the internal instinct that leads those thus characterized to associate together are intensified. The instinct is intensified, because any member of the community that is deficient in the desire to keep with companions of that kind will stray away and fail of breeding with the rest. This process I call social selection. The peculiarity of colour or plumage is preserved and accumulated, because any individual deficient in the characteristic is less likely to succeed in pairing and leaving progeny. This latter process is sexual selection. It can hardly be questioned that both these principles are operative in producing permanent varieties and initial species ; and in the circumstances I have supposed, I do not see how the process can be attributed to natural selection. Varieties thus segregated may often develop divergent habits in their use of the environment, resulting in divergent forms of natural selection, and producing additional changes ; but so long as their habits of using the environment remain unchanged, their divergencies cannot be due to natural selection.

Mr. Wallace's very interesting section on "Colour as a Means of Recognition," taken in connection with the section on "Selective Association," already referred to, and another on "Sexual Characters due to Natural Selection," offers an explanation of "the curious fact that prominent differences of colour often distinguish species otherwise very closely allied to each other" (p. 226). His exposition differs from mine in that he denies the influence of sexual selection, and attributes the whole process to natural selection, on the ground that "means of easy recognition must be of vital importance" (p. 217). The reasoning, however, seems to me to be defective, because the general necessity for means of easy recognition is taken as equivalent to the necessity for a specialization of recognition marks that shall enable the different varieties to avoid crossing. In the cases I am considering, there is, however, no advantage in the separate breeding of the different varieties, and even in cases where there is such an advantage (as there would be if the variety had habits enabling it to escape from competition with the parent stock, but only partially preventing it from crossing with the same), it does not appear how this advantage can prevent the individual that is defective in the special colouring from following and associating with those that are more clearly marked. The significant part of the process in the development of recognition marks must be in the failure of such individuals to secure mates, which is sexual selection ; or in the unwillingness of the community to tolerate the company of such, which might be called social selection.

It is often assumed by writers on evolution that permanent differences in the methods in which a life-preserving function is performed are necessarily useful differences. That this is not so may be shown by an illustration drawn from the methods of language. The general usefulness of language is most apparent, and it is certain that some of the laws of linguistic development are determined by a principle which may be called "the survival of the fittest;" but it is equally certain that all the divergences which separate languages are not useful divergences. That one race of men should count by tens and another by twenties is not determined by differences in the environments of the races, or by any advantage derived from the difference in the methods. So easy recognition of other members of the species is of the highest importance for every species; but difference in "recognition marks" in portions of a species separated in different districts of the same environment is no advantage. Under the same conditions, habits of feeding may become divergent; but, since any new habit that may be found advantageous in one district would be of equal advantage in the other district, the divergence must be attributed to some initial difference in the two portions of the species.

I have recently observed that, of two closely allied species of flat-fish found on the coasts of Japan, one always has its eyes on the right side, and the other always on the left. As either arrangement would be equally useful in the environment of either species, the divergence cannot be considered advantageous.

Osaka, Japan. JOHN T. GULICK.

## Self-Colonization of the Coco-nut Palm.

THE question whether the coco-nut palm is capable of establishing itself on oceanic islands, or other shores for the matter of that, from seed cast ashore, was long doubted; and if the recent evidence collected by Prof. Moseley, Mr. H. O. Forbes, and Dr. Guppy, together with the general distribution of the palm, be not sufficient to convince the most sceptical person on this point, there is now absolutely incontrovertible evidence that it is capable of doing so, even under apparently very unfavourable conditions.

In the current volume of NATURE (p. 276) Captain Wharton describes the newly-raised Falcon Island in the Pacific; and in the last part of the Proceedings of the Royal Geographical Society, Mr. J. J. Lister gives an account of the natural history of the island. From this interesting contribution to the sources of insular floras we learn that he found two young coco-nut palms, not in a very flourishing condition, it is true; but they were there, and had evidently obtained a footing unaided by man. There were also a grass, a leguminous plant, and a young candle-nut (Aleurites), on this new volcanic island—a very good start under the circumstances, and suggestive of what might happen in the course of centuries.

W. BOTTING HEMSLEY.

## On Certain Devonian Plants from Scotland.

I AM indebted to Mr. James Reid, of Allan House, Blairgowrie, Scotland, for the opportunity to examine a collection of fossil plants obtained by him from the Old Red Sandstone of Murthly and Blairgowrie in Perthshire, some of which have been noticed by Dr. Geikie in his "Text-book of Geology."

The collection is remarkable for the striking resemblance of the matrix and the contained vegetable debris to those of the lower part of the Gaspé sandstones of Logan, and the species of plants are, so far as can be determined, the same.[1]

*Psilophyton princeps* largely predominates, as in Gaspé, and is represented by a profusion of fragments of stems and branches, and more rarely by specimens of the rhizoma and of the sporocarps. *P. robustius* is represented by fragments of stems, but is less abundant, and *Arthrostigma gracile* by some portions of stems. On the whole the assemblage is exactly those of the sandstone beds of the lower division of the Gaspé sandstones. There is nothing distinctively Upper Devonian in the collection.

The collection also contains two slabs of dark-coloured sandstone from Caithness, one of which contains what appears to be a fern stipe similar to those of the genus *Rhodea*. Another shows a remarkable plant having apparently a short stem giving origin to a quantity of crowded leaves which are long, narrow, and parallel-sided, and show only a very faint linear striation. This plant is identical both in the form and arrangement of the leaves with that found in the Devonian of Canada, and which I have named *Cordaites angustifolia*. I have, however, already stated in my Reports on the Flora of the Erian of Canada (Geological Survey of Canada, 1871 and 1882), that I do not consider this plant as closely related to the true Cordaites, and that I have not changed the generic name merely because I am still in doubt as to the actual affinities of the plant. Mr. Reid's specimens would rather tend to the belief that it was, as I have already suggested in the reports above cited, a Zostera-like plant growing in tufts at the bottom of water.

Some of the sandstone slabs from Murthly contain specimens of rounded objects referable to *Pachytheca* (Hooker), a genus of uncertain affinities but characteristic of Silurian and Lower Devonian beds on both sides of the Atlantic. One of these is perfectly spherical with a shining surface, and 2·75 mm. in diameter, the others have been broken so as to show a central cavity or nucleus about 1 mm. in diameter, and with a thick carbonaceous wall partly pyritised and showing obscure radiating fibres. Prof. Penhallow, of McGill University, has kindly examined these, and has compared them with slices of Pachytheca from the Wenlock limestone, kindly communicated by Mr. Barber, of Cambridge, and with specimens presented by Prof. Hicks from the Silurian of Corwen and with specimens in the author's collection from the Silurian of Cape Bon Ami; and also with the excellent figures in Mr. Barber's paper in the *Annals of Botany*. He has not been able, however, to arrive at any conclusions beyond the probable general similarity in structure of the various forms, which may, however, as Mr. Barber suggests, have differed in their nature and origin. The only thing certain at present seems to be that these puzzling organisms had a thicker outer coat of radiating fibres, and of so great density that it was less liable to compression than the other vegetable tissues with which it is associated.

A few small specimens sent more recently by Mr. Reid contain some curious but not very intelligible objects from the same beds. One is a stem coiled at the end very closely in a circinate manner. In form it resembles the circinate vernation of *Psilophyton princeps*, but is much larger. It may belong to *P. robustius*, or possibly to a fern, but is too obscure for certain determination. Several others appear to represent flattened fruits or sporangia of obovate form and of large size. One has a stalk attached with what seems a rudiment of a bract, and another shows obscure indications of having contained round or disk-shaped bodies about 2 mm. in diameter. All show minute longitudinal striation. I have not previously met with bodies of this kind in the Devonian, and can only suggest that they may represent the fructification of some unknown plant, possibly that to which Pachytheca belonged. J. WM. DAWSON.

Montreal, March 5.

[1] See papers by the author, Journal Geol. Society, London, 1859, and Proceedings Geol. Society, Edinburgh, 1877.

## Exact Thermometry.

I AM glad to observe that Prof. Sydney Young and myself are now in substantial agreement as regards the tension theory of the ascent of the zero in thermometers, and approximately in agreement as regards the actual cause of the ascent in the neighbourhood of the ordinary temperature.

Some time ago, in connection with an investigation of melting-point, I devoted three years to an examination of the properties of the mercurial thermometer. Among other conclusions which then seemed to me probable, the application of the known plasticity of glass under pressure to account for the enormous ascent (in lead-glass) of the zero at high temperatures appeared of some value. I have never advanced it as a mature theory, and am perfectly open to correction on the subject; but neither Prof. Crafts (with whom I at that time discussed the matter), nor any subsequent experimenter, has submitted the suggestion to a crucial examination.

Prof. Young's experiments (NATURE, March 27, p. 489) are very interesting as far as they go; but the kind of glass of which his thermometers are constructed is not that which brings out the peculiarities of the material in their most striking development. This, indeed, has long been known. It may well be that, in German soda-glass, the plasticity is masked by a preponderating tendency of the harder or more crystalline silicates of the bulb to set. Much could be done towards settling the question as to plasticity, if three thermometers of lead-glass—one vacuous, one open to the air, and one with air sealed in—were heated together and successively to 100° C., 120°, 150°, 200°, 250°, 270°, and 300°, and the zeros observed. Even then, there still would remain to be explained the strange depression which I noticed in several sealed thermometers of lead-glass in the neighbourhood of 270°. At present, I regard the suggestion as neither proved nor disproved.

We are, in fact, only beginning to learn what silica and silicates are. I have quite lately, for example, found a critical point in the action of heat upon fire-clays, similar to the 270° point in the zeros (before referred to) of my lead-glass thermometers; and a similar point is known to exist in the relation of the refractive index of quartz to temperature. Results of this kind show clearly that thermometry is by no means an easy subject. Indeed, I might define it as a mixture of very complicated chemistry with very complicated physics.

Glasgow, March 28. EDMUND J. MILLS.

### The Shuckburgh Scale and Kater Pendulum.

By permission of Prof. T. C. Mendenhall, Superintendent of the United States Coast and Geodetic Survey, and of Weights and Measures, I enclose to you for publication, if deemed suitable, a note relating to an abstract of a paper by General J. T. Walker, R.E., F.R.S., published in NATURE of February 20 (p. 381).

As the subject-matter refers to U.S.C. and G.S. Bulletin No. 9, I take the liberty of enclosing it also.

O. H. TITTMANN.

United States Coast and Geodetic Survey, Office of Weights and Measures, Washington, D.C., March 13.

Last summer the United States Coast and Geodetic Survey published an investigation, Bulletin No. 9, on the relation of the yard to the metre.

As the result of this investigation, values were deduced for the length of certain historic standards in England which differed very materially from the values previously assigned to them in metric measures.

Thus the length of the Royal Society's platinum metre, certified by Arago to be $17 \cdot 59\,\mu$ too short, was found to be only $7\,\mu$ too short.

This metre was compared by Captain Kater with a certain space (0–39·4 inches) on the Shuckburgh scale, and this space was in turn compared with his pendulum. It is therefore of interest to know whether the value deduced in the investigation referred to is accurate. It is the object of this note to call attention to a surprising verification of the deductions contained in Bulletin No. 9. Using the equation for the platinum metre found in that paper, namely—

$$\text{Platinum Metre} = 1\text{ m.} - 7\,\mu + 9 \cdot 126\,\mu,\ t\,\mathrm{C}^\circ,$$

we find

$$\text{at } 15^\circ \cdot 98\text{ C., P.M.} = 1 + 138 \cdot 8\,\mu;$$

but at this temperature Captain Kater found the space on the Shuckburgh scale

$$(0\text{–}39 \cdot 4\text{ inches}) = \text{P.M.} + 0 \cdot 02400\text{ inch, or } 0 \cdot 6096\text{ mm.,}$$

whence the space in question of the Shuckburgh scale $= 1 \cdot 007484$ m., and using for the coefficient expansion $18 \cdot 85 \times 10^{-6}$ for 1° C., we have at 16°·67

$$\text{the space} = 1 \cdot 0007614\text{ m.}$$

NATURE of February 20 (p. 381) publishes an abstract of a paper by General J. T. Walker, R.E., F.R.S., "On the Unit of Length of a Standard Scale by Sir George Shuckburgh, appertaining to the Royal Society," in which he states that the Shuckburgh scale was taken to Paris and compared with one of the standard bars of the International Bureau of Weights and Measures, by Commandant Defforges. The result of this comparison reduced to 16°·67 C., and as given by General Walker is

$$\text{the space} = 1 \cdot 0007619\text{ m.}$$

This agreement is perfect, more so, in fact, than the circumstances allow one to expect.

The agreement implies the correctness of the new values deduced in Bulletin No. 9 for the Ordnance metre and the platinum metre of the Royal Society, and gives the value of the metre as equal to 39·3699 inches as therein computed from Baily's and Sheepshank's comparisons, which established the relation between the Imperial yard and the space on the Shuckburgh scale.

It is to be noted that General Walker, ignoring Baily's and Sheepshank's comparisons, and adhering to the Clarke value 39·3704 + inches, deduces the (the writer of this thinks) erroneous conclusion, that the space on the Shuckburgh scale equals 39·400428 inches, the value according to their comparisons being 39·399896 inches. If to this value be added 0·04090 inch, the amount by which the distance between the knife-edges of the Kater pendulum exceeds the space 0–39·4 inches, the resulting length of the Kater pendulum at 16°·67 C. is 39·44080 inches, a value practically identical with that published by Kater, which is 39·44085 inches.

