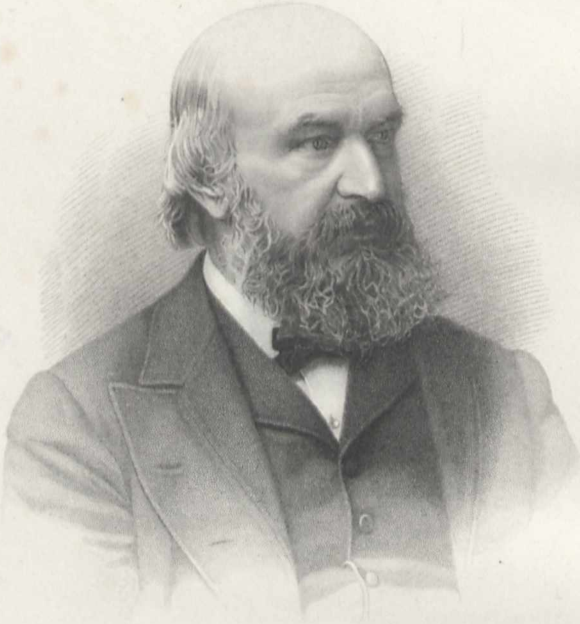
Nature. October 14th 1886



John Couch Adams

Engraved by G. J. Stodart from a Photograph by J. E. Mayall.

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A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

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

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NATURE

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"*To the solid ground*
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THURSDAY, MAY 6, 1886

HOMER'S SENSE OF COLOUR

Le Sens des Couleurs chez Homère. By Dr. Alb. de Keersmaecker. Part I., xii. + 152 pp. (London: Trübner, 1885.)

THIS appears to be Part I. of a monograph on the colour-sense developed in ancient times, although chiefly based on the language of the Homeric poems. It is to a large extent a criticism of the essays of Mr. Gladstone and Dr. Magnus (of Breslau) on this subject. It is generally admitted that the colour-nomenclature of the Homeric poems is far less copious and less precise than that of modern times. Various theories have been proposed about this. The author represents (p. 22, &c.) Mr. Gladstone's view to be that Homer's *perception* of colour was ill-defined, and that his so-called colour-terms are often really descriptive of luminosity rather than colour. And he describes (p. 6, &c.) that of Dr. Magnus similarly, with the addition that the human eye was in those days less perfect in colour-perception than now, and has gradually improved to its present state.

After a lengthy criticism of these and other theories, the author's conclusions are briefly that there is no evidence of any improvement in the human eye itself during these ages, and that the progress that had taken place is solely one of human knowledge of colour: also that Homer's colour-terms are probably often vague, but not more so than is admissible in poetry.

As to evolution, however, the author goes much further: he lays down broadly (p. 32) that no change has taken place in any organ in any species, and most certainly not in man. It is strange that he also expresses himself as a follower of Darwin. After this it will not seem strange that the general argument is not particularly convincing: the mode of argument, too, is not pleasant; in fact the author pleads guilty to a certain sharpness of manner (*acescence de la forme*) in his criticism of persons.

Waiving however the form, there is much in the matter that is interesting. A short account (9 pages) is first given of what is known of Homer's life, and it is argued that Homer—as being an illegitimate child—was constitutionally liable to the infirmity of blindness traditionally ascribed to him: it is fairly urged by some that this blindness, coupled perhaps with *colour-blindness*, may itself be responsible for some of the uncertainty attached to Homer's colour-terms; but the conclusion is that there is no evidence of colour-blindness.

As to the misuse (?) of colour-names sometimes ascribed to Homer, the author points out (with numerous quotations) that the usage of modern French and English poets is often, to say the least, inexact, so that it is absurd to expect exactitude of application in ancient poetry.

Among the detailed criticisms on Mr. Gladstone's essays may be noticed the following:—Exception had been taken to the use of the word φοῖνιξ (usually translated *red*) as descriptive of a horse; hereon it has been urged (by Mr. Prior in NATURE) that this word should here be translated *Phœnician;* but, if this be really a colour-term in this place, why not translate it as a *bay* or *chestnut* (horse) if the term *red* jars on the English ear? Again, surely a poet may describe a (mythical) serpent as δαφοινός (red ?), and the (mythical) ambrosia as ῥοδόεις (rosy ?) without being called to account. In one case (Odys. B. VI. v. 163), where the use of φοῖνιξ as a colour-term had been objected to, the author explains that its other meaning, *palm-tree*, makes sense of the passage. Special exception is taken to Mr. Gladstone's interpretation of αἴθοψ, which the author considers to be not a colour-term but a word descriptive of combustion, so covering a wide range of meanings, *e.g.* fiery, glowing, smoky, golden, &c.

The Homeric expression οἴνοψ applied to the sea—hitherto far from clear—receives a new explanation from a traveller in the Ægean, viz. that that sea has at times a blood-red appearance with a red horizon all round. In commenting on the word χλωρὸς, which seems to mean both *green* and *fresh* or vigorous, the author endeavours to connect the syllable ι with the meaning of vigour, *e.g. harit* (Sanskr.), *sairit* (Zend), ἶφι (Greek), *vi* (Lat.), (to which may surely be added the English *might*), but the connection seems very slight; in fact the syllable ι recurs in many terms expressing weakness or smallness, *e.g.* μικρός, *minimus*, *slight*, *schlimm*, *weich*, *faible*.

The remarkable fact is brought to notice that the term *sky-blue* is almost unknown in the ancient writings of any Asiatic people, *e.g.* in the Vedic hymns, in the Zend-Avesta, in the Old Testament, in Hebrew writings generally, and in Homer and Hesiod; the epithets applied to the sky being expressive of its vastness, depth, purity, brilliancy, &c., but not of its colour. A similar want of a precise colour-term is shown to exist in many modern barbarous languages. But it does not seem warrantable to conclude that sky-blue was a colour unknown to these peoples; indeed sky-blue pigments have been found (p. 37) at both Memphis and Thebes.

A part of Dr. Magnus's theory of the evolution of the colour-sense is that the eye acquired the power of recognising different colours in the order of their luminosity; but the order which he seems to assign (p. 71), viz. red, yellow, &c., is certainly not that of their luminosity. The physiological and emotional effects of colours on men and animals are noticed in this connection. Thus red is known to excite bulls and turkeys: the experiments of M. Paul Bert on the small crustacean Daphnia are quoted; when placed in a solar spectrum they congregate most thickly in the orange to green region, which is also the most luminous region. Goethe's speculations on the effects of colour on the emotions of mankind are noticed at length. A curious "colour-treatment" (chromo-photothérapie) proposed for the insane is also mentioned, which consists in placing the patients amidst surroundings of a tint supposed to be capable of exciting healthful effects: thus red is said to excite, blue and violet to sadden, green to soothe. The results of this treatment do not seem to have been very definite (pp. 78, 79).

The comparative philology of colour-terms takes up—as might be expected—much of the work; the author has spared no pains in endeavouring to trace out the meanings of Homer's colour-terms by the help of the related words in other languages. As to the uncertainties of this process, take the words related to *blue* as an instance. Mr. L. Geiger's opinion is quoted (p. 50) that the modern European words *blue*, *blae*, *blau*, *blå*, *bleu*, &c. (English, Scotch, German, Danish, French), now meaning *blue*, meant *black* in early Europe, whilst another (p. 101) connects them with words conveying the idea of brightness, *e.g.* *briller*, *blanc*, *blink*, *bleach*, *blank*.