### The Green Flash at Sunset.

THE explanation of the bluish (?) green flash of light sometimes seen at sunset given in your note last week (p. 495) does not seem to me to be a sufficient explanation of all the observations. If the phenomenon were due simply to refraction it would last for only a fraction of a second, and the colour would be much more blue than green. But, so far as my own observations go, the colour may last for several seconds, and is a bright pea-green, exactly similar to that shown by the sun many degrees above the horizon in South India in September 1883. To produce that green, as I have shown elsewhere, all that is required is the absorption due to a great thickness of vapour, combined with a certain amount of dust—water dust or other.

I saw a very pretty example of this last July when off the coast of Vancouver, B.C. The air was very moist and the rain-band correspondingly strong, while fine dust was supplied by the land breeze carrying with it particles from the burning forests inland. The sky was cloudless, but the haze was thick enough to allow one to look at the sun while it was still some degrees above the horizon, and the disk appeared of a brilliant golden-red, gradually changing to yellow, and, finally, while part was still above the horizon, it became a bright pea-green. The spectrum was similar to that figured in my paper on the green sun (R.S.E. Trans., xxxii. 389).

A few days later I had a view of the sunset from the Selkirks, where the air was very dry, the rain-band slight, but the haze considerable. The colours of the sun's disk were much less brilliant, and never passed beyond the stage of a reddish-copper tint.

C. MICHIE SMITH.

73 George Street, Edinburgh, March 31.

### Foreign Substances attached to Crabs.

I MUST of course accept Prof. McIntosh's interpretation of his own statement, and admit that he has found *Molgula arenosa* frequently in the stomachs of Cod and Haddock. This Ascidian differs from the majority of its class in having allocryptic habits, but I have not yet made a sufficient number of experiments to be satisfied as to its edibility. It has also been a considerable difficulty to me that the extensive investigations of Brook and Ramsay Smith lend no support at all to the opinion that this Ascidian forms an article of food for ground-feeding fish. In any case the matter, though of much interest, is not one for discussion here, since *Molgula arenosa* is never one of the "foreign substances attached to crabs."

The statement made by Mr. Holt that "*Actinia mesembryanthemum* is a favourite food of the Cod," was so inconsistent with our knowledge of the habits and distribution of the two species that, as I expected, the grounds for his assertion prove to be entirely fallacious. My statement with regard to the offensiveness of Actinians to fishes was made after prolonged observation of the habits of the living animals and after experiment, while Mr. Holt bases his objection on the ground that the St. Andrews fishermen find *A. mesembryanthemum* to be a successful bait for Cod. One might as well argue that because bits of red flannel or of tobacco-pipe are highly successful baits in whiffing for Mackerel, therefore these substances form a "favourite food" of this fish. A moment's reflection also would have shown Mr. Holt that an Anemone impaled upon a fish-hook is a much less dangerous creature than one under natural conditions and with tentacles expanded.

During the past week an interesting observation of Eisig's has come under my notice which corroborates the view that the association between Crabs and Anemones is of primary importance for the protection of the Crabs. Eisig observed (see Journ. R.M.S., iii., 1883, p. 493) that an *Octopus* in its attacks upon a Hermit Crab would instantly retreat upon being touched by the stinging organs of the Actinian associated with it.

Plymouth, April 5. WALTER GARSTANG.

## THE THAMES ESTUARY.

ALTHOUGH it is not practicable to say precisely where the river ends and the estuary commences, it will be sufficient for general purposes if the westward, or inner, boundary of the Thames estuary is assumed to be a line from Southend to Sheerness, the northern boundary as the coast of Essex, and the southern the coast of Kent; and it may be said to extend eastward to the meridian of the Kentish Knock light-vessel. The area inclosed between these lines is upwards of 800 square nautical miles, and the whole of the space is encumbered with banks, between which are the several channels leading to the river.

As the shores of Essex and Kent are low, and have no natural features by which they may be distinguished at a distance, and as a great part of the estuary is out of sight of land, even in the clear weather so rare in this country, it is evident that artificial marks in considerable number are required to make navigation at all practicable between the banks. In early times, when vessels were small and of light draught, few marks were necessary, but with increasing trade, necessitating vessels of heavy draught, new channels have to be marked farther from shore, and the demand for additional security to navigation has especially increased of late years, so that now there are no less than 3 lighthouses, 11 light-vessels, 8 gas buoys, 10 beacons, and 117 ordinary buoys marking the channels at present in use; and the demand for additional marks is likely to increase rather than diminish, for the deepest channels through the estuary have not yet been buoyed, and the changes in progress seem to favour the opinion that before many years some of them will have to be opened up to facilitate traffic.

In endeavouring to give an account of the changes in the channels of the estuary, it is difficult to obtain any authentic records earlier than the commencement of the present century. If such records exist, they are not at the Admiralty or Trinity House, the earliest surveys worthy of notice being those of Mackenzie, Graeme Spence, and Thomas, between 1790 and 1810; but no thorough investigation appears to have been taken up until Sir Francis Beaufort was Hydrographer, when, under his instructions, Captain Bullock surveyed the whole estuary between 1835 and 1845. Since then, Calver re-surveyed the whole of the southern part in 1862–63, and examined the northern banks in 1864, and lately the *Triton* has re-surveyed all the important channels and delineated the banks, and from these several surveys some idea can be obtained of the condition of the estuary at different epochs, and of the changes that are taking place.

These changes seem to be of two kinds; viz. permanent changes and periodic changes.

Before, however, describing the changes in progress, it will be well to give a general description of the estuary; and, to render the description more intelligible, three plans have been constructed, the first showing the whole estuary on a small scale with the tracks followed by vessels; the second being a diagram showing the state of an obstruction in a channel at different epochs, a characteristic permanent change; whilst the third plan shows the state of the Duke of Edinburgh Channel from the time of its first opening out to the present date, to illustrate what seems to be a channel opening and closing periodically.

It is worthy of notice that all the banks of the estuary are of sand intermixed with shells; even the foreshore consists mostly of sand, between high and low water marks; in two places only is it of shingle (viz. off Whitstable and at Garrison Point, Sheerness); and in a few places, near the entrance of the rivers discharging into the estuary, there is a little mud, whilst in the vicinity of Margate there are some ledges of chalk. The sand is very fine, and although, when dry, it possesses a tolerably hard surface, directly it begins to be covered it is all alive. When beacons are erected on any of the banks, or a ship gets on shore, the tidal streams scour out the sand in the immediate neighbourhood, and cause the wrecks to sink and finally disappear. Although without actual boring it is not possible to give the exact depth of these sands, it is probable that they are upwards of 60 feet thick, for channels of that depth have opened out across the sands and again closed up, so that the bank has been dry at low water where 60 feet formerly existed; and the Goodwin Sands, in the Downs, which have been bored, proved to be 80 feet in thickness. All the banks, and the channels between them, trend in a north-east and south-west direction: this is doubtless due to the fact that the stream outside the estuary is running to the northward whilst the tide is ebbing from the river, and, consequently, the ebb stream in the estuary is deflected to the north-eastward.

The channels into the estuary, therefore, must be classed under two headings: (*a*) those which follow the main line of the flood and ebb streams, and (*b*) those which do not follow the general stream of the tide.

In the former category are the Warp, West Swin, Middle Deep, East Swin, Barrow Deep, Oaze Deep, and Black Deep; in the latter are the Middle Swin, Queen's Channel, Prince's Channel, Alexandra Channel, Duke of Edinburgh Channel, Gore Channel, &c., which are all more or less of the nature of swatchways across the main line of the sand-banks of the estuary. In the Black and Barrow Deeps, which are the deepest and straightest channels through the estuary, the ebb stream runs 7 hours and the flood 5 hours, and the ebb is much stronger than the flood, the stream setting fairly through. In the Duke of Edinburgh Channel, the deepest swatchway of the estuary, the streams at the north and south ends are of a rotatory character, revolving with the hands of the clock.

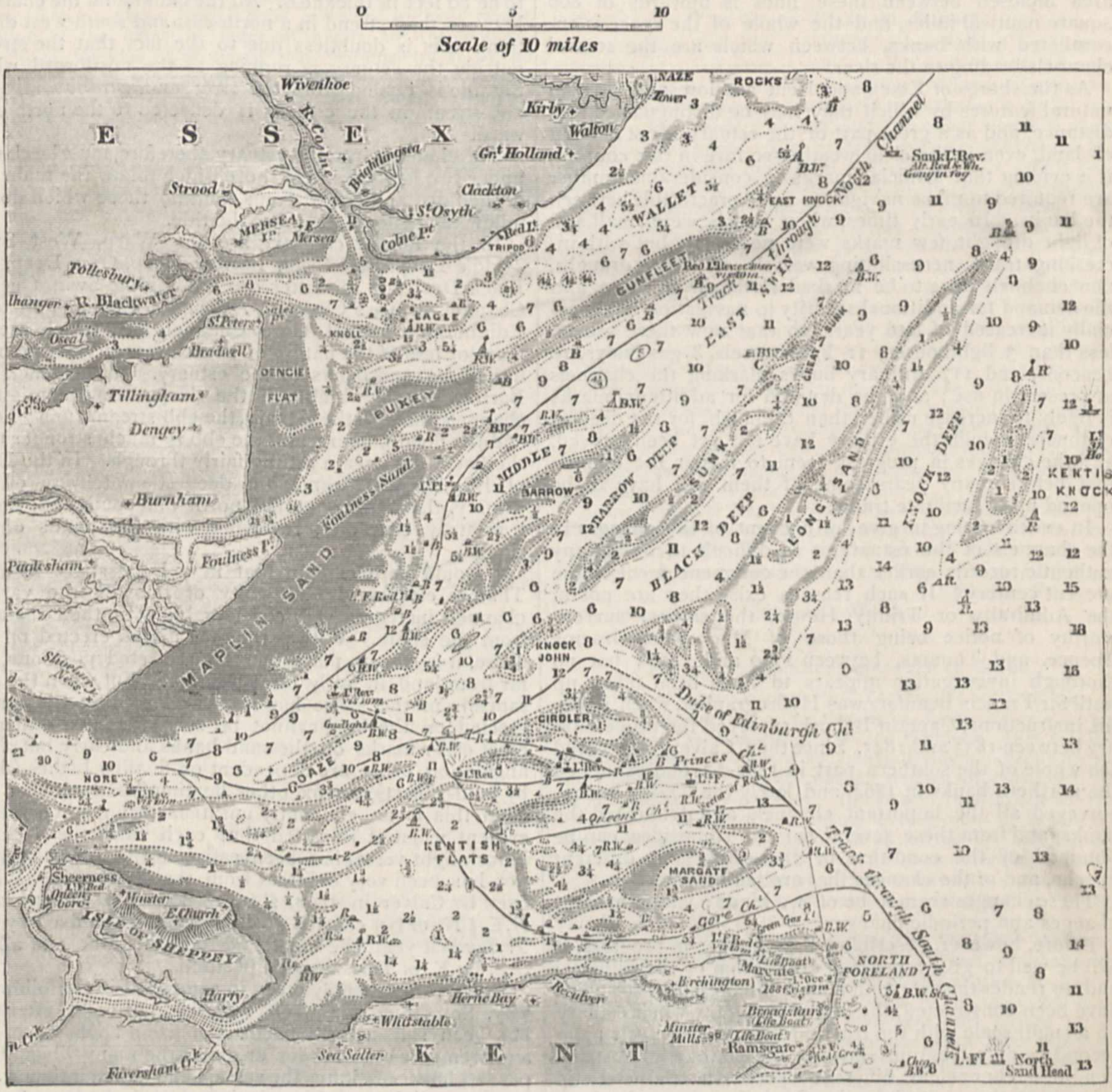
I would here explain that in a large space like the Thames estuary the difficulty of buoying the various channels increases very considerably with their distance from the shore. With permanent marks erected on the shore, it is easy to place buoys in selected positions, not far from land, in fairly clear weather. But when the distance from the shore has increased so that the marks erected on the land cannot be seen, we have either to erect other marks on the sand-banks and carry out a triangulation, or we are dependent on floating bodies (fixed by land objects) to fix other floating bodies farther off. That this is an eminently unsatisfactory method will be evident when it is stated that each time the Kentish Knock light-vessel has been satisfactorily fixed, the position has been very different from that supposed. When fixed by Calver in 1864, she was found to be one mile N.E. ½ N. of her charted position; and when fixed by the *Triton* last year, she was found to be one mile and a half S.E. by E. of her supposed position.

The errors probably creep in somewhat in the following way. Something goes wrong with the light-vessel after she has been satisfactorily fixed: a collision takes place, the fog-siren gets out of order, or one of the many things happens which necessitates the vessel being taken into port. A temporary light-vessel is substituted, and she is anchored in almost precisely the same position as the other, but probably before her mushroom bites the ground it has dragged somewhat. By the time the other vessel is repaired and brought out, the temporary one may be a cable or so away from the original position. As the weather is usually thick, the permanent vessel has to be anchored as nearly as practicable in the position of the temporary craft, and her mushroom may drag somewhat before biting the ground, &c. Thus a series of errors creep in without there being adequate means of checking the position of the light-vessel, and within the last few years the *Triton* has found the Leman and Ower light-vessel one mile away from her charted position, the

Dudgeon light-vessel about one mile from her supposed position, and the Outer Downing light-vessel nearly two miles from the charted position.

All these light-vessels are either out of sight of land, or can only be seen from an elevated position on the shore on rare occasions.

It is therefore naturally the object of the Elder Brethren of the Trinity House to utilize the channels closest to the shore, and, as these channels are also the most direct into the Thames, the northern channel following the general trend of the Essex coast, and the southern that of the Kentish coast, no other channels would require marking if the depth in these was sufficient for the traffic. Hitherto the one northern channel has been enough, but this is steadily shoaling, as will be described further on; but the southern channels are mostly shoal, and one after another has had to be opened up as the size of the vessels and their draught of water increased, until there are now five buoyed channels off the Kentish coast, two of which are lit; but only one can be termed a deep-water channel,




PLAN I.—THAMES ESTUARY. (Depths in Fathoms.)

and this would seem to be the very channel which opens and closes periodically, as will be shown subsequently. Should this prove to be the case, there will be intervals during which there will be no deep-water channel into the river on the south side of the estuary.

By a reference to Plan I., showing, on a small scale, the whole estuary, it will be seen that the northernmost channel, viz. that close to the coast of Essex, is named the Wallet, and that this is separated by a series of banks, termed Buxey and Gunfleet, from the channel next it. These banks, which are collectively 18 miles long, are dry for the most part at low water; there are, however, two narrow passages across them, one separating the Buxey from the Gunfleet, called the Spitway, and the other separating the Buxey from the Dengie flat (extending from the Essex coast). The Spitway, which, when sounded in 1800, had a depth of nine feet, has remained at that depth until recently, but now has only a depth of 5 feet at low water; the channel between the Buxey sand and Dengie flat has about 12 feet, and is merely an outlet for the River Crouch. It will therefore be seen that the Wallet is really only a channel to the Rivers Colne, Blackwater, and Crouch, and is of no importance as a channel towards the Thames. It was last surveyed by Staff-Captain Parsons in 1877, and as its features have not materially changed since 1800, it will probably not be surveyed again for many years, unless the swatchways across the Gunfleet should deepen or others open up of sufficient importance to render the Wallet useful as a traffic channel. There were formerly other swatchways across the Gunfleet, but these are now closed.

The channel next the Wallet is named the King's Channel, or Swin; the eastern part is named East Swin; the central part Middle Swin, and the inner part West Swin. This is the channel through which all the traffic between London and the northern ports of the Kingdom passes, and it is almost always crowded with shipping. The East Swin is bounded at first by the Gunfleet sand to the north-westward and the Sunk sand to the south-eastward, and is 3 miles wide; but 8 miles within its entrance two other banks commence—one, the Barrow, being very extensive, upwards of 13 miles in length and 2 in breadth; and the other, the Middle or Hook sand, a narrow ridge about 6 miles long, extending along the north-west face of the Barrow sand, and leaving a channel nowhere less than $\frac{3}{4}$ of a mile wide between them. It will thus be seen that 8 miles within the entrance of the East Swin it is split up into 3 channels; the northernmost retaining the same name, the channel between the Middle, or Hook sand, and the Barrow being known as the Middle Deep, whilst the channel between the Barrow and Sunk sands is known as the Barrow Deep. The Middle Deep rejoins the Middle Swin, but the Barrow Deep and West Swin both run into what is known as the Warp. The Swin is well buoyed and lighted throughout, but the Middle and Barrow Deeps have not yet been buoyed. In fact, it has hitherto not been necessary to do so, as the least water in the main channel of the Swin has, up to recently, been ample for all that has been required; but a steady shoaling has been taking place in a critical part of this channel since 1800, and it now seems to be only a question of time before the Middle Deep will have to be marked.

To illustrate the changes in progress here, Plan II. has been constructed, showing the condition of the critical part of the navigation in the Swin each time it has been thoroughly surveyed. By this diagram it will be seen that in 1800 the ruling depth in the channel between Foulness sand and the Middle or Hook sand was 35 feet at low water. Forty-three years later, a bar, on which the depth at low water was 28 feet, had formed between the Foulness sand and the Middle. In 1864 the depth had decreased to 24 feet, and, in 1889, to 21 feet, showing a steady decrease since 1800 of about one foot in every six years. The deposit is of sand, shells, and mud. This is the only shallow part of the Swin; and as it is evident that, so far as our knowledge extends, we may expect it to continue to decrease in depth, and as even now, with strong south-west winds prevailing in the North Sea, it is by no means rare for the tide to fall 3 feet below the level of low water ordinary springs, so that the depth would be reduced to 18 feet, it is clear that vessels of heavy draught will either have to wait for tide or use another channel. Already our small armoured vessels of war have to time themselves to reach this obstruction by half-tide. Fortunately, the Middle Deep is an alternative channel with ample depth in it, which only requires to be buoyed, and this can readily be done. This Deep seems to be in a better condition now than it has been for 50 years, for, when surveyed by Bullock, in 1843, there was a bar of 25 feet at its east end. This had disappeared when it was surveyed by Calver in 1864, and there was then a channel of two cables in width between the edges of the 30 feet contour lines of soundings surrounding the Middle sand and Barrow. There is now a channel four cables in width between those contour lines in the narrowest part of the Deep.

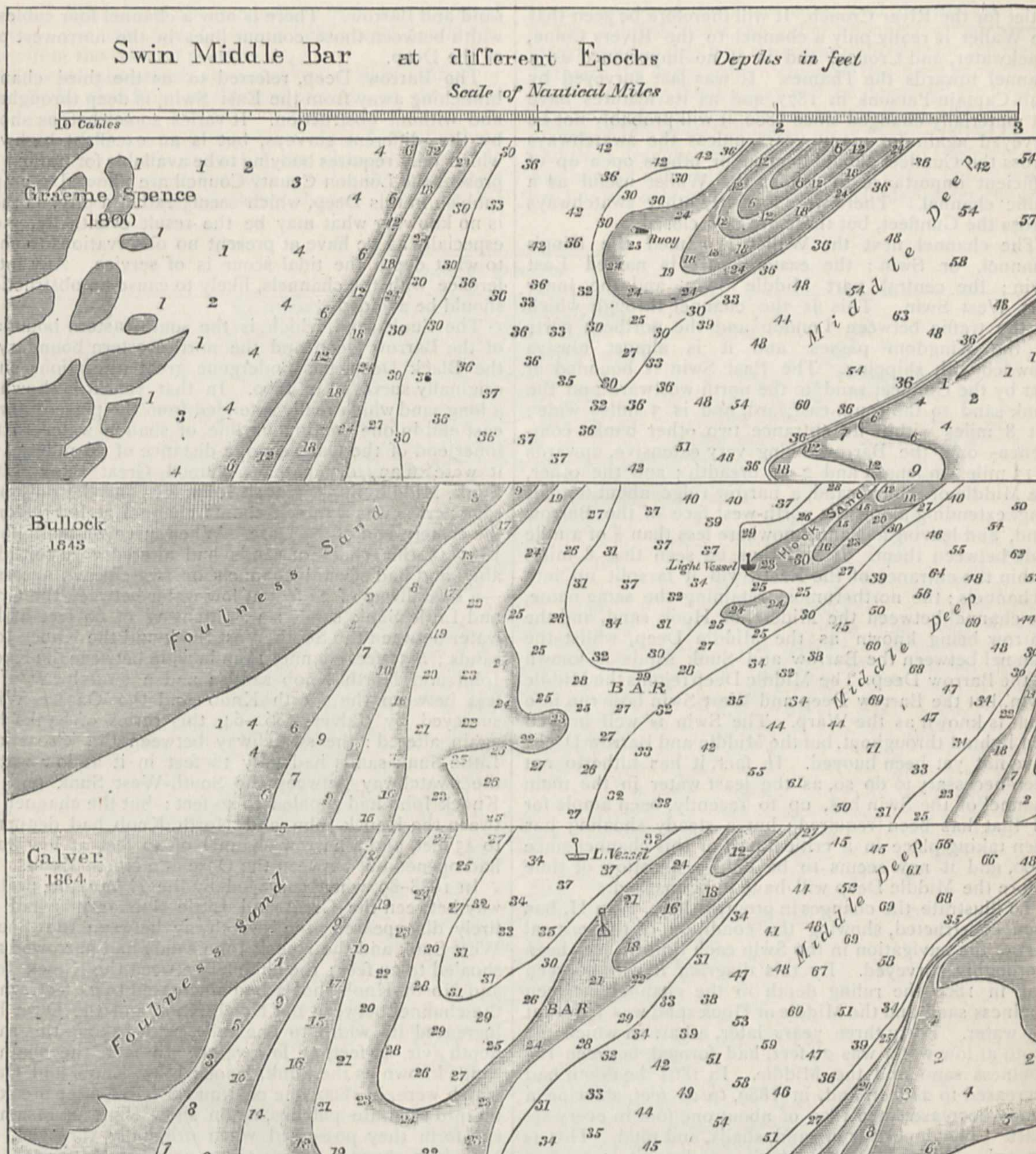
The Barrow Deep, referred to as the third channel branching away from the East Swin, is deep throughout, and without obstruction. It varies somewhat, as shown by the different surveys, but is an excellent highway, which only requires buoying to be available for traffic. At present the London County Council are allowed to empty rubbish in this Deep, which seems rather a pity, as there is no knowing what may be the result eventually, more especially as we have at present no observations to show to what depth the tidal scour is of service. Any interference with the channels, likely to cause an obstruction, should be avoided.

The Sunk sand, which is the south-eastern boundary of the Barrow Deep and the north-western boundary of the Black Deep, has undergone great alterations since originally surveyed in 1800. In that year it is shown as a long sand which really extended from the present north-east end in one continuous line of shallow water to the inner end of the Oaze sand, a distance of 26 miles. On it were many dry patches, named Great Sunk, Little Sunk, Middle Sunk, Knock John, &c., and the only passage across was a three-fathoms channel at low water at the eastern end of the Oaze. When surveyed by Bullock, 1835–45, this chain of sands had altered very considerably, and had several channels or swatchways across it —a swatchway of 22 feet at low water between the Great and Little Sunk sands: a swatchway of 60 feet at low water between the South-West Sunk and the Knock John sands; a 35-feet channel 1½ mile wide between the Knock John and North Knob sands; and a swatchway of 26 feet between the North Knob and the Oaze. When surveyed by Calver, 1862–64, this series of banks had again altered: the swatchway between the Great and Little Sunk sands had only 12 feet in it at low water; the swatchway between the South-West Sunk and the Knock John had shoaled to 40 feet; but the channel between the Knock John and North Knob had deepened to 45 feet, and a narrow channel of 40 feet at low water had opened out between the Oaze and North Knob.

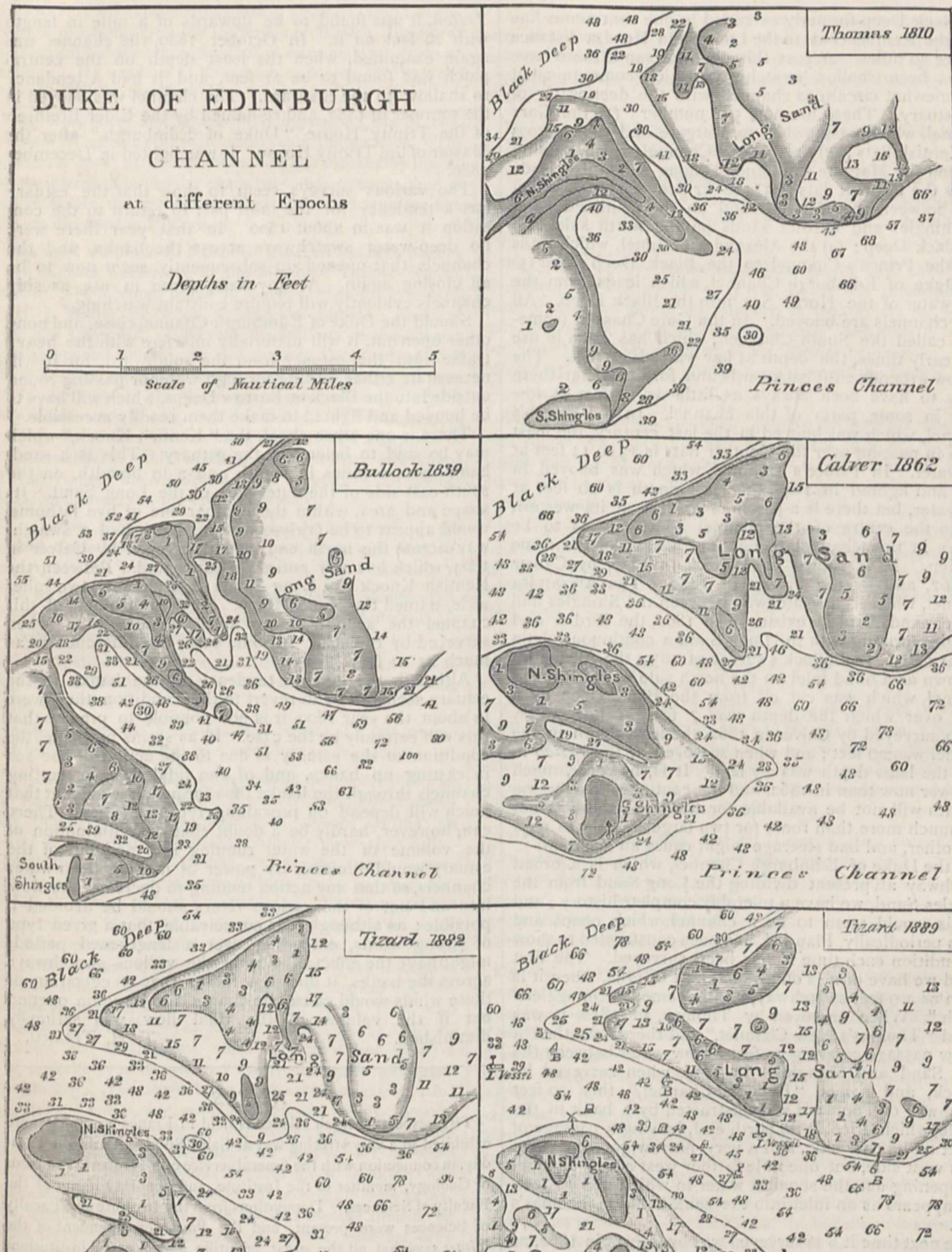
In 1888–89, when surveyed by the *Triton*, the swatchway between the Great and Little Sunk sands had entirely disappeared; the swatchway between the South-West Sunk and the Knock John sands had narrowed and shoaled to 29 feet; the channel between the Knock John and North Knob shoals had decreased to 24 feet, whilst the channel between the North Knob and the Oaze had increased its width to one mile, with about the same depth (viz. 40 feet) at low water. In fact, the chain of sands known as the Sunk, Knock John, Knob, and Oaze, which were, in 1800, one continuous bank, after breaking up into separate patches, again show signs of resuming the form they possessed when originally surveyed, the only deep channel across them now being between the Oaze and North Knob.