The author promises a further instalment of this essay, in which the evidence from the fine arts, pottery, and dyers' work, and that from morphology and physiology are to be set forth; also a full statement of conclusions.

ALLAN CUNNINGHAM (Major, R.E.)

OUR BOOK SHELF

The Journal of the Engineering Society of the Lehigh University, March, 1886.)

THE practice of forming engineering societies in universities where engineering is taught is an exceedingly good one, and should receive every encouragement and help from the authorities. In fact every college should have its society. The meetings give the students an opportunity of discussing interesting engineering works, and give them a greater interest in the subject-matter taught in the class-room. These junior engineering societies, if I may so call them, ought not to be only found in colleges, but all large engineering works should have a society of their own, the members of which should include those of the pupils, apprentices, and men who are anxious to improve themselves by the reading and discussing of papers prepared in rotation by the members themselves. Visits to other works might also be arranged. No doubt the formation of such societies may seem very hard to accomplish, but in most works there will be found men willing and anxious to form such societies and to keep them going until their utility is recognised.

The *Journal* before us contains several articles of an interesting nature, the first being by Prof. Merriman on "The Internal Work and the Deflection of Beams"; the second article gives an account of "Boring the Big Aqueduct" for the New York water-supply from Croton Lake. We next have a short notice on technical education in Mexico, followed by a very good account dealing with "The Requisites of a Successful Engineer.'

After notices on "Mine Water Formations" and "The Foundations of the Washington Monument," the *Journal* concludes with a condensed report dealing with the measurements necessary to ascertain "the velocity and discharge of the Lehigh River about Bethlehem."

Taken as a whole the contents of this *Journal* are disappointing from a professional point of view, Prof. Merriman's article on the deflection of beams being excepted. The descriptions are much too general and popular; the subjects are not treated with that accuracy demanded by an engineering article, and are written in a style more fitted for the columns of a daily paper than a journal published by an engineering society.

N. J. L.

Fresenius's Quantitative Analysis. Parts I. and II. Vol. II Translated by C. E. Groves, F.R.S. From New Edition of Fresenius commencing in 1877. (No date.)

IT is a great pity these books cannot be pushed forward much faster. The plan adopted by many German authors of sending out books in "Lieferungen" has some advantages, but generally these are more than balanced by the time allowed to elapse between each part. This slowness on the part of authors makes it somewhat unpleasant for a translator, who must of necessity be still somewhat later. In this particular instance, however, the translator has improved on the time by introducing or referring to methods not in the original, but it might have been carried further. The original does not contain anything about Victor Meyer's methods of vapour-density determination, and the translator has also refrained from noticing these methods. There may be some reason for this, but we think at least the methods might have been mentioned, as they are simpler to perform than any other, and do not fall behind any in accuracy.

The whole of Part I. and a small portion of Part II. is taken up with analysis of organic bodies; the remainder of Part II. is on the analysis of potable and spring waters, &c. If an index or table of contents had been added, it would have rendered the English edition more practical.

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. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

Protective Influence of Black Colour from Light and Heat

IN NATURE, vol. xxxiii. p. 559, a correspondent refers to the effect of blackening the skin round the eyes as a protection against the glare of strong sunlight. Probably the practice has good scientific grounds.

The shape of the orbit at once suggests the reflecting cone of a thermopile, with the eyeball centred on its axis in the position of the pile, but of course much less deeply placed. The cone is, in this case, oblique, the maximum slant side being internal, *i.e.* towards the nose, and the minimum slant side external. A plane through the outer orbital angle, and perpendicular to the axis, will be pretty nearly coincident with the tangential plane of the eyeball at the anterior end of its antero-posterior diameter, and there will be a considerable part of the nasal surface of the cone in front of that plane. This part will act as a reflecting surface, and concentrate the rays upon the eyeball. Probably variations of complexion will not much affect the reflecting power of this surface, seeing that the difference in the skin of black and of white races is mainly a difference in the amount of pigment in the rete mucosum, and not in the superficial parts of the epidermis.

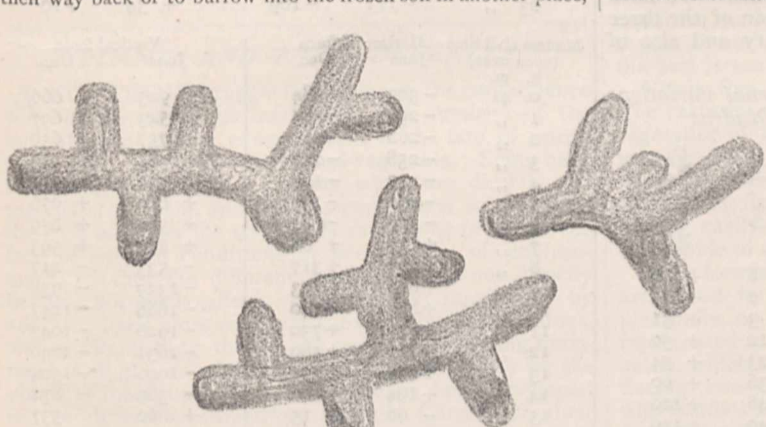
It is evident that rays reflected from the ground, and from objects of no great altitude, are the rays which will have the greatest chance of striking the eye after reflection from the sides of the orbital cone. The direct rays of the sun in tropical countries will, during the hottest part of the day, be too nearly vertical to take this course. Now it would seem that it is in the case of intense light reflected from rocks, snow, &c., that the blackening has been found useful.

Whether to any appreciable extent the amount of light entering the eye is increased by the shape and projection of the orbit is a different question. For here it is not enough that the rays should be concentrated upon the eyeball. They must enter the pupil. Nevertheless, it would seem from observations made for another purpose upon the pupil-reflex, that the diameter of the aperture is increased by blackening the skin round the orbit, say by means of a piece of black cloth with an elliptical hole in it for the eye, the light of course being kept of constant intensity.

April 19 G. N. S.

On the Form of Mole-Hills Thrown up under Snow

MOLES must have an opportunity of getting to the surface here and there to dispose of the results of their excavations. When they meet with a deep-laid hard road they come out and cross it. When frost has bound the soil into an impenetrable cake they sometimes come out of the ground, and, travelling away to seek a place more suitable for their operations, are unable to find their way back or to burrow into the frozen soil in another place,



and so they get killed in considerable numbers. When there is a little snow on the ground, protecting it from the frost, the moles come to the surface as usual, and throw up mounds of earth under or through the snow. But, when deep-drifted snow has covered the ground, the mole-hills under it are found to be arranged in more or less symmetrical ridges of uniform height and breadth, as represented in the sketch. It would appear that the moles in these circumstances make galleries about the size of their own bodies on the surface of the turf in the bottom of the snow, into which they push the earth to be disposed of, finding it easier to make these small tunnels than to raise the usual mound of earth under the superincumbent snow-drift. The severe winter just over has caused the snow-drifts to lie long in the north of England, where examples of this peculiar form of mole-hill may be commonly seen on the Fells.