The Black Deep is the channel bounded to the north-westward by the chain of sands just described, and to the south-eastward by another chain of sands named Long Sand: Shingles, Girdler, and the flats extending from the Kentish shore. It is a deep-water channel, the inner part of which has been buoyed since 1882, and lighted since December last, as it communicates by a deep-water swatchway, named the Duke of Edinburgh Channel, with the deep water off the North Foreland, and so forms a convenient outlet for the heavy-draught vessels bound southward from the Thames. There seems to be some tendency to shoal in the north-east end of the Black Deep, but it has only once been sounded—viz. by Bullock, in 1843; and we have not yet quite completed our examination of it throughout, so that no thorough comparison is yet practicable.

The chain of sands which bound the south-east side of


Swin Middle Bar at different Epochs
Depths in feet
Scale of Nautical Miles
10 Cables
0
1
2
3
Graeme Spence
1800
Buoy
Middle Deep
Bullock
1845
Foulness Sand
Light Vessel
Hook Sand
BAR
Middle Deep
Calver
1864
L.Vessel
Foulness Sand
Middle Deep
BAR
Tizard
1889
Foulness Sand
Middle L.V.
S.W. Middle
Black & White
Vertical Stripes
BAR
Middle Deep

PLAN II.


DUKE OF EDINBURGH
CHANNEL
at different Epochs
Depths in Feet
0 1 2 3 4 5
Scale of Nautical Miles
Thomas 1810
Black Deep
Long Sand
N. Shingles
S. Shingles
Princes Channel
Bullock 1839
South Shingles
Calver 1862
Tizard 1882
Tizard 1889
L. Vessel

PLAN III.

the Black Deep formerly extended in one continuous line from the Kentish coast to the Long Sand Head, a distance of over 30 miles. Across this chain of sands there have always been shallow swatchways which communicated by somewhat circuitous channels with the deep water of the estuary. These are now 5 in number: (1) the Gore Channel, which passes close to Margate and then across the Kentish flats; (2) the Queen's Channel, which, passing between the Margate sand and Tongue sand, also leads across the Kentish flats; (3) the Prince's Channel, which leads between the Tongue sand on the south side, and the Shingles and Girdler sands on the north side, into the Black Deep; (4) the Alexandra Channel, which leads from the Prince's Channel to the Black Deep; and (5) the Duke of Edinburgh Channel, which leads from the deep water of the North Sea into the Black Deep. All these channels are buoyed. In the Gore Channel (sometimes called the South Channel), which has been in use from early times, the depth at low water is 10 feet. The shallow grounds shift backwards and forwards, but there seems to have been always as little as 10 feet at low water in some parts of this channel. In the Queen's Channel, which was buoyed in the last century, the least depth in passing over the Kentish flats is 13 to 14 feet at low water. In Prince's Channel, which was buoyed in 1846, and lighted in 1848, the least depth is 20 feet at low water, but there is a patch of 17 feet at its western end in the centre of the channel which seems to be always in this channel though not always in the same position. It is shown by Bullock in 1839, by Calver in 1862, and by the *Triton* in 1880. The Alexandra Channel, which is a swatchway between the Shingles and Girdler sands, had no existence in 1800, the Girdler and Shingles forming with the Long Sand a continuous chain at that date. In Bullock's survey of 1839, the Alexandra is shown as a blind inlet on the north side of the Prince's Channel, which was cut off from the Black Deep by a ridge over which the depth was 7 feet at low water. When surveyed by Calver in 1862, the least depth in the channel was 20 feet; and when surveyed by the *Triton* in 1888, the least depth was 23 feet. It is, however, much narrower now than in 1862, and if it continues to decrease in width will not be available for traffic, as there is not now much more than room for two large vessels to pass each other, and bad steerage might cause an accident.

Of the Duke of Edinburgh Channel, which is a broad swatchway at present dividing the Long Sand from the Shingles Sand, we have a tolerably complete history; and as this would seem to be a channel which opens and closes periodically, Plan III. has been constructed to show its condition each time it has been surveyed. The first record we have of it is on an old chart of 1794, when it is shown as a 9-feet swatchway, and is named "Smugglers' swatch." When surveyed by Thomas, in 1810, it was named "Thomas's New Channel," and there was then a narrow passage carrying 30 feet at low water between the Long Sand and Shingles. In 1839, when surveyed by Bullock, and named "Bullock Channel," this 30-feet swatchway of Thomas's was obstructed by a bank in the middle, which dried at its north end, leaving a passage of 15 feet on its east side, and a very narrow gat of 25 feet on its west side, but one mile farther west a new channel was opening out, the shoalest water in which was 16 feet. This appears as an inlet into the sand-bank on Thomas's chart.

The next time it was surveyed was by Calver, in 1862, at which date Thomas's Channel had closed completely, but the channel west of it had opened out and become a wide deep-water swatchway, the least depth in which was 42 feet at low water. Early in 1882 it was thought advisable to buoy this channel, and the *Triton* was ordered to examine it, when a 30-feet patch was discovered near its centre. In the autumn of 1887, this patch was reported to have shoaled; and in 1888, when examined again by the *Triton*, it was found to be upwards of a mile in length with 22 feet on it. In October 1889, the channel was again examined, when the least depth on the central patch was found to be 21 feet, and it had a tendency to shallow to the eastward. The channel was buoyed in the summer of 1882, and re-named by the Elder Brethren of the Trinity House "Duke of Edinburgh," after the Master of the Trinity House. It was lighted in December 1889.

The various surveys seem to show that the estuary has a tendency for the most part to return to the condition it was in about 1800. In that year there were no deep-water swatchways across the banks, and the channels that opened up subsequently seem now to be all closing again. At any rate, those in use as ship channels evidently will require constant watching.

Should the Duke of Edinburgh Channel close, and none other open out, it will materially interfere with the heavy traffic into the estuary from the southward, for it will necessitate either waiting for high water or passing round outside into the Black or Barrow Deeps, which will have to be buoyed and lighted to make them readily accessible.

There is one other shoal, the "Kentish Knock," which may be said to belong to the estuary. This is a sand-bank about 6 miles in length and 2 in breadth, on the south-east side of the outer part of the Long Sand. Its shape and area, within the contour-line of five fathoms, would appear to be fairly constant; but it had a swatchway across the north end, when surveyed by Calver in 1864, which has now entirely disappeared. Between the Kentish Knock and Long Sands is a channel, two miles wide, named the Knock Deep. At the north end of this channel the soundings are much shoaler than when surveyed by Bullock. In some cases the difference is as much as 12 feet.

Although the general tendency of the banks in the estuary seems to be to revert to the condition they were in about the year 1800, it is not possible to predict that this will certainly be the case. If, as seems probable, the condition of the estuary is due to the action of the sea in casting up banks, and of the tidal flow in cutting channels through the banks thus formed, it is evident that much will depend on prevailing types of gales. There can, however, hardly be a doubt that any diminution of the volume of the water running into and out of the estuary would diminish its power of making deep-water channels, so that any action tending to decrease the flow into and out of the various rivers should be avoided if possible; as although it is conceivable that a given type of strong winds, extending over a lengthened period, might have the effect of closing the various swatchways across the banks, it does not follow that a cessation of these winds would cause the channels to be again opened out if the volume of the tidal flow was seriously diminished.

T. H. TIZARD.

## NOTES.

THE respect in which science is held in France was once more exhibited in a very striking way at Saint Sulpice, Paris, on Tuesday, in connection with the funeral service of M. Hébert, Professor of Geology, member of the Institute, and honorary *doyen* of the Faculty of Sciences. Deputations from the Institute and Faculty of Sciences were present, and the Paris correspondent of the *Times* says that all the great scientific and literary institutions of Paris were represented. At the cemetery of Montparnasse, where the interment took place, speeches were delivered by M. Gaudry, in the name of the Institute; M. Darboux, in the name of the Faculty of Sciences; M. Marcel Bertrand, in the name of the Geological Society; M. Jannery, in the name of the Normal School; and M. Bergeron, in the name of the old pupils of M. Hébert.

GERMAN papers announce the death of Dr. Karl Jacob Loewig, Professor of Chemistry at the University of Breslau, Director of the Chemical Laboratory, and author of many eminent works on chemistry. He was born at Kreuznach on March 17, 1803, and died at Breslau on March 27.

THE "Inspectors' Instructions" relating to the Code of 1890 have been issued this year with remarkable promptitude. The document is one of great importance, and it is satisfactory that all who are interested in popular education will have ample time to study it before the various questions connected with the new Code are discussed in Parliament.

THIS week the National Union of Teachers has been holding its 21st Annual Conference at the Merchant Taylors' School, London. The meetings began on Monday, when the President, Mr. H. J. Walter, delivered his inaugural address. Speaking of the new Code, Mr. Walter said the teachers of the country would accept and welcome it; and although they reserved their right to criticize the details freely, and unhesitatingly to state that in many points the Code was capable of improvement, "they would work loyally with the Education Department in the endeavour to show such an improvement in the education of the country that the public would be ready to listen with attention and respect when teachers made suggestions for further changes and advance in the same direction."

M. GASTON BONNIER has been elected President of the Botanical Society of France for the year 1890, and MM. E. Roze, A. Michel, J. Poisson, and J. Vallot, Vice-Presidents.

THE International Exhibition of Geographical, Commercial, and Industrial Botany, proposed to be held at Antwerp, has been postponed till next year.

AN International Exhibition of Horticulture, which will be largely of a scientific character, will be held in Berlin from April 25 to May 5.

AN Electro-technical Exhibition is to be held at Frankfort-on-the-Main next year. It will be divided into twelve sections.

SOME exhibits in the Science Department (under the direction of the Rev. Dr. West and Mr. C. Carus-Wilson) of the Bournemouth Industrial and Loan Exhibition, opened on the 7th inst., are worthy of special notice. Among these are a collection of British and foreign oysters lent by the Poole Oyster-fishing Company, and a collection of birds' eggs, for which Mr. R. G. H. Gray has received a special prize. The first prize has been awarded to Mr. E. H. V. Davies, who exhibits an interesting collection of recent and fossil local shells. The various stages in the process of developing photographs are illustrated in a series exhibited by Mr. Jones. In the Geological Section, large specimens of fluor-spar have been lent by Dr. West, who also contributes a collection of Eocene fossils from the London, Hampshire, and Paris basins. Mr. C. Carus-Wilson shows a case of remarkably well-preserved fossils of various geological ages, including a gigantic shark's tooth (*Carcharodon*) from Rio; also, garnets in quartz, and samples of musical sands. Leaves from the Bournemouth Beds are well represented by Mr. Bennett's collection. In the Entomological Section, Mr. McRae's collection of British Lepidoptera attracts much attention; the Rhopalocera and Macro-Heterocera are nearly all represented, a large number having been bred by Mr. McRae from larvæ obtained in or near Bournemouth. A special prize has been awarded to Mr. Harding for a large astronomical telescope constructed entirely by himself. The Exhibition will close on the 21st inst., when the prizes will be distributed by the Duchess of Albany.

THE Royal Microscopical Society will hold its first evening *soirée* in its new rooms, 20 Hanover Square, on Wednesday, April 30, at 8 p.m.