Cambridge THOS. MCKENNY HUGHES

Protective Imitation

I HAVE been watching for hours with great interest what I believe to be a very curious instance of protective imitation. A large old thrush has been, all that time, trying to make itself look like a serpent, and succeeding remarkably well. The object appears to be to frighten away a smaller and more active thrush—no doubt younger and with sharper ears—which seems to be getting all the worms. It appears afraid to attack its young rival, but runs towards it as if it meant to do so, and when the young one turns round and faces it, the old one crouches down so that nothing of it is seen but a crest-like back, two glaring eyes, the spotted throat, and a dark line formed by the front view of the beak and the lines at the corners of the mouth, which look very much like a serpent's mouth. If I saw the creature protruding from a bush or from the grass, I should certainly take it for a snake of some kind. The young bird looks alarmed and retreats, though just before it was ready to attack the other. No sooner has it recovered its courage and advanced to attack than the old one retreats, and resumes its serpent-like mask. There has been a little sparring in the air occasionally, just enough to show the nature of the feeling, but if allowed to do so the young one evidently would be content to feed quietly. The old thrush (I know it by a small white feather on one wing) is very much at home on this lawn, and seems to consider it as its own private domain, at all events as far as thrushes are concerned. A short time ago, when the ground was for a long time hard from frost and drought, this thrush moped about and seemed nearly starved, and at last fell upon two great clumps of yellow crocuses, and not only tore them to pieces, as if in a rage, but devoured them entirely, returning again and again to them, and gobbling up the yellow petals as a rabbit does a lettuce. At that time many birds that are usually too shy came down from the hills and strolled about the fields and lawns—snipes, plovers, &c. Two exquisite crested plovers (I think they are called) stalked about with graceful dignity for some days in a garden close by, and roosted in an old hen-house. The thrush touched no crocuses but the yellow ones, and no other bird did so. I should be glad to know if the resemblance to a serpent has been observed by any one else. J. M. H.

Sidmouth, April 19

P.S.—It may be thought that the crouching is only a preparation for a spring, but it does not suggest that to the eye, and it is not followed by a spring. If it really is a fact and not a fancy, the instincts of imitation and of fear in this case must be a very ancient inheritance indeed.

Iridescent Clouds

THIS evening at sunset there was here a fine instance of iridescent clouds. About 7 I drew the attention of my companion to some remarkable clouds; three long arms of stratus of peculiar texture, like pulled-out cotton-wool, and of striking colour, blue-black and silver, stretched nearly to where the sun had gone down behind a hill. At 5 minutes past 7 a detached portion of this cloud assumed lovely iridescent colours like bright mother-of-pearl. This gradually died away, but other portions assumed the same tints. At 7.30 the tints vanished. Wind, south to south-west.

Glencar, Kerry, April 26 J. G. GRENFELL

MADRAS MAGNETICAL OBSERVATIONS [1]

WE are indebted for the present volume to Mr. Pogson, the Government Astronomer at Madras, from whose introductory remarks we learn that he is not yet at the end of his editorial labours.

[1] "Magnetical Observations made at Madras in the Years 1851-1855, under the Superintendence of Mr. W. S. Jacob." Edited by Mr. N. R. Pogson, Government Astronomer. (Madras: Lawrence Asylum Press, 1884.)

Mr. Pogson intends as soon as possible to continue his work, and the greatest praise must be given to this distinguished astronomer for his persistent efforts to complete the records of his Observatory. But what can be thought of a system of administration under which observations are reduced about half a century after they are made? If this were the only instance of such a monstrous delay it would be bad enough, but we seem destined to have another instance, no less flagrant. The late Mr. John Allan Broun finished his work at the Trevandrum Observatory in 1864, and as yet only the first volume of his reductions has seen the light. Here the Observatory has been discontinued, and we do not know that any one has come forward to complete the labours of Mr. Broun, so that the publication of the remaining volumes seems to be adjourned indefinitely. Surely there is something in this system which requires putting right.

Mr. Pogson tells us in his introduction that the vertical force results were never entitled to any confidence, especially before March 1853, when, for the first time, the needle was placed nearly perpendicular to the magnetic meridian, agreeably to the directions given in the report of the Royal Society. Our readers are probably aware that at the present moment a Committee of the British Association is engaged in discussing magnetic observations, and they are anxious to bring together all reasonably good determinations of the solar-diurnal variations of the three magnetic elements for as many places as possible.

It may therefore be of interest, especially after the above remark by Mr. Pogson, to apply some sort of preliminary test to the Madras observations. I shall therefore compare them with the similar results obtained at Bombay, and discussed by Mr. C. Chambers in his recent elaborate and excellent volume.

In the following table we have in the first place a comparison of the solar-diurnal variations of declination at the Colaba Observatory, near Bombay, and at Madras. For the purpose of this comparison it is unnecessary to give the scale values or to exhibit all the months. We have therefore limited our comparisons to a mean of the three months, November, December, and January, and also of the three months, May, June, and July.

TABLE I.—*Comparison of the Solar-Diurnal Variations of Declination at Bombay and at Madras*

Bombay civil time (noon = 12) h. m.	Mean of Nov., Dec., Jan.	Mean of May, June, July	Madras civil time (noon = 12) h. m.	Mean of Nov., Dec., Jan.	Mean of May, June, July
0 12	+23	+ 23	0 41	+ 8	+ 16
1 ,,	+17	+ 37	1 ,,	+ 2	+ 25
2 ,,	+ 4	+ 44	2 ,,	− 3	+ 31
3 ,,	−12	+ 46	3 ,,	−12	+ 30
4 ,,	−33	+ 51	4 ,,	−23	+ 34
5 ,,	−54	+ 85	5 ,,	−36	+ 60
6 ,,	−67	+206	6 ,,	−48	+120
7 ,,	−74	+272	7 ,,	−40	+129
8 ,,	−11	+249	8 ,,	− 4	+ 91
9 ,,	+48	+128	9 ,,	+10	+ 21
10 ,,	+33	− 30	10 ,,	− 4	− 47
11 ,,	−26	−165	11 ,,	−10	−101
12 ,,	−34	−245	12 ,,	0	−121
13 ,,	+ 8	−236	13 ,,	+12	−105
14 ,,	+28	−184	14 ,,	+14	− 76
15 ,,	+31	−105	15 ,,	+22	− 40
16 ,,	+26	− 34	16 ,,	+23	− 12
17 ,,	0	0	17 ,,	+12	0
18 ,,	+ 1	− 6	18 ,,	+16	− 13
19 ,,	+19	− 45	19 ,,	+19	− 22
20 ,,	+17	− 48	20 ,,	+13	− 19
21 ,,	+14	− 33	21 ,,	+ 9	− 9
22 ,,	+18	− 15	22 ,,	+10	0
23 ,,	+24	+ 5	23 ,,	+10	+ 8

Now it will, we think, be seen from Table I. that at both stations the type as well as the range of the solar-diurnal variation is very different for the two groups of months. It will likewise be seen that the peculiarities of the summer variation are very much alike at both stations, and that the peculiarities of the winter variation are also very much alike. Thus the comparison is favourable to the accuracy of the observations at both stations.

Let us now turn to the force components. In Table II. we have a comparison of the horizontal and vertical force variations at the two stations for the two months, June and December.