M. LECLERC DU SABLON has been appointed to a Professorship of Botany at Toulouse, and is succeeded in his post of assistant naturalist to the chair of Organography and Vegetable Physiology at the Museum of Natural History at Paris, by M. Morot.

DR. LUDWIG KLEIN has been appointed Professor of Botany in the University of Freiburg-in-Breisgau.

M. PAUL MAURY has been attached to the Geographical Exploring Commission of the Mexican Republic in the capacity of botanist, and is about to depart for Mexico on a botanical expedition.

THE plans of the Danish expedition to the east coast of Greenland are now complete. Lieut. Ryder will command a party of nine, and during next summer, as soon as the ice permits, they will go by steamer to the east coast, and then devote two years to the investigation of the district between lat. N. 66° and 73°. At the end of that time they will be fetched by the steamer from Denmark.

THE French Society "Scientia" informs its members that its next dinner, on April 30, will be presided over by M. C. Richet and by M. de Lacaze-Duthiers, in whose honour the dinner is to be given. The last dinner was given in honour of Francis Darwin.

AT the general monthly meeting of the Royal Institution, on April 7, the special thanks of the members were returned for the following donations to the fund for the promotion of experimental research: Mr. Ludwig Mond, £100; Mr. Lachlan M. Rate, £50.

AT the Royal Institution the Hon. George C. Brodrick will begin a course of three lectures, on the place of Oxford University in English history, on Tuesday (April 15); Prof. C. V. Boys will begin a course of three lectures, on the heat of the moon and stars, on Thursday (April 17); and Captain Abney will begin a course of three lectures, on colour and its chemical action, on Saturday (April 19). The evening meetings will be resumed on Friday (April 18), when Sir Frederick Bramwell will give a discourse on welding by electricity.

THE Marlborough College Natural History Society, according to its latest Report, is in a most flourishing condition. The year 1889 was for the Society "one of continued prosperity and progress." On April 9, 1889, the Society completed its twenty-fifth year, and the members afterwards commemorated the occasion by an excursion to Stonehenge.

DR. VON DANCKELMAN has contributed to *Mittheilungen aus den deutschen Schutzgebieten*, vol. iii., an important paper on the climate of German Togoland, and of the neighbouring districts of the Gold and Slave Coasts. The observations are drawn from all available sources, from those first made by Dr. Isert at the then Danish settlements in 1783–85, down to the most recent observations by English, French, and German observers. A good deal of information exists, comparatively speaking, from this part of West Africa, and among the best of the observations are those made in 1888–89 by the German officials at Bismarckburg (lat. 8° 12′ N., long. 0° 34′ E.), at an altitude of about 2330 feet above the sea. A comparison of the tables given for the various colonies shows that the highest air pressure occurs in July and August, and the lowest in February and March. The monthly range is small, amounting to less than 0·2 inch. Temperature varies considerably with the position relatively to the coast. While at Akassa, on the coast, the mean daily range is only about 10°, at Bismarckburg it is double that amount. And during the hot season the range is double what it is in the cool season. Rainfall also varies with position relatively to the coast. The rainy seasons are March to June, and September to November. Dr. von Danckelman gives valuable statistics about the harmattan, which is generally understood to be a cold wind. He shows, however, that during the periods of this wind the temperature both in the morning and evening is warmer than on other days, and that the mean daily temperature is nearly 2° warmer. The air on these occasions is so dry that the hygrometric tables are not low enough for the reduction of the observations. On one occasion the relative humidity was only 9 per cent., with a temperature of 94°.

We have received from Mr. D. Dewar his "Weather and Tidal Forecasts for 1890." The author has previously published similar forecasts for past years, and they are said to be mainly based upon the simple idea that the prevailing westerly movement of the air in the two great belts in the north and south temperate zones is due to the continued westerly (west to east) movement of the sun and the moon, and it is claimed that the probable weather, while referring generally to the northern hemisphere, is chiefly applicable to the British Isles and neighbourhood. We have made a rough comparison of the forecasts with the actual weather experienced in the British Isles during the first three months of this year. The weather predicted by Mr. Dewar for January largely consists of cold and anticyclones, whilst the actual weather experienced was conspicuous for the absence of cold, with the exception of the first two or three days, and its mildness probably exceeded that of any January during the last half-century. At Greenwich the thermometer did not once fall below the freezing-point after the 3rd. Considering February as a whole, the forecasts were rather more successful. In March, the early part of the month was to have been mild, except in the north. The first few days were colder than in any March during the last half-century, except in the north, where milder weather was experienced. The weather predicted for the remainder of the month consists almost wholly of cold and snow, whereas the weather was exceptionally mild, and the Greenwich temperature on the 28th has only twice been exceeded in March during the last fifty years.

In the current number of the *Zoologist* it is stated that a wealthy Berlin manufacturer has a shooting near Luckenwald, where the Wapiti, *Cervus canadensis*, has been acclimatised. Between January 20, 1889, and January 20, 1890, seven of these animals were shot there, one of them having a head of fourteen points.

Dr. W. King, Director of the Geological Survey of India, has commenced, in the current number of the Records of the Survey, the publication of the provincial index of the minerals of India, which is intended as a help towards the compilation of an annual statement showing the quantities and value of mineral products in British India, for the publication of the mining and mineral statistics of the Empire. Dr. King's classification is of a broad and popular nature. The provinces or Presidencies and Native States are taken in alphabetical order, and the mineral products of each are set down with notes as to the quantity, quality, and output. The mineral products themselves are divided into "Important Minerals," "Miscellaneous Minerals," "Gem Stones," and "Quarry Stones." Under the first head are included only coal, iron ores, gold, petroleum, and salt. Under the second head come metallic ores, borax, gypsum, asbestos, soapstone, sulphur, and the like. "Gems" include amber, beryl, diamond, garnet, jade and jadeite; while clays, limestones, marbles, kunkar, slate, &c., are grouped as quarry stones. The first instalment of the list ends with the Central Provinces. This index may help to dispel the common idea that India is rich in minerals. The greater part of the entries are mere indications of the reported existence of ores, while those which note a regular production of any commercial importance are few and far between.

In one of the Bombay Natural History Society's papers, Mr. G. Carstensen, Superintendent of the Victoria Gardens, Bombay, makes a bold suggestion for facilitating the study of botany in India. His experience, he says, has taught him that the study of botany is far more popular in the northern countries of the European Continent than in British possessions, and he cannot help thinking that this fact may be clearly attributed to the difference in the botanical terminology. While the terms used in English works on botany are too frequently quite unintelligible for the layman, because they are in most cases Anglicized Latin words, the terms used by German and Danish authors are generally easily comprehended, because they are translated into the mother language, refer to objects of daily life, or are derived from the language itself. He therefore proposes that the Botanical Committee of the Bombay Society be requested to revise the existing terminology, and to substitute English and intelligible terms for the more unintelligible ones. He gives a few examples of the English substitutes he proposes. The natural arrangement of plants consists of two large divisions, Phanerogams, or "flower-plants," and Cryptogamous plants, or "spore-plants." "Flower-plants" are again divided into Dicotyledons, or "two-seed-leaved." The "two-seed-leaved" in the same way are divided into Angiosperms, or "seed-vessel-plants," and Gymnosperms, or "naked-seeded plants," and so on. For the "natural orders" he would substitute existing or new English names, and for "genera" he would substitute "forms." In a complete flower the calyx would become the "cup," the sepals "cup-leaves," the corolla the "crown," the petals "crown leaves;" the cup and crown together, now known as the perianth, would be the "floral cover," and so on through the andræcium and gynæcium, and the whole anatomy of the plant. The adoption of this method would, Mr. Carstensen thinks, "vastly increase the number of students of botany, and in the end would materially further the progress of this unfortunately neglected science."

The subject of dreams seems to demand more thorough study than it has yet received from science. An American, Dr. Julius Nelson, of New York, has lately published the results of an examination he made of some 4000 of his dreams. He finds that the dreams of evening generally follow great physical or mental fatigue, and are associated with the events of the day. The same applies to night dreams, which, however, have more of a terrifying element in them. The most remarkable and pleasant are the morning dreams, occurring after complete rest of the brain. Fancy then appears to have its widest range and activity, working marvellous transformations, and giving clear vision of the past and the future. Dr. Nelson further finds that the vividness of his dreams is subject to regular fluctuations of 28 days, and that they also vary with the seasons, so that they are very vivid in December, and least vivid in March and April. An old popular superstition attaches special importance to dreams in the twelve nights from Christmas to January 6, and it is suggested that this is perhaps because dreams at that time have been found very vivid and distinct.

The skin of Arctic voyagers, after the long night of winter, often appears pale, with a tinge of yellowish-green, on return of sunlight. The nature of this phenomenon, was, at the instance of Prof. Holmgren, studied by Dr. Gyllencreutz, in the expedition of 1882–83, and the results are given in a German physiological journal. Holmgren pointed out that the phenomenon might be subjective, due to a change in colour-sense through the long darkness; or objective, due to changes in pigment of the blood; or both. An examination of the colour-sense of the men before and after the polar night revealed no change in this. The blood was examined by measuring the position of absorption bands of hæmoglobin with a given thickness of layer, and estimating their darkness. No change in the quality of hæmoglobin was detected, but the quantity, in some individuals, judging by changes in the width and darkness of the bands, was lessened towards the end of winter. Holmgren suggested, as an *experimentum crucis* with regard to the question of a subjective or objective cause, that someone should exclude himself from sunlight a month longer than the others: and to this infliction the engineer Andrée submitted. When he left his prison, his skin had a greyish-yellow tint. The conclusion arrived at is that the change of skin is due to an anæmic-chlorotic condition, possibly that of incipient scurvy.

WE have received Tylar's "Photographic Calendar" for the year 1890. It comprises, among other advantages, practical hints selected from the best contributors, and various reproductions of several of the pictures that gained prizes in the competition held last year. There is also an extended list of the author's specialities, as well as those of other dealers; and throughout there is a variety of useful information handy for reference. The prize list is more varied and comprehensive than that given last year.

THE "Photographers' Diary and Desk-book" for the year 1890, which is issued by the proprietors of the *Camera*, is a very handy and useful volume. Developing and other formulæ are printed in large type, capable of being read in the dim light of the dark room. A series of dark-room procedures has been added, including the work of developing the negative, silver printing and toning, platinotype printing (cold, hot, and sepia processes), Blanchard's platinum black process, and bromide printing. A selection of the most important and useful of the recent improvements in photographic apparatus is given, with several illustrations, preceded by some particulars of the objects of the Photographic Convention of Great Britain, with a list of its officers. The diary portion, interleaved throughout with blotting-paper, gives ample space for the daily record of photographic work.

THE Royal Horticultural Society has issued the first part of vol. i. of its Journal. This part includes reports of the Vegetable Conference held at Chiswick on September 24, 25, and 26, 1889, and of the Chrysanthemum Conference held at Chiswick on November 5 and 6, 1889.

THE Transactions of the Congrès Colonial and the Congrès d'Hygiène et de Démographie, held in Paris last summer, have been issued. The Transactions of the latter Congress cover over 1200 octavo pages, and include many really useful papers.

MICHEL TROJA was one of the first surgeons who experimented (1775) on the regeneration of bone. His book, "De Ossium Regeneratione," has just been published, for the first time, in French.

THE last Annual Report of the Dutch Colonies in the East Indies contains references to several subjects of scientific interest. The military surveys were carried out on the west coast of Sumatra and in Dutch Borneo. In the former a large area was mapped on a scale of 1 : 20,000, and in Borneo a flying survey of 1 : 200,000 was made over a considerable district. Triangulation and cartographical work were continued in Sumatra; various maps were finished in Batavia; and the parts of the great map of Netherlands India, including the Residencies of Madura and Pasuruan, were put in hand at the Hague. The members of the Hydrographic Department were busy on the coasts of Java and Madura; an astronomical station was established on the Sunda Islands; and the study of the languages of the archipelago was continued by gentlemen appointed for the purpose—Balin, Javanese, Old Javanese, Macassar, Bugin, &c. There are 182 meteorological stations in working order, 100 in Java and Madura, 34 in Sumatra, 6 in Billiton and Banka, 9 in Borneo, 17 in Celebes, 2 in Bali, and the remainder at other points in the archipelago. Of scientific expeditions of various kinds a long list is given. These include geological investigations in Sumatra and Flores, botanical on Key Islands, ethnological in the Balta region of Sumatra, ethnological, botanical, and zoological, on the east coast of Borneo. An arrangement has been made, by which in each year one student from home will be able to spend some months in the famous Buitenzorg Botanical Gardens.