TABLE II.—*Comparison of the Solar-Diurnal Variations of the Horizontal and Vertical Force at Bombay and at Madras*

Bombay civil time (noon = 12) h. m.	Horizontal force June	Horizontal force Dec.	Vertical force June	Vertical force Dec.
0 18	−105	− 98	+ 36	+11
1 ,,	− 96	− 88	+ 37	+ 9
2 ,,	− 97	− 84	+ 36	+ 9
3 ,,	− 94	− 77	+ 30	+ 5
4 ,,	− 92	− 64	+ 36	+ 7
5 ,,	− 90	− 50	+ 59	+ 5
6 ,,	− 47	− 25	+ 95	+ 3
7 ,,	+ 21	+ 28	+ 74	+ 8
8 ,,	+101	+ 93	+ 10	+28
9 ,,	+189	+161	− 80	+ 1
10 ,,	+287	+232	−153	−57
11 ,,	+302	+242	−162	−61
12 ,,	+278	+204	−116	−19
13 ,,	+214	+134	65	+ 6
14 ,,	+120	+ 66	− 17	+ 9
15 ,,	+ 21	+ 17	+ 19	+ 8
16 ,,	− 56	− 27	+ 31	+ 7
17 ,,	−105	− 65	+ 22	− 8
18 ,,	−132	− 7[illegible]	+ 4	+ 6
19 ,,	−124	− 86	+ 3	+ 8
20 ,,	−124	−105	+ 18	+ 6
21 ,,	−121	−114	+ 21	+ 4
22 ,,	−119	−111	+ 31	+ 9
23 ,,	−111	−109	+ 34	+10

Madras civil time (noon = 12) h. m.	Horizontal force June	Horizontal force Dec.	Vertical force June	Vertical force Dec.
0 41	−309	−284	+ 923	+ 666
1 ,,	−299	−245	+ 543	+ 697
2 ,,	−268	−226	+ 757	+ 650
3 ,,	−258	−218	+ 515	+ 529
4 ,,	−243	−197	+ 558	+ 711
5 ,,	−236	−159	+ 617	+ 976
6 ,,	−128	− 80	+ 300	+ 879
7 ,,	+ 58	+ 88	+ 259	+ 593
8 ,,	+365	+317	− 533	− 217
9 ,,	+658	+573	−1329	− 938
10 ,,	+873	+740	−1688	−1247
11 ,,	+876	+730	−1926	−1043
12 ,,	+716	+580	−1631	−1246
13 ,,	+483	+354	−1096	−1304
14 ,,	+194	+160	− 389	− 872
15 ,,	− 66	+ 15	+ 60	337
16 ,,	−211	− 91	+ 241	− 289
17 ,,	−281	−185	+ 30	+ 23
18 ,,	−319	−256	+ 426	+ 75
19 ,,	−338	−326	+ 555	+ 152
20 ,,	−323	−369	+ 596	+ 280
21 ,,	−336	−374	+ 640	+ 376
22 ,,	−319	−341	+ 779	+ 585
23 ,,	−311	−314	+ 991	+ 747

It will be seen from this table that at both stations and for both components the type for June is nearly the same as that for December, the chief difference being in range. Also that the type at the one station is very similar to that at the other. The most marked difference between the two stations is for the vertical force, the range of this element in December bearing a smaller proportion to its range in June at Bombay than at Madras. To investigate this point it will be desirable to give the comparative ranges for the various elements for the various months at the two stations. This is done in the following table.

TABLE III.—*Ranges for the Various Months of the Diurnal Variations of the Three Elements at the Two Stations*

Month	Bombay Declination	Bombay Hor. force	Bombay Vert. force	Madras Declination	Madras Hor. force	Madras Vert. force
January ...	162	389	167	91	1318	3414
February ...	117	507	120	64	1585	3778
March ...	263	571	175	104	1785	4847
April... ...	392	576	216	218	1851	6273
May	486	473	265	243	1522	4198
June	480	434	257	260	1214	2917
July	468	439	263	249	1218	2445
August ...	545	423	301	273	1101	3203
September...	550	407	365	282	1331	6401
October ...	258	437	213	110	1595	5163
November...	103	414	91	73	1362	3633
December...	136	356	89	86	1114	2280

From this table it will be seen that for both stations there is a smaller maximum of declination range about May or June, and a larger maximum in September, while the most decided minima are in November and February for both stations. Again, there is a maximum of horizontal force range for both stations in April, and also in October, while the minima are at Bombay in September and December, and at Madras in August and December.

Finally, at Bombay there is a smaller maximum of vertical force range in May and a larger in September, while at Madras these occur in April and September. The most pronounced minimum of vertical force is in December for both stations.

It would thus appear that there is a very striking likeness between the variations of the three elements at the two stations, and that, notwithstanding Mr. Pogson's remark about the vertical force instrument, its results do not appear to be without value in a comparison of the above nature. BALFOUR STEWART

PLANTS AND THEIR DEFENCES

A CONSTANT struggle for existence, the consequence of the enormous increase in the numbers of the individuals of almost every species, is the fate of nearly every organism, both animal and vegetable. Some have to sustain the attacks of others which are directly antagonistic to them, and which regard them as prey; in the case of others the struggle is rather one to live in the face of adverse conditions or peculiarities of environment, so that the different organisms are not directly hostile, but each affects its neighbour injuriously by adapting itself more readily to the changing surroundings, and so diminishing the other's power of obtaining nutriment, sunlight, or whatever other condition may be the object of their competition. Thus have been developed in the different competitors different features of their constitution—many perfecting powers of active assault, others facilities for active or passive defence. The last-named is particularly the feature found in the vegetable kingdom. The want of locomotion prevents any aggressive movement of the individual, and hence success in the struggle can only be secured by more complete adaptation to environment than its competitors can show, or by protective mechanisms guarding the individual from the assaults of organisms inclined to prey upon it. These mechanisms exhibit very great variety, and their object often seems obscure till they are looked at in the light of the environment of the plant, the conditions of its life, and the enemies against which it has to contend. The specially-exposed points of attack are three: the succulent leaves and shoots or the attractive fruits are assailed by animals in search of food; the honey secreted by the flower to allure to it the particular insect adapted to bring about properly the process of fertilisation attracts also other insects whose presence is useless for such purpose, and which therefore are only robbers; while the fertilising pollen is itself the object of desire on the part of others which are equally unable to apply it to its legitimate purpose.

The protective mechanisms of plants, therefore, so far as they are directed against aggressive animals, are to be looked for mainly in the neighbourhood of the young growing parts or the reproductive organs. Not exclusively, however, but generally the older vegetative parts are defended by their own inherent qualities, such as their hardness or wiriness, which keep them from being suitable for the food of their assailants. Such young growing parts in many plants, particularly those growing in exposed regions, are plentifully supplied with thorns, spines, or prickles, rendering them in many cases extremely formidable. The thorns or prickles may be produced on almost all the vegetative organs, and may be merely epidermal structures, or much stronger in composition, containing considerable developments of woody tissue. These thorny plants are most noteworthy in desert countries, some that are met with there, notably the so-called "wait-a-bit" thorn of Africa, having spines of immense length, and being quite impenetrable by man or beast. Cases are not of infrequent occurrence where even the lion himself is a considerable sufferer by coming into collision with this plant. So great is the development of the thorny character in this region that Grisebach connects it particularly with desert exposure and scarcity of vegetation. Nor are thorny plants by any means confined to such regions—on our own heaths the gorse is a familiar plant, and one sufficiently formidable to passers-by; while other spiny Leguminosæ, as the wrest-harrow (*Ononis spinosa*), are not infrequent by the wayside. A further peculiarity may be noted in connection with these plants: often the thorns do not occur above the point which is assailable by the animal in its search for food; while, when the shoot has outlived its period of succulent condition, and its tissues have become hard and dry, the thorns do not persist, being much more numerous when the part is young.

Nor is this spiny habit confined to shrubs or trees. The cactuses, which are so remarkable a feature of the vegetation of America, are equally well protected. Their surfaces show great variety of development in this particular: some have small groups of thick rigid spines, others long flexible needles of intense sharpness, penetrating easily the skin of the assailant, and almost impossible to extract.

More formidable defences even than thorns or prickles are found in the varieties of stinging hairs borne so plentifully on the leaves of many plants. These are represented in England by the two species of stinging nettle, which are, as every one knows, capable of producing considerable discomfort to the unwary person who handles them. These are, however, not worth mentioning by the side of many of their tropical relations. The structure of the hair in all these is similar: a mass of cells forms a kind of swollen cushion below; on this is seated the long tapering hair, which ends in a somewhat recurved point or hook. The walls of the upper part of the hair are very strongly silicified, and are, consequently, easily ruptured. Lower down there is but little silica. When touched or rubbed by the hand, the pressure drives the hair downward; at the same time the brittle hook penetrates the skin and breaks off. The downward pressure forces out from the broken hair a fluid of intensely acrid nature, which, on entering the wound made by the point, sets up more or less severe inflammation. This fluid is generally conjectured to be formic acid—a view based on the fact that this acid can be obtained from the nettle plant by suitable means.

While the English representatives of this group of plants are sufficiently formidable to careless intruders, some of their connections in other parts of the globe are distinctly dangerous. A traveller in Australia describes a specimen of *Urtica gigas* in the following terms :—" A specimen seen by Sir W. McArthur, still in full vigour, rises from its base by a series of buttresses of singularly regular outline, gradually tapering, without a branch, to a height of 120 to 140 feet. The trunk then divides into a regularly-formed, wide-spreading head, which excites admiration from its extraordinary size. But the ordinary elevation of this tree is 25 to 50 feet, with a circumference of 12 to 20 feet. The leaves, when young and in vigorous growth, attain a breadth of 12 to 15 inches, and are of a beautiful dark-green colour. As may be expected, the poisonous fluid secreted from the foliage is very powerful, particularly in the younger leaves, and their sting is exceedingly virulent, producing great suffering, not unattended with danger. It is found in the northern part of New South Wales, and is a great impediment to the traveller." An Indian species (*Urtica* or *Laportea crenulata*) is equally obnoxious. It has rather large leaves, round which numerous small stinging hairs are placed. At certain seasons it emits when bruised so irritating an aroma as to cause a copious flow of saliva and mucus from the nose and eyes for many hours, while violent fevers have been caused by the fluid poured out from its ruptured hairs. *Urtica urentissima*, a Timor species, which is known to the natives by the significant appellation of "devil's leaf," has been known to produce effects so violent as to last twelve months, and has in some cases even caused death. *Malpighia urens* bears on its leaves hairs 1½ inch long, which are pressed flat along the surface. These act very similarly to those of Urtica.

The Loaseæ, or Chili nettles, exhibit similar defences, their power of stinging being very severe.

Other plants are protected also by hairs, which play rather a mechanical than a chemical part. Such are various species of Deutzia, particularly *D. scabra*, which bears on its leaves numerous star-shaped hairs whose walls are permeated with silica.

Besides these defences, which are chiefly mechanical, though in the case of the nettle a secretion acting chemically plays an important part in their behaviour, many plants are protected by chemical means alone. This is seen chiefly, though by no means exclusively, in the case of flowers and fruit. The plant secretes in different parts, or it may be throughout its system, a juice which may be poisonous, or acrid, or harmless in effect, but very unpleasant to its assailant. Thus very many of the Solanaceous plants have poisonous fruit, as *Atropa Belladonna*, and some species of Solanum. The whole plant is charged with juice of great pungency in many of the Ranunculaceæ, *R. sceleratus* causing sores if allowed to come into contact with a delicate mucous membrane such as that of the mouth. Parts of the Aconite (*A. Napellus*) are intensely poisonous, while the seeds of *Strychnos Nux-vomica* yield the well-known drug strychnine. Others have a latex or juice which is intensely bitter and unpleasant to the taste, as the different species of spurge (Euphorbia), the dandelion, the wild lettuce, different species of poppy, and many others. An acrid juice is to be met with in many Cruciferæ, as the mustard and the radish. The aromatic Umbelliferæ, also, are protected in this way from many of their enemies, the peculiar flavour which they possess being very unpalatable to many birds which are attracted by their fruits. Other plants pour out resinous and other sticky secretions which serve the same purpose. Some others are protected by the possession of a very fœtid odour, much resembling putrefying animal matter, though this has probably been developed to attract the carrion-loving flies which secure cross-fertilisation of the plants. Such are *Arum Dracunculus* and Stapelia, a genus of Asclepiadaceæ.

A very different kind of defence against intruders is found in a Sumatran parasite, *Hydriophytum formicarum*. This plant, instead of developing special weapons of its own, attracts to itself a colony of ants whose sting is very severe. These resent very effectually the attacks of animals inimical to the plant. It is described as parasitic on trees in the form of a large irregular tuber, fastening itself to them by fibrous roots, and throwing out several branches above. The tuber is generally inhabited by ants, and is hollowed out by them into numerous winding passages, which frequently extend a good way along the branches also, giving them the appearance of being fistular. A similar arrangement is found in *Acacia sphærocephala*, but a more elaborate one, as the plant not only serves as a habitation for the ants, but develops certain organs to attract them to it. The stem and branches are furnished with very large thorns, which are set along them in pairs. The thorns are enormously swollen at their bases, which are hollow, and in these swellings the nests of the ants are found, the magnitude of the enlargement being no doubt caused by the irritation of the insects. At the base of each pair of thorns, about midway between the two, is found a large nectar-secreting gland, which is very active. The leaves of the plant are pinnate, and on the leaflets are numerous small pear-shaped glands, consisting of delicate masses of cells containing an oily secretion. *Cecropia* is also protected in the same way; its stem is hollow, and contains the nests of the ants. As in the case of the Acacia, glandular structures are present, which attract the ants and afford them food. Schomburgk describes a plant belonging to the order Polygonaceæ (*Triplaris Schomburgkiana*), a native of Guiana, as having its trunk and branches hollow between the nodes, and serving as the habitation of venomous ants. He also mentions an orchis (*Schomburgkia tibicinis*), which, he says, has pseudo-bulbs arising from creeping root-stocks. These have a small hole at their base, and ants and other insects construct their nests therein.