ANOTHER paper by Drs. Curtius and Jay upon hydrazine, $N_2H_4$, describing a new and very simple method of obtaining this recently isolated base from the ammonia addition compound of aldehyde, $CH_3 . C \left\langle \begin{matrix} H \\ OH \\ NH_2 \end{matrix} \right.$, is communicated to the latest number of the *Berichte*. The first step consists in acting with sodium nitrite upon a cold slightly acidified aqueous solution of aldehyde-ammonia, by which a nitroso-compound of the composition $C_5H_{11}O_2 . C \left\langle \begin{matrix} H \\ N.NO \end{matrix} \right.$ is formed. The reaction probably completes itself on the lines of the following equation—

$$3CH_3 . C \left\langle \begin{matrix} H \\ OH \\ NH_2 \end{matrix} \right. + NO . OH = C_5H_{11}O_2 . C \left\langle \begin{matrix} H \\ N-NO \end{matrix} \right. + 2H_2O +$$

$2NH_3$. About 300 grams of aldehyde ammonia are dissolved in a little ice-cold water, and neutralized with cold dilute sulphuric acid. About 40 c.c. more of the dilute acid are then added, and afterwards a concentrated solution of 70 grams sodium nitrite in iced water. The liquid at once becomes turbid owing to separation of minute yellow globules of the nitroso-compound, termed nitroso-paraldimine, on account of its derivation from paraldehyde, the triple polymer of common aldehyde. This nitroso-paraldimine is a lemon-yellow liquid possessing an intense camphor-like odour. Its molecular weight has been determined by Hofmann's density method, and found to correspond with the formula above quoted. It decomposes at its boiling-point, but may be readily distilled in steam or *in vacuo* without suffering change. The imine itself, corresponding to the nitroso-compound, has also been isolated. The hydrochloride, $C_5H_{11}O_2 . C \left\langle \begin{matrix} H \\ NH . HCl \end{matrix} \right.$, is obtained when moist hydrochloric acid gas is passed through an ethereal solution of nitroso-paraldimine, in the form of a mass of white needles. From this hydrochloride the free base, paraldimine, $C_5H_{11}O_2 . C \left\langle \begin{matrix} H \\ NH \end{matrix} \right.$, may be obtained by treating its ether solution with silver oxide. Paraldimine is a clear colourless liquid of a sharp odour resembling that of paraldehyde. It solidifies to white crystals in a freezing mixture. It boils almost without change at 140° C., but polymerizes to a white solid on standing in a sealed tube for some weeks. Water or alcohol decompose it into paraldehyde and ammonia. Its hydrochloride, which is readily formed from the base with great evolution of heat by leading dry hydrochloric acid gas over the pure liquid, may be converted into the nitroso-compound by treating with a strong solution of sodium nitrite. The nitroso-compound itself, on reduction with zinc dust and dilute sulphuric acid, at once yields hydrazine sulphate, $N_2H_4 . H_2SO_4$. The course of the reaction is better seen when the gentler reducing mixture, zinc dust and glacial acetic acid, is allowed to act upon an ethereal solution of nitroso-paraldimine. An amide termed amidoparaldimine, $C_5H_{11}O_2 . C \left\langle \begin{matrix} H \\ N . NH_2 \end{matrix} \right.$, is then first formed, and may be isolated as a strongly basic volatile liquid, which yields a very hygroscopic hydrochloride with hydrochloric acid. On boiling this hydrochloride with dilute sulphuric acid, it is decomposed, with assimilation of the elements of water, into paraldehyde and hydrazine—

$$C_5H_{11}O_2 . C\begin{matrix}/H \\ \backslash N . NH_2\end{matrix} + H_2O = C_5H_{11}O_2 . C\begin{matrix}/H \\ \backslash O\end{matrix} + N_2H_4.$$

The hydrate of hydrazine is readily obtained from the sulphate by simple distillation with alkalies.

The additions to the Zoological Society's Gardens during the past week include an Egyptian Cat (*Felis chaus*) from North Africa, presented by Mrs. Florence J. Waghorn; a Stoat (*Mustela erminea* ♂), British, presented by Mr. Cuthbert Johnson; two Mantchurian Cranes (*Grus viridirostris*) from Corea, presented by Mr. Campbell; three Long-eared Owls (*Asio otus*), British, presented by Mr. W. Geoffrey N. Powell; a Black-faced Weaver-Bird (*Hyphantornis* sp. inc.), from South Africa, presented by Commander W. M. Latham, R.N., F.Z.S.; a Three-toed Sand Skink (*Seps tridactylus*), European, presented by Mr. J. C. Warburg; two Hybrid Deer (between *Cervus elaphus* ♂ and *Cervus sika* ♀), deposited; a Diana Monkey (*Cercopithecus diana* ♀) from West Africa, eight Undulated Grass Parrakeets (*Melopsittacus undulatus*) from Australia, purchased; a Rhesus Monkey (*Macacus rhesus*), born in the Gardens.

## *OUR ASTRONOMICAL COLUMN.*

### Objects for the Spectroscope.

Sidereal Time at Greenwich at 10 p.m. on April 10 = 11h. 16m. 18s.

| Name. | Mag. | Colour. | R.A. 1890. | Decl. 1890. |
|---|---|---|---|---|
| | | | h. m. s. | ° ′ |
| (1) G.C. 2386 ... ... | — | — | 11 15 47 | + 3 50 |
| (2) 72 Leonis ... ... | 5 | Yellowish-red. | 11 9 22 | +23 42 |
| (3) υ Leonis ... ... | 4 | Yellowish-white. | 11 31 18 | − 0 13 |
| (4) δ Leonis... ... ... | 2 | White. | 11 8 18 | +21 8 |
| (5) 152 Schj. ... ... | 5 | Red. | 12 39 58 | +46 3 |
| (6) R Hydræ ... ... | Var. | Very red. | 13 23 43 | −22 43 |

*Remarks.*

(1) The General Catalogue description of this nebula is as follows: "Bright, pretty large, round, pretty suddenly much brighter in the middle." In 1869, Prof. Winlock observed the spectrum at Harvard College Observatory, and stated that it was continuous, with a possible bright line near λ 525. The nebula does not appear to have been spectroscopically examined by any other observer, so that further observations are required to confirm this result. If there really be a bright line as recorded, others may certainly be expected. Comparisons with the carbon flutings in the Bunsen or spirit-lamp flame spectrum should be made. It seems highly probable that many of the so-called "continuous" spectra of nebulæ really consist of bright lines or flutings superposed upon a continuous spectrum, as Dr. Huggins has stated that brighter parts have been suspected in some cases, and I myself have often noted irregularities, notably in the Great Nebula of Andromeda. In 1866 Dr. Huggins was careful to point out that his use of the term "continuous" was not to be understood to mean more than that, when the slit was made as narrow as the feeble light permitted, the spectrum was not resolved into bright lines.

(2) This star has a very fine spectrum of Group II. According to Dunér, the bands 2–8 are wide and dark, especially those in the red. This indicates, as I have pointed out on previous occasions, that the star is probably considerably advanced towards Group III., in which the bands will be replaced by lines. It will be interesting to know if any lines exist in the spectrum of the star at present, and, if so, what lines they are.

(3) A star of the solar type (Konkoly). The usual differential observations are required.

(4) A star of Group IV. (Gothard). Usual observations required.

(5) It is generally agreed that 152 Schj. is one of the finest examples of stars of Group VI. It shows the usual bands of carbon very strongly marked, and all of the secondary bands are well visible. We have certainly still a great deal to learn about stars of this group, and the present favourable position of a typical example may therefore be taken advantage of for further inquiry.

(6) At the last maximum of this interesting variable, Mr. Espin found that the F line was bright in its spectrum, the general spectrum being a very fine one of Group II. Mr. Espin also noted that the bright bands (probably the bright flutings of carbon) were relatively brighter as the star was on the increase, and weaker when its luminosity was decreasing. It is very important that a recurrence of these phenomena at the approaching maximum of April 11 should not escape observation, even though the star is not one which rises early in the evening at this time of the year. The period of the variable is about 434 days, but is apparently decreasing. In 1708 it was about 500 days. It varies from magnitude 4–5 at maximum to about 10 at minimum.

A. Fowler.

The Apex of the Sun's Way.—A determination of the amount and direction of solar motion is given by Mr. Lewis Boss in *Astronomical Journal* No. 213. This determination is an important one, because of the fact that, out of the 253 stellar motions used, only 49 are known to have been previously employed in a similar research, and it is by means of new material and variations of arrangements in its use that any general facts or laws are likely to be discovered. The stars whose proper motions have been utilized were given in No. 200 of the above journal, and are all contained in the Albany zone, which is 4° 20′ in breadth, and at a mean declination of 3° north of the celestial equator.

The method employed is substantially that proposed by Airy, and in the first solution five stars having proper motion greater than 100″ in a century were excluded, with the following results:—

| | Mean magnitude. | Proper motion per century. | Maximum angular value of the solar motion for 100 years as viewed from the unit of distance. | R.A. of the apex of solar motion. | Decl. of the apex of solar motion. |
|---|---|---|---|---|---|
| | | ″ | ″ | ° | ° |
| First series (135 stars) | 6·6 | 21·9 | 12·39 | 280·4 | + 42·8 |
| Second series (144 stars) | 8·6 | 20·9 | 13·73 | 285·7 | + 45·1 |
| Both series combined | 7·6 | 21·4 | 13·09 | 283·3 | + 44·1 |
| Probable errors | — | — | ± 1·00 | ± 6·9 | ± 3·2 |

When stars are excluded whose proper motions per century amounted to 40″ or more, the following are the resulting values:—

| | | | | | |
|---|---|---|---|---|---|
| | | ″ | ″ | ° | ° |
| Single series (253 stars) | 7·7 | 17·80 | 10·58 | 288·7 | + 51·5 |
| Probable errors | — | — | ± 0·60 | ± 7·2 | ± 3·2 |

The values of the several elements of solar motion, as determined by Struve and Bischof, are as follows:—

| | | | | | |
|---|---|---|---|---|---|
| | | ″ | ″ | ° | ° |
| Struve ... ... | 6·0 | 8·00 | 4·36 | 273·3 | + 27·3 |
| Bischof ... ... | 7·5 | 47·58 | 33·67 | 290·8 | + 43·5 |
| ,, (using Argelander's method) | | | — | 285·7 | + 48·5 |

By using the present declinations of the American ephemeris, Mr. Boss finds that the value given by Struve for the declination of the sun's way requires a correction of + 10°·4, thus making it + 37°·7, which is more in accordance with the other values given above.

The most probable co-ordinates of solar motion might therefore be assumed to be—

R.A. = 280°; Decl. = + 40°.

Stability of the Rings of Saturn.—The *Bulletin Astronomique* for February 1890 contains an interesting paper by M. O. Callandreau, on the calculations of the late Clerk-Maxwell, relative to the movement of a rigid ring around Saturn. It is well known that Laplace found it impossible for a homogeneous and uniform ring surrounding a planet to be in a state of stable equilibrium, and remarked that irregularities must exist in the form of the ring, which, in combination with a slight eccentricity, secured its stability. Maxwell found that the irregularities of a ring possessing a permanent movement ought to be very sensible, and that the appearance of the rings of Saturn was incompatible with that required by his demonstration. He considered the case of a planet occupying the centre of the ring, whereas Laplace's hypothesis required a slight eccentricity. This question was not, however, treated separately, and M. Callandreau has subjected it to mathematical analysis. First, taking the case of a symmetrical ring when the centre of gravity will be on a symmetrical axis, and then the case required by Laplace, viz. that the centre of gravity is not exactly coincident with the geometrical centre, the author shows that the conditions stated by Laplace are not sufficient to ensure stability.

BROOKS'S COMET (*a* 1890).—This comet was observed at Paris on March 28 and 30. It was seen as a round nebulosity, about 40″ or 50″ in diameter, with a very pronounced central condensation, and was about the tenth magnitude.

BRIGHT LINES IN STELLAR SPECTRA.—The Rev. J. E. Espin reports the discovery of bright lines in the spectrum of $\theta_1$ as well as in that of $\theta_2$ Orionis, and possibly in that of S Coronæ as well.

## ON THE DEFORMATION OF AN ELASTIC SHELL.[1]

THIS paper treats of the deformation of an elastic shell whose radii of curvature are everywhere great in comparison with the thickness, which is supposed uniform. The subject has been dealt with in a very able manner by Mr. A. E. H. Love in a recent paper (Phil. Trans., 1885), but it seemed desirable, on various grounds, that it should be attacked from an independent point of view. The method here followed is that explained in a former communication, "On the Flexure of an Elastic Plate" (December 1889). The results, as regards the general theory, are closely analogous with those of Mr. Love, and a comparison of the two investigations gives a physical interpretation to the various groups of terms which enter into his equations. There are some differences of detail, arising from a slight difference in the quantities chosen to express the flexural strains, but they are not practically important.

The great difficulty of the present subject, as contrasted with the theory for a plane plate, is, that we cannot draw an absolute line of demarcation between the deformations in which the cardinal feature is the extension of the middle surface, and those which involve flexure with little or no extension. This appears to arise mainly from the fact pointed out by Mr. Love, that it is in general impossible to satisfy the boundary conditions by a deformation in which the middle surface is absolutely unextended. But, this being admitted, the question remains in any specific problem, as to the amount and distribution of the extension, and, in particular, whether there are any modes of deformation (or of free vibration) in which, after all, it plays only a subordinate part. Mr. Love answers this question in the negative, in opposition to the views advocated by Lord Rayleigh in two well-known papers. In the present communication Mr. Love's argument is examined, and it is pointed out that cases may occur in which the extensions (though comparable with the flexural strains) may be confined to so small a region of the shell (near the edges) that their contribution to the total energy of deformation is insignificant.