Turning more especially to the reproductive organs of plants, we find them attractive to intruders, not only on account of their own palatability or succulence, but as providing two especial delicacies much sought after by the insect world—honey or nectar, and pollen. The object of the secretion of the former is to secure the due transference of the latter from the stamen of one flower to the pistil of another, and this is effected in most cases by some particular insect. The invasion of others would hence lead to loss of honey or pollen, or both, without securing the end aimed at. It is natural, therefore, to expect to find many contrivances to secure the secretion to the appropriate insect, and an almost infinite variety is found, some mechanical, others chemical, others partaking of the nature of both. The enemies most guarded against are those insects which we have seen in some other plants especially courted—ants. In assailing the plant they must usually ascend the stem from the ground, and many and various are the pitfalls placed in their way. In the teasle, the leaves, arranged in pairs along the stem, have their bases attached to it and to one another, forming deep cups, which are filled with water, thus presenting an obstacle to their ascent. The leaves of the pine-apple are arranged to bring about the same result. Some plants are surrounded in their growth by water, as many of the Polygonaceæ. In *P. amphibium*, which grows sometimes in water, and sometimes on land, and has two characteristic forms accordingly, the land form has developed round the flower-stalks a number of sticky glands, while the water form has nothing of the sort. The two forms are protected from the ants, but by different means. *Silene*, the catchfly, and *Circea*, the enchanter's nightshade, also are examples of plants furnished with sticky glands. *Lactuca*, the wild lettuce, emits a milky juice on being assailed by them. Other plants, as some varieties of the willow, have very slippery flower-stalks, which the ants cannot pass along. The forms of the flower, too, lend themselves to protective purposes: thus *Antirrhinum* and *Linaria* have a close-shutting corolla, which they cannot enter; *Cobæa* is furnished with free hairs growing on the corolla, which block the way to the nectar, and which are insurmountable by the insects. Where such means are not found, in some cases a counter-attraction is provided to draw the unwelcome visitors to parts where their attentions will be harmless: thus *Impatiens* has honey-glands on the leaves which are said to stop the ants on their way to the flower.

Other insects than ants are also to be guarded against. Many flowers are capable of fertilisation by more than one species of insect, but others are especially adapted only to one kind. In these the form of the flower, while affording facilities for the proper insect to receive its pollen upon the proper region of its body, also presents obstacles to others which would be useless. The peculiar construction of the corolla in such cases serves as a protection to both nectar and pollen. This may be carried still further, access to the honey by other than the appropriate channel being hindered by chemical means. An instance of this is seen in the Alpine varieties of the Aconite, which are adapted for fertilisation by bees. Instead of the insect inserting its proboscis into the flower from the front, so as to make it pass the stamens and pistil, one bee (*Bombus mastrucatus*) bites a hole in the back of the hood formed by the sepals, and abstracts the honey. The white variety of the flower is unprotected against the theft, but the other, blue in colour, has a nauseous, bitter taste, and so is let alone.

Besides meeting the attacks of animals in these different ways, plants have to cope with other dangers, and require for these another system of defences, which are more associated with peculiarities of environment. They are assailed continually by varying conditions of climate and temperature, and have in many cases very curious modifications of structure and habit to correspond with these. A danger that threatens most plants, except in a few regions of the world, is that of having their pollen injured by rain. To meet this many varieties of form of corolla have been developed. Many have a long narrow tubular shape, the claws of the petals cohering together, while the free limbs can curve outwards in fine weather, but arch over the tube when wet. Others have a campanulate form, with the base of the bell upwards, so that rain falling on the flower cannot get near the stamens, but is shot off as by a roof. In others the stamens are covered over by development of another part of the flower, as in the Iris; the filament of the stamen, too, may be broad, and bear the anther on its under surface, as in the Naiadaceæ. It is rather curious that flowers that produce large quantities of pollen have not such defences against this danger as those which form but little, while the most complete adaptations are found in the cases of plants that inhabit damp climates.

Many flowers are defended by habit rather than structure. In wet weather they do not open their corollas at all, and not a few, even in fine weather, keep open for a very little while, only a few hours in many cases.

Besides rain, other meteorological conditions are fraught with danger. One of the most commonly occurring is frost; and allied to this is the loss of heat by radiation during the night. The power of resistance to these conditions varies very much, but in many whose constitution makes them peculiarly susceptible to damage thereby there has been developed the so-called power of sleep. The term is no doubt a misnomer, but it has been adopted and associated with certain well-defined movements which the leaves of the plants perform at the close and at the beginning of day. The movements differ very greatly with different plants, but they bring about such a position of the leaves as will protect the upper surface from radiation. Some of them are of a very complex nature, particularly those shown by certain of the Leguminosæ, which have pinnate leaves. It is in this natural order that the property of sleep is most prevalent, certain of the Oxalidaceæ and their allies coming next to them.

A similar mechanism protects very many plants from excess of sunlight, which is injurious to the chlorophyll. In bright sunshine the leaves assume a position which has been called "diurnal sleep." In it they present their edges and not their faces to the light. In other leaves the chlorophyll corpuscles themselves move, taking up a position on the lateral walls of the cells rather than on the front ones, or so placing themselves that their profile and not their surface is exposed to the sun. In some of the Algæ, as *Mesocarpus* and *Vaucheria*, this sensitiveness is seen.

Other protective devices may be seen by studying the adaptations of plants to their conditions of life. Thus the leaves of submerged plants are preserved from being broken by the currents of water by being minutely subdivided, so that they adapt themselves easily to the motion, and do not oppose a resistance. Desert plants are protected from drought by the development of a succulent habit. Aërial parts of plants, again, are protected in many cases from becoming moistened by water by a deposition in the cuticular layers of the epidermis of varying amounts of wax or resin.

THE ORIGIN OF OUR POTATO

THE year 1886, by its tercentenary associations, brings once before us the subject of the introduction of the potato into our islands, but brings it still with most of the connected questions unsolved.

How, and when, and whence it was brought was considered by Banks in 1808, and it was by him attention was drawn to a manuscript statement in 1693 by Dr. Southwold Smith, F.R.S., that his grandfather received it from Sir Walter Ralegh, and sent it to Ireland.

It was considered by Sabine in 1822, when he concluded a paper before the Royal Horticultural Society with the remark, "The introduction of the potato *into* Virginia is still involved in obscurity."

It has been considered by De Candolle in his "Géogr. Bot. Raisonée" in 1855, and more recently in his "Origin of Cultivated Plants" in 1882. It has also been considered by others. While of the old unanswered questions some are now regarded as of mere antiquarian interest, there are others to which greater importance is attached than there ever has been before.

Among the latter a fresh interest has been given by Mr. Baker's paper before the Linnean Society in January, 1884, to the old question, was it *S. tuberosum* that was introduced from Virginia? The suggestion he, in conjunction with Earl Cathcart, has thrown out, that to strengthen our cultivated potato against disease we should cross with some other species of tuber-bearing Solanum, makes it important we should clearly know what is the species we have been for 300 years cultivating. There are many other questions surrounding the consideration, some of which border on that fundamental question, What constitutes a species?

That simple but highly practical method of approaching the question, "What is our species?" the method of introducing supposed distinct wild species, and watching their changes from year to year in cultivation, has not yet been followed sufficiently long, nor with a sufficient number of such species to effect much more than establish well-founded hopes that by it there is much we may learn. At present the twenty (?) years' cultivation of *S. maglia* is the only experiment on which we can rely. What conclusions such experiments may eventually lead s to it is impossible to predict, but this is certain, that proceeding by such a method on fact, and untrammelled by tradition, the results will be sure. Hitherto we have relied over much upon traditions and mis-called history. It has been assumed that our species is a Virginian species, and beyond that the question, till recently, has not been pushed.

It would be a fitting observance of the third centenary of the date that may be most reasonably fixed for the introduction from Virginia, if we could celebrate it, not by speeches and after-dinner toasts to the memory of Drake or of Ralegh, but by clearly laying down our lines of inquiry, for they have been very ill-defined.