In order to bring the matter to an issue in a definite instance, I have chosen the case of a cylindrical plate (such as a boiler-plate) bent by a proper application of force over its straight edges, so that the strained form remains a surface of revolution, the circular edges being free. The analytical work in this case is very simple, and the physical meaning of the various terms which occur is easily recognized. In the interpretation of the result it appears that a good deal turns upon the ratio which the breadth of the plate (in the direction of the generating lines) bears to a mean proportional between the radius and the thickness. If this ratio is large, the bending forces may be practically replaced by two equal and opposite couples uniformly distributed over the straight edges, and having these edges as axes. The strained form is almost accurately cylindrical; near the circular edges we have extensions of the same order as the flexural strains, but these rapidly die out (at the same time fluctuating in sign) as we press inwards, and the anticipation that their total energy would be small compared with that due to flexure is confirmed. In such a case, then, the approximate methods used by Lord Rayleigh, in which no account is taken of the conditions at a free edge, are fully justified. But if, keeping the radius and the thickness constant, we diminish the breadth of the plate until it is comparable with the mean proportional aforesaid, we get a sort of transition case between a plate and a bar, which cannot be satisfactorily treated except on the basis of the general equations. Finally, when the breadth becomes small in comparison with the mean proportional, the plate behaves like a curved bar, and an approximate treatment is again applicable.

In an appendix I have worked out, from the general equations of elasticity, the uniform flexure of an infinitely long cylindrical plate; this being, at present, the only case of flexure in which it appears easy to carry out the solution (on these lines) to a full interpretation.

[1] Abstract of a Paper read by Prof. Horace Lamb, F.R.S., before the Mathematical Society on January 9.

## SCIENTIFIC SERIALS.

*Timehri*, being the Journal of the Royal Agricultural and Commercial Society of British Guiana (printed at the Argosy Press, Demerara, vol. iii., part ii., new series).—This interesting *brochure* contains matter of general interest, as well as information which might be expected in an agricultural and commercial journal. Specialization cannot be pushed to its extreme limits in a colony, and a Society of this nature naturally admits matter into its Journal which are not strictly either agricultural or commercial. Thus the papers on primitive games and on the wild flowers of Georgetown must be regarded, respectively, as of ethnological and purely botanical interest, but, nevertheless, occupy a great part of the number, especially if we leave out of consideration the reports of meetings and other official matter connected with the working of the Society. Fruit-growing in the Gulf States of America, Caracas as a place of resort, and a short paper on some scale insects inimical to vegetation are the principal topics of a distinctly economic value. The paper entitled the "Letters of Aristodemus and Sincerus" is a review of an old book published in 1785-88 in twelve volumes, dealing with the colonies of Demerara and Essequibo, and are therefore of great interest to the present population. In 1785 the colonies had just been given over by the French, who held them on behalf of the Dutch for about three years. No town existed up to that date in Demerara, but during the French occupation a little village had grown up in the neighbourhood of Brandwagt, which they called *la nouvelle ville*, or Longchamps. The fort on the east bank of the Demerara River (now called Fort William Frederick) was also built at the time, and named Le Dauphin, while another on the opposite side was called La Raine. From such historical, social, scientific, and economic materials a most interesting although somewhat diffusive number has been produced, showing evidence of mental activity and high culture, pleasant to see far away from the main centres of civilization. The style of the writing, the printing, and the illustrations are all of a high class. How far the London publisher, Mr. E. Stanford, of Cockspur Street, is responsible for the excellent "get up" of the volume we are unable to even conjecture; but we trust we may be permitted to say, without offence, that the number of *Timehri* before us is highly creditable to the literary talent and tastes of British Guiana.

*Quarterly Journal of Microscopical Science*, February.—On the anatomy of the Madreporia; V., by Dr. G. Herbert Fowler (plate xxviii.). Gives an account of the anatomy of *Duncania barbadensis*, *Galaxea esperi*, *Heteropsammia multilobata*, and *Bathyactis symmetrica*, and gives a figure of the typical structure of the genus Madrepora.—Contributions to the anatomy of earthworms, with descriptions of some new species, by Frank E. Beddard (plates xxix. and xxx.). This paper gives an account of the structure of three new species of Acanthodrilus, with remarks on other species of the genus. The new species are *A. antarcticus*, *A. rosæ*, and *A. dalei*. Further remarks on the reproductive organs of Eudrilus, with special reference to the continuity of ovary and oviduct.—On the certain points in the anatomy of Perichæta, with description of *Perichæta intermedia*, n.sp.—On the phagocytes of the alimentary canal, by Armand Ruffer (plate xxxi.). Concludes that the wandering cells of the lymphoid tissues of the alimentary canal have the power of proceeding to the free surfaces of such tissues, and of taking into their interior lower micro-organisms and foreign matter (charcoal, &c.): there are both macro- and microphages; these are stages, the larger can swallow the smaller and digest them.—Notes on the hydroid phase of *Limnocodium sowerbyi*, by Dr. G. Herbert Fowler (plate xxxii.), records observations made during May 1888; neither medusoid or hydroid appeared in 1889; two hydroids and a budding medusoid are figured.—Note on certain terminal organs resembling touch corpuscles or end bulbs in intramuscular connective tissue of the skate, by Dr. G. C. Purvis (plate xxxiii.).—Note on the transformation of ciliated into stratified squamous epithelium as the result of the application of friction, by Drs. J. B. Haycroft and E. W. Carlier (plate xxxiii.).—On the development of the ear and accessory organs in the common frog, by Francis Villy (plates xxxiv. and xxxv.).—On *Thelaceros rhizophoræ*, n.g. et sp., an Actinian from Celebes, by P. C. Mitchell (plate xxxvi.). The Actinian here described was obtained by Dr. Hickson in a mangrove swamp in Celebes, by the side of one of the roots of a Rhizophora; the tentacles have compound hollow protuberances round the margins of the oral surface, with numerous small simple or compound hollow protuberances (rudimentary accessory tentacles) in radial lines on the oral disk.—Notes on the genus Monstrilla, Dana, by Gilbert C. Bourne (plate xxxvii.). Gives details of all the known species of this aberrant genus of Copepods.—On the maturation of the ovum, and the early stages in the development of Allopora, by Dr. Sydney J. Hickson (plate xxxviii.). Gives a general summary of events; the formation and fate of the trophodisc, the changes of the germinal vesicle, the formation of the embryonic ectoderm the history of the yolk, and general considerations.

## SOCIETIES AND ACADEMIES

### LONDON.

**Royal Society**, March 27.—"The Variability of the Temperature of the British Isles, 1869–83 inclusive." By Robert H. Scott, F.R.S.

The material discussed has been the daily mean temperature derived from twenty-four hourly measurements of the thermograms at the seven British observatories during the period of their continuance, 1869–83.

The differences between the successive daily means have been extracted, irrespective of sign, and these values averaged monthly.

To the figures for the 7 observatories certain values have been added from Dr. Hann's paper in the *Sitzungsberichte* of the Vienna Academy for 1875 for Makerstoun and Oxford, the only British stations in Hann's list, and for Vienna, St. Petersburg, and Barnaul, as instances of Continental climates, as well as for Georgetown, Demerara, as an instance for a tropical station.

The figures for the 7 stations are much lower than those for Makerstoun and Oxford, probably owing to the fact that the means used in the two latter cases were not twenty-four hourly, nor for as many as fifteen years.

The highest variability on the mean of the year is at Kew (2°·7). Then follow Armagh, Glasgow, and Stonyhurst (2°·5), Aberdeen (2°·4), and Falmouth and Valencia (1°·9). The greatest absolute monthly value is 5°·4 for Glasgow, November 1880; the least, 0°·7, for Valencia, July 1879.

The mean values for each month are given.

The question of whether great changes are more frequently positive or negative has been investigated. Mr. Blanford states ("Climate of India") that in India (Calcutta and Lahore) sudden falls of temperature are more frequent and greater than sudden rises.

A preliminary inquiry showed that it was not interesting to investigate all changes, as the numbers showing + and − signs respectively were nearly equal.

The changes above 5° in the twenty-four hours were all examined, and the result showed that in these islands sudden rises of large amount are more frequent and more extensive in amount than sudden falls—the reverse to what obtains in India.

One instance of a rise of 23°·8 at Aberdeen, December 16, 1882, was the greatest recorded, and this disturbance was confined to the east of Scotland.

The figures were then examined for frequency. The values were arranged, irrespective of sign, according to their magnitude, in six subdivisions:—0–0°·9, 1·0–4°·9, 5·0–9°·9, 10·0–14°·9, 15·0–19°·9, 20·0–24°·9, and the totals divided by 15. The first two intervals taken together are equal to one of the others, but, as by far the greater number of the changes fell below 5°·0, it seemed well to see how many fell below 1°·0.

The range of changes is least at Falmouth and Valencia. In all cases the mean number of changes between 1°·0 and 4°·9 exceeds half the number of days in the month.

The daily mean values have also all been examined, with the view of discovering their distribution on the thermometer scale.

Seven columns were taken, covering the space from 10° to 80°, of 10° each, excepting that the space from 20° to 40° was not divided equally.

In 1881, Stonyhurst had four days in January with a mean below 20°, and nineteen days in which the mean temperature was below 32°. At Aberdeen and Glasgow the cold was not so intense. Neither at Falmouth nor Valencia did the mean temperature ever fall below 20°. The hottest station is Kew. In the fifteen years it shows in all thirty-five days with a mean above 70°.

The figures were then divided by 15, to obtain frequency, as before, and the results shown. They are also shown graphically in a plate, but there all the curves do not appear. Those for Valencia and Falmouth agree almost exactly, except in July and August. Those for Armagh, Glasgow, and Stonyhurst are so close to each other, that one curve is taken to represent all.

**Royal Microscopical Society**, March 19.—Prof. Urban Pritchard, Vice-President, in the chair.—A letter from the President, regretting his inability to attend in consequence of a fall, was read.—Mr. J. Mayall, Jun., read a letter from Prof. E. Abbe, of Jena, announcing the donation of one of Zeiss's new apochromatic $\frac{1}{10}$ objectives of 1·6 N.A. He also sent a condenser of 1·6 N.A., and a flint glass slide containing mixed diatoms mounted by Dr. H. van Heurck, of Antwerp, together with a supply of flint glass slips and cover-glasses for use in mounting objects for examination with the new objective. It was of course understood that in order to exhibit the full power of the increased aperture it was necessary to employ a condenser of corresponding aperture, and the objects to be viewed must be mounted on slips with covers, and mounting and immersion fluids of correspondingly high refractive power. In order to further test this lens, a committee has been appointed. Mr. Mayall called attention to and described two microscopes by MM. Nachet and Pellin, of Paris, which were exhibited by Mr. Crisp.—Mr. Rousselet exhibited a number of Rotifers to show their abundance at this season of the year.—A specimen sent by Colonel O'Hara, supposed to be some kind of entozoon which had been passed in urine, was exhibited.—Prof. Bell gave a *résumé* of Mr. A. D. Michael's paper on the variations of the female reproductive organs, especially the vestibule, in different species of *Uropoda*, the author being unavoidably absent through illness.—Mr. C. H. Wright exhibited and described specimens of a new British Hymenolichen, *Cyconema interruptum*.—Mr. E. M. Nelson read a short note on the images of external objects produced from the markings of *P. formosum*.—A note was read from Dr. H. van Heurck correcting an error in his recent communication to the Society relating to the structure of diatoms.—Mr. Mayall read a translation of an article by Prof. E. Abbe on the use of fluorite for optical purposes, in which it appeared that the special qualities of the new apochromatic lenses were due to the employment of this mineral in their construction.—Mr. C. H. Gill read a paper on some methods of preparing diatoms so as to exhibit clearly the nature of the workings, which was illustrated by numerous photomicrographs.—Mr. P. Braham exhibited and described a new form of oxyhydrogen lamp adapted for microscopical purposes, the lamp being so mounted as to be used in any position above or below the object. Its application to photomicrography was demonstrated in the room.—Mr. Clarkson also exhibited one of the same lamps separate from the photomicrographic arrangement.—The next *conversazione* was announced to take place on April 30.

**Zoological Society**, March 18.—Prof. W. H. Flower, F.R.S., President, in the chair.—The Secretary exhibited (on behalf of the Rev. G. H. R. Fisk) a specimen of a White Bat, obtained at Somerset West, near Cape Town, believed to be an albino variety of *Vesperus capensis*.—Captain Percy Armitage exhibited and made remarks on two heads of the Panolia Deer (*Cervus eldi*), obtained on the Sittang River, Burmah. One of these was of an abnormal form.—Mr. Sclater exhibited (on behalf of Mr. Robert B. White) examples of four species of Mammals, obtained in the Upper Magdalena Valley, in the department of Tolima, U.S. of Colombia.—Dr. Mivart, F.R.S., read a paper on the South-American Canidæ. The author called attention to the difficulties in the way of the correct discrimination of these animals, and to what appeared to him to be the unsatisfactory character of some of Burmeister's determinations and descriptions. Forms to which the names *fulvipes*, *griseus*, *patagonicus*, *entrerianus*, *gracilis*, *vetulus*, and *fulvicaudus* had been assigned were declared to be quite insufficiently discriminated from *Canis azaræ*. On the other hand, two very marked varieties, or possibly species, were noted and distinguished under the appellations *Canis parvidens* and *Canis urostictus*, the type of each of which was in the British Museum, both the skin and the skull extracted from it in each case.—Mr. R. I. Pocock read a revision of the genera of Scorpions of the family *Buthidæ*, and gave descriptions of some new South African species of this family.—Mr. F. E. Beddard read a paper on some points in the anatomy of the Condor (*Sarcorhamphus gryphus*).—A communication was read from Prof. R. Collett, containing the description of a new Monkey from North-East Sumatra, proposed to be called *Semnopithecus thomasi*.