It may be one useful part of the work to reconsider the traditions and inferred history of our potato—for there is no doubt that botanists, if not perhaps actually led astray, have at least been hampered and puzzled by them.

One of the commonest traditions repeated over and over again in histories, dictionaries, works of gardening and agriculture, is that Sir Walter Ralegh brought the potato from Virginia. The great error in this is that Ralegh never was in or near Virginia.

His patent for founding an English colony in the New World was granted March 25, 1585, and he parted with it on March 7, 1589. We have records of the various expeditions sent out at his cost to endeavour to establish and maintain a colony, with the dates of sailing and returning, the names of the captains, and other details. Ralegh's life all through the period is known, and his time is so fully accounted for that he could not have gone out even *incognito*. The traditions, therefore, that he brought both the potato and tobacco from Virginia, may be for ever laid at rest. Whether some of his returning colonists, or one of the returning ships that had been sent out with supplies, brought it, is another question. There is not even tradition to that effect, far less any statement in the contemporary history of any of the expeditions.

Gerard, however, in his "Herbal," 1597, at p. 781, describing the "Potatoes of Virginia," says:—"I have received rootes hereof from Virginia, otherwise called Novembeya, which grow and prosper in my garden, as in their owne native countrie." The value of Gerard's picture and letterpress will be presently discussed, but the point here to notice is that he makes the statement that he did receive "rootes" (by which, of course, he means tubers) from Virginia. One of the names he mentions for the potato is "papus." The name "papus" also occurs in the first catalogue of plants growing in his garden in 1596, so that the "rootes" he had he received not later than early in that year. The exact date is perhaps unimportant, as there is no record of any expedition to Virginia after 1590 till 1606. The land named Virginia was first visited in 1584. The introduction is therefore limited to some time between 1584 and 1590. At a period when the study of plants was confined almost wholly to apothecaries, and when sea-captains thought more of fighting a Spanish or Portuguese ship than of observing the natural products of a newly-discovered land, it was not expected that the account of a voyage should refer to roots brought home. The sea-lion that roared its presage of Sir Humphry Gilbert's death is of course carefully described as a marvel, but a root is too ordinary a thing for notice. Can we by any consistent inferences account for the introduction between 1584 and 1590?

That learned mathematician, Thomas Heriot, who went out in the expedition of 1585 and returned in 1586, wrote a report on the "commodities" of the then known area of Virginia. The Island of Roanoak contained the head-quarters, and we know from Lane's report that exploring expeditions had been sent to the south for 80 miles, to the north for 130 miles, and also to the north-west for 130 miles. But that was all that was known of Virginia till the time of James I. The second part of Heriot's report is "of such commodities as Virginia is knowen to yeeld for victuall and sustenance of man's life usually fed upon by the naturall inhabitants as well also as by us during the time of our abode; and first such as are sowed and husbanded." Under the sub-heading "of roots" he says:—"Openauk are a kinde of root of round forme, some of the bignesse of walnuts, some farre bigger, which are found in *moist* and *marshy* grounds growing many together one by another in ropes as though fastened with a string. Being boiled or sodden, they are very good meat." In the third edition is added, "Monardes calleth these roots beads or paternostri of St. Helena" ("Monardes," parte 2, lib. 1, cap. 4). This report is dated February, 1587, seven months after his return to England. How far it was written from memory we have no means of knowing. But this should be noticed—that Lane says that when, after much discussion, the colonists decided on returning to England, their departure was so hurried that there were "left or thrown over, cards, books, and writings." Heriot nowhere speaks of writing or making notes on the spot.

It has been generally supposed that the root here described under the name "openauk" is the potato. It should not escape notice, however, that Gerard does not in any way allude to the name "openauk," and it is nowhere said that openauk was brought to England. The only mentioned habitat, "moist and marshy grounds," seems strange, but the usual answer (in conversation at least) to the objection is, if the openauk is not the potato, what is it? and Gerard's statement that he received potatoes from Virginia is taken to strengthen the supposition. The suggestion, however, has been made that it was the Jerusalem artichoke.[1] All that can be said is, there stands Heriot's description, and there stands Gerard's statement. To link the two together may be a fair assumption, but it remains a mere assumption. The omission by Gerard of any reference to the name "openauk" is against the supposition he received roots from Heriot personally. Gerard's use of the word "papus" calls for notice, but there is one point that should be referred to before quitting the openauk.

Heriot, who is said to have been Ralegh's mathematical tutor, describes himself in his report as "servant to Sir Walter Ralegh, a member of the colony, and then employed in discovery a full twelvemonths." If he brought potatoes with him, it would be by courtesy said Sir W. Ralegh introduced them. All the expeditions were his. But there is another tradition that Sir Francis Drake brought them. Different writers give different dates for this, which are evidently wrong. He could not have brought them in 1580 from the west coast of South America, because he arrived in November, after coming round by India and the Cape, and they would have sprouted on the voyage. That was the return from his famous circumnavigation. It could not have been 1585, because he left England, after four years ashore, in that year, and did not return till July 1586. If Heriot had anything to do with the introduction of the openauk, it is almost certain Drake brought it in 1586, for the circumstances of his return then were these. His knighthood, conferred upon him after months of deliberation for his great voyage round the world, firmly established his position, and he was intrusted with the command of a fleet to the Gulf of Mexico to harass the Spaniards. His instructions were to visit Ralegh's colony at Virginia on his way home. He called there on June 8, 1586, and found the colonists much distressed that the ship from England that it had been promised should be sent with supplies in the spring had not arrived. He stayed there many days, granted their request for a ship to be left with them, but, as many unexpected troubles arose, which are described by Lane,

[1] Asa Gray and Trumbull, *Amer. Journ. Sci. and Art*, xiii., May, 1877, p. 351.

they asked to be taken home, and this was done. Although at the last their departure was so hurried that writings, &c., were not embarked, it does not follow that there had not been opportunity during previous days to embark roots among other provisions. As openauk was among the products "husbanded," Heriot may have had a supply of unplanted roots ready to send home. If this were so, then two traditions would be reconciled. It would be Drake's ships, but Ralegh's colonists, that brought the potato, assuming the openauk to be the potato. This, however, is mere assumption. For the fact that Drake brought home the people there is abundant evidence, but respecting the roots there is not a word. If we wish, however, to account at all for Gerard's receiving potatoes from Virginia, this seems the only likely way in which he could have received them. The overdue relief ship that arrived a few days subsequent to the departure of the colony, and returned after a brief search, may possibly have brought them. All the other expeditions were later in the season than even Drake's return, while of the 349 colonists who went out in 1587 nothing was ever known after they were landed, though a relief expedition made search for them. Gerard distinctly says it was the "rootes" he received, and these could not, like seeds, be available at any time of the year.

It is commonly supposed that the introduction of the potato from Virginia is a duly authenticated historic fact. What forgotten manuscript records or letters there may be it is impossible to say, but at present our sole authority that it was brought thence is Gerard, while the linking of two traditions as here suggested is only assumption.

It has been already mentioned that while Gerard does not use the word openauk, he does give the name papus. Papus is not mentioned by Heriot as a word in use in Virginia; *how then did Gerard come to use it?*

From the travels of Pedro Cieza de Leon [1532–1550] we know that papas was the general name in Peru for an edible root in his time. The root was cultivated, and it was eaten boiled, or else dried in the sun and preserved, when it was called chuña. Acosta, whose travels in the same regions were later [1570–1587], gives almost identically the same information, as also does the native-born Garcilasso. They none of them, however, give any description of papas by which it is possible to identify the plant known by that name.