**Geological Society**, March 26.—J. W. Hulke, F.R.S., Vice-President, in the chair.—The following communications were read:—On a new species of *Cyphaspis* from the Carboniferous rocks of Yorkshire, by Miss Coignou, Cambridge. Communicated by Prof. T. McK. Hughes, F.R.S.—On composite spherulites in obsidian from hot springs, near Little Lake, California, by Frank Rutley, Lecturer on Mineralogy in the Royal School of Mines. The spherulites which form the subject of the present communication have been previously noticed, and it was then suggested that a smaller spherulitic structure was set up in the large spherules after their formation. In the present paper evidence was adduced in favour of a different mode of origin. It was argued that the small spherulitic bodies (primitive spherulites) were developed in the obsidian before it assumed a condition of rigidity, and that they floated towards certain points in the still viscid lava, and segregated in more or less spherical groups, though there is no evidence to show what determined their movements; furthermore, that from a point or points situated at or near the centre of each group, crystallization was set up, giving rise to a radiating fibrous structure, which gradually developed zone after zone of divergent fibres until the entire mass of primitive spherulites was permeated by this secondary structure—a structure engendering a molecular rearrangement of the mass, such as would obliterate any trace of structure which the primitive spherulites might have originally possessed. In a supplementary note the views of Mr. J. P. Iddings with reference to the spherulites in question were given. Mr. Iddings considers that the structures here described as primary are of secondary origin. The author stated in detail his reasons for adhering to the conclusions given in this paper. The Chairman said that the sequence of the different portions brought forward with so much care by the author is one which admits of much discussion. Rev. E. Hill said that the explanation of the divergence of these crystallizations was extremely interesting. As to which structure came first, it is difficult to determine. In the section exhibited under the microscope he agreed with Mr. Rutley as to the sequence. The question of molecular motion after consolidation in igneous rocks is a subject of great importance.—A monograph of the Bryozoa (Polyzoa) of the Hunstanton Red Chalk, by George Robert Vine. Communicated by Prof. P. Martin Duncan, F.R.S.—Evidence furnished by the Quaternary glacial-epoch morainic deposits of Pennsylvania, U.S.A., for a similar mode of formation of the Permian breccias of Leicestershire and South Derbyshire, by William S. Gresley.

PARIS.

**Academy of Sciences**, March 31.—M. Hermite in the chair.—M. de Jonquières, having presented a memoir containing the complete text and review of a posthumous work of Descartes, "De Solidorum Elementis," with a translation and commentary of the work, addressed a note giving some brief explanations of the matter contained in it. In communications made on February 10 and 17, the author endeavoured to show that Descartes knew and applied the relation between the faces, apices, and edges of a polyhedron, known as Euler's formula, and expressed as $F + S = A + 2$. The present communication seems to put the matter beyond doubt.—M. P. Schutzenberger, in reply to criticisms of M. Berthelot, adduces experiments pointing to the conclusion that the condensation of carbonic oxide by the silent discharge cannot be effected without the presence of water.—Some further remarks on the preceding communication, and on the desiccation of gases, by M. Berthelot. The author still holds the opinion that the water shown by M. Schutzenberger to be present in his condensed carbonic oxide may have passed through the glass tube under the action of the electric discharge.—A new method for the microscopical study of warm-blooded animals at their physiological temperatures has been devised by M. L. Ranvier, and consists of placing the microscope and the preparation under examination in a bath of warm water (36° C. to 39° C.).—Deformities of the feet and toes following phlebitis of inferior members; phlebitic club-feet, by M. Verneuil.—Observations of Brooks's new comet (*a* 1890), made at the Paris Observatory, by M. G. Bigourdan.—Observations of the same comet, made with the great equatorial of Bordeaux, by MM. Rayet and L. Picart.—Observations and elements of the new minor planet (289) discovered at the Nice Observatory on March 10, by M. Charlois.—On the position of the sun-spot of March 4, by M. Spœrer.—On the graphic statics of elastic arcs, by M. Bertrand de Fontviolant.—Theoretical and experimental researches on Ruhmkorff's coil, by M. R. Colley. The author has investigated the current which results from the superposition of two currents—one non-periodic, diminishing according to the law of an exponential curve; the other periodic, and with progressively decreasing amplitude.—On the conductivities of the phenols and of oxybenzoic acids, by M. Daniel Berthelot. In this important paper the author gives the results of an examination of the three oxybenzoic acids by means of their electrical conductivities, and a research into the way they behave in the presence of one, two, or three molecules of soda. These acids having both phenol and acid functions, the conductivities of alkaline phenates were first determined.—The laws of annealing, and their consequences from the point of view of the mechanical properties of metals, by M. André Le Chatelier. These laws have been studied by heating metallic wires, hardened by a series of passages through a draw plate, to different temperatures and during different periods of time.—On the indices of refraction of salt-solutions, by M. B. Walter.—Action of hyposulphite of soda on silver salts, by M. J. Fogh. The amount of heat disengaged during the action of hyposulphite of silver upon various silver salts has been investigated.—M. V. Marcano, from his anthropological researches at Venezuela, gives evidence of the existence of metallurgy in South America previous to Columbus.—Influence of the chemical constitution of compounds of carbon upon the sense and variation of their rotary power, by M. Philippe A. Guye.—On the preparation and some of the properties of fluoroform, by M. Meslans. The density of the gas obtained is 2·44, and it is found to liquefy at 20° under a pressure of 40 atmospheres.—On some thiophenols derived from ordinary camphor, by M. P. Cazeneuve.—On the stranding of a whale on the island of Rhé, by MM. Georges Pouchet and Beauregard.—On the blood and the lymphatic gland of the Aphysia (sea-hare), by M. L. Cuénot.—On the method of union of sexual cells in the act of fecundation, by M. Léon Guignard.—On a new and dangerous parasite of the vine, by M. G. de Lagerheim. The description of the parasite is here given:—"*Uredo Vialæ*: Soris hypophyllis, solitariis majoribus vel dense gregariis minimis, solitariis in pagina superiore foliorum maculas parvas formantibus; uredosporis pyriformibus vel ovoideis 20μ–27μ longis, 15μ–18μ latis, membrana hyalina tenui aculeata et contentu aureo præditis, paraphysibus cylindricis curvatis incoloribus circumdatis. Hab in foliis vivis *Vitis* sp. parasitica in insula Jamaica, inter Kingston et Rockfort, Octob. 1889."—On the series of eruptions of Mézenc and Meygal (Velay); also a note on the existence of ægyrine in the phonolites of Velay, by M. P. Termier.—Composition of some rocks from the north of France, by M. Henri Boursault.—General results of a study of the carboniferous earths of the central plateau of France, by M. A. Julien.

BERLIN.

**Physical Society**, March 21.—Prof. du Bois-Reymond, President, in the chair.—Dr. Brodhun described a new contrast-photometer, based on the principle of one he and Dr. Lummer had previously constructed (see NATURE, vol. xxxix. p. 336), and intended to compare by contrast the intensity of any illumination with that of the standard light. Experiment had shown that the sensitiveness of the instrument is greatest when the difference of the contrasted illuminations is 3 per cent., and amounts then to ¼ per cent. He further gave an account of experiments which he and Dr. Lummer had made on the utilization of glow-lamps as standards of comparison. When fed by accumulators these lamps yield a light which only varies by 1 per cent. during a period of 200 hours provided the E.M.F. of the accumulators is kept constant. The authors are now busy with the endeavour to construct a standard glow-lamp for comparison with unknown sources of light. Dr. Lummer demonstrated Abbé's apparatus for testing transparent films with plane-parallel surfaces. After briefly describing the interference phenomena produced by thick plane-parallel glass plates, he explained how Tizeau's bands and Newton's rings are employed for testing the plates, using monochromatic sodium-light. The light passes through a reflecting prism and through a lens, and then falls on the plate, from which it is reflected and passes back by the same path to the eye, being now passed through a second lens by means of which the bands or rings may be seen. The occurrence of interference-bands is entirely dependent upon the thickness of the plate: if this is absolutely uniformly thick throughout, the interference phenomena show no change if the plate is moved from side to side in its own plane, and by so doing the parallelism of its sides may be rapidly tested.

AMSTERDAM.

**Royal Academy of Sciences,** February 22.—Prof. van de Sande Bakhuysen, in the chair.—Prof. Behrens added a number of reagents for microscopical analysis to those already known from former publications by himself and MM. Streng and Haushofer:—

For K and Na: sulphate of bismuth.
,, Ba, Sr, Ca: chloride of tin and oxalic acid.
,, Ba, Sr: bichromate of ammonium.
,, Sr, Ca, Mg: tartrate of sodium and potassium.
,, Al: fluoride of ammonium and sulphate of thallium.
,, Be: chloride of mercury and oxalic acid.
,, Ce, La, Di: oxalic acid, ferrocyamide of potassium.
,, Zn, Ca: acetate of aluminium and oxalic acid.
,, Zn, Cn, Co: sulphocyanide of mercury and ammonium.
,, Co, Ni: nitrite of potassium and acetate of lead.
,, Pb, Bi, Fe: bichromate of potassium and potash.
,, Bi, Sb, Sn: oxalic acid, chloride of rubidium.
,, Sb, Sn, Ti: chloride of barium and oxalic acid.

Details will soon be published, when the necessary finish has been given to the methods for separation, hitherto somewhat neglected.—M. Martin read a paper on the geology of the Kei Islands, and, in connection therewith, on the Australian-Asiatic boundary line. In accordance with the fact that in Great Kei we meet with nothing but a Tertiary formation, and that the nature of the rocks of Great Kei agrees with that of the coast of New Guinea, M. Martin inferred that this boundary line must be drawn geognostically, to the west of Great Kei and to the north-west of Timor.—Dr. Beyerinck treated of the luminous food and the plastic food of phosphorescent Bacteria. Of the six species of phosphorescent Bacteria hitherto known, four—viz. the alimental gelatine non-melting *Bacterium phosphorescens* and *B. Pflügeri* of luminous fish, and the Baltic phosphorescent Bacteria, *B. Fischeri* and *B. balticum*, require, besides peptone, a second carbonic combination, as glycerine, glucose, or asparagine, for their complete nourishment, *i.e.* to "phosphoresce" and grow. They may be called peptone-carbon-bacteria. The gelatine quick-melting phosphorescent bacteria from the West Indian Sea and the North Sea, *B. indicum* and *B. luminosum*, can phosphoresce and grow on peptone alone. They are, therefore, peptone-bacteria. Again, other bacteria can derive their nitrogen either from amids, the amid-bacteria, or from ammoniac, the ammoniac-bacteria. Also moulds, yeasts, and some Protozoa may be classed in this system. The *Bacterium Pflügeri* does emit light with peptone and glucose, but not with peptone and maltose, while the *Bacterium phosphorescens* emits light both with glucose and maltose. Now if we mix some starch in a phosphorescens-peptone-gelatine, obtained by mixing this gelatine with a very great number of *B. phosphorescens*, and place upon this some ptyaline, pancreas-diastase, or urindiastase (nefrozymase), fields of light make their appearance; if, however, we placed these same sorts of diastase on a Pflügeri-peptone-starch-gelatine, then no fields of light would appear, which proves that in this instance no glucose whatever is formed, as was lately believed to be the case. The development of luminosity is constantly accompanied by the transition of peptones into organized, living matter, under the influence of free oxygen, with or without the concurrence of another carbonic combination.

## BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Among the Selkirk Glaciers: W. S. Green (Macmillan).—Flora Tangutica, fasc. i.: C. J. Maximowicz (Petropoli).—Enumeratio Plantarum Hucusque in Mongolia, fasc. i.: C. J. Maximowicz (Petropoli).—The Human Epic, Canto i.: J. F. Rowbotham (K. Paul).—Agende de Chimiste, Salet, Girard and Pabst (Hachette).—The Theory of Determinants in the Historical Order of its Development; Part i., Determinants in General: T. Muir (Macmillan).—The Microtomist's Vade-Mecum, 2nd Edition: A. B. Lee (Churchill).—Guide Pratique de L'Amateur Électricien: E. Keignart (Paris, Michelet).—Musiconomia o Leggi Fondamentali della Scienza Musicale: P. Crotti (Parma, Battei).—L'Éclairage Électrique Actuel, 2nd Edition: J. Couture (Paris, Michelet).—Das Reizleitende Gewebesystem der Sinnpflanze: Dr. G. Haberlandt (Leipzig, Engelmann).—Traité Ency. de Photographie, 15 Mars: C. Fabre (Paris, Gauthier-Villars).—Proceedings of the Aristotelian Society, vol. i. No. 3, Part 1 (Williams and Norgate).—Mind, April (Williams and Norgate).—Geological Magazine, April (K. Paul).—Quarterly Journal of Microscopical Science, April (Churchill).—Journal of the Royal Agricultural Society of England, 3rd Series, Part 1 (Murray).—Journal of the Royal Horticultural Society, vol. xii. Part 1 (London).

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