The two oldest known Continental botanists that give the name papas *in conjunction with a description* of the plant, are Clusius and Bauhin. In addition to descriptions, both give figures.

In his Φυτοπίναξ (1596) Bauhin describes a plant to which he gives the name *Solanum tuberosum*, but without any figure [Lib. v. Sec. 1, No. xix.]. In his "Matthiolus" (1598) he refers to it with a figure. Here he adds, "Vulgo Pappar Hispanorum vel Indorum dicitur." Clusius, in his "Rariorum Plant. Hist." (1601), describes a plant clearly the same, with a figure, under the name *Papas peruvanorum.* He says there is no doubt this was the plant Cieza de Leon refers to. The expression, "there is no doubt," is, however, somewhat removed from certainty. In 1620, Bauhin again, in his Πρόδρομος, in describing *Solanum tuberosum*, to which he here adds "esculentum," refers to Cieza; and again, in 1623, in his Πίναξ, mentions that this is the plant from which Acosta says chuña is made. Both Bauhin and Clusius give their descriptions as from growing plants.

It might be readily surmised that with such continuous traffic as there was between Spain and the domains she had conquered in South America, the roots so highly prized by the Indians should be carried home. To strengthen this surmise there is the tradition that gives the name of the first to introduce them, a "doctor" named Hieronymus Cardan. What is the history of the introduction into Spain is beside the present question. It is not improbable that with the sustained and frequent intercommunication between Spain and America it was repeatedly introduced. The case is by no means parallel to the question of the introduction into England from Virginia, in Gerard's time, when out of the six expeditions sent out only one made any explorations inland. The opportunities of introduction from Virginia were few. From South America to Spain they were numerous. It seems sufficiently established, both by Bauhin and Clusius, that a plant called papas was introduced and grown in botanical gardens, if not as a food; and that it came to be known as the papas of the Peruvians, of the Indians, and of the Spaniards, for Peruvanorum, Indorum, and Hispanorum seem indiscriminately used. That Clusius suggested its identity with the Arachnida of Theophrastus and other Greek writers is now of little interest. Bauhin was the first to recognise the plant as a Solanum, and his *tuberosum* occurs as No. XIX. in his list of Solanums, in his Φυτοπίναξ.

Though Cieza, Acosta, and Garcilasso drew what appears to have been a consistent distinction between papas (potato) and battatas (sweet potato), that distinction was not always maintained by later European writers. In a way it seems hopeless to endeavour to trace, the Portuguese and Spaniards now use different words for the potato: the former call it batata, and the latter papa. The confusion is more bewildering when the two names were used as synonyms. In botanical nomenclature we have lost papas, but retained battatas. The identity or not of *Battatas edulis* with the battata of the three Spanish travellers is wide of the present consideration. So also would be the question why the Quichan word *ascu* was not used by them. This, however, appears a safe rule—that when papas is mentioned by sixteenth-century writers it may be read as = Solanum (but not necessarily *tuberosum*); when battatas is mentioned it is requisite to see whether it is wrongly used as a synonym or intentionally used for a distinct plant. To the present day chuña is made in Peru from "papas," but apparently not from "battata."

Assuming the rule is a safe one that papas cannot be taken to mean battatas, but battatas may and often does mean papas, then such chronological data as the following are of interest as some indication of the spread of the plant among botanists in Europe. There may be others, but these are all the writer has been able to collect.

Dr. Scholtz had papas growing in his garden at Breslau (Vratislavia), 1587; Clusius received two tubers at Vienna from Hannonia, 1588; Bauhin, in his Πρόδρομος, mentions "iconem suis coloribus delineatam," 1590; Dr. Scholtz's "*Papas hispanorum*" is mentioned in a "Carmen" (pub. at Vratislavia), 1592; Bauhin refers to a "*Pappar hispanorum*" growing in his garden, of which he gives a description, 1596.

It was in this year (1596) that Gerard published the catalogue of plants growing in his garden in Holborn. There occur in it the two names *Papus orbiculatus* and *Papus hispanorum.* In this 1596 catalogue these names, as all the rest, occur without any English equivalent or any description or note. The catalogue is simply a list of names. The word batata does not occur, but Sisarum does. Another catalogue, commonly called a second edition, was published in 1599. The "Herbal" had been published in the meantime (1597). In this 1599 catalogue English names are added to the Latin. These occur: *Papus orbiculatus*, bastard potatoes; *Papus hispanorum*, Spanish potatoes. Batata does not occur. Sisarum does, but without any adjective (we cannot call these second names "specific," while the first were in no sense of the word "generic"), and the English name with this is skyrrits.

Although it would be a natural supposition that with the aid of the figures and descriptions in the "Herbal" it would be easy to identify the plants named in the catalogues, it is, on the contrary, a most perplexing puzzle. There are names introduced into the "Herbal" which do not occur in the catalogues, and names in the catalogues which do not occur in the "Herbal." That the "Herbal" of 1597 should not exactly agree with the catalogue of 1596, hardly excites surprise, but that the catalogue of 1599 should so differ from the "Herbal" is more than surprising, it is perplexing. If the explanation given by Mr. Daydon Jackson in his annotations to the catalogues is correct, then the *Papus hispanorum* of Gerard's garden was not the *Papus hispanorum* of Clusius and Bauhin; but this requires very close attention. It involves not only the question whether the *Papus hispanorum* of Dr. Scholtz was Solanum or Batatas, but also whether Bauhin is to be trusted as a cautious incorporator of statements. However highly Bauhin is to be esteemed as a botanist, he may have had a Pliny-like weakness for accepting anything he was told.

Mr. Daydon Jackson's explanation is this:—

"Herbal" of 1597		Catalogue of 1599
Battata virginiana and *pappus*—Potatoes of Virginia (p. 781) ...	=	*Papus orbiculatus*—Bastard potatoes.
Sisarum peruvianorum, sive *Batata hispanorum*—Potatus or Potatoes (p. 780)	=	*Papus hispanorum*—Spanish potatoes.
Sisarum (p. 871)	=	*Sisarum*—Skyrrits.

Supposing this to be the correct explanation, what are we to think of Gerard allowing his second catalogue to appear so like his first and so unlike his "Herbal"? One point is clear—he uses Papus, Batata, and Sisarum with such want of discrimination that no importance can be attached to his names. But it is strange he should, in both his catalogues, use Papus twice and Batata not at all, while in his "Herbal" he has both *Batata virginiana* and *Batata hispanorum*. According to accounts that have been handed down to us, the "Herbal" was based on Dr. Priest's translation of the Pemptades of Dodonæus, and the plates, with the exception of sixteen, were those that had been used to illustrate works by Jacobus Theodorus ("Tabernæmontanus") and L'Obel. It is said that Gerard so little understood his work that he put cuts in the wrong places, and made so many mistakes that Norton, the publisher and proprietor of the work, engaged L'Obel, who was then living in England, to correct the errors. Gerard resented this, and a quarrel with L'Obel followed. To what extent L'Obel's corrections went we have no record. He would at any rate, we may assume, prevent wrong names and cuts being printed with the letterpress. In the particular case of the three names under consideration, he was already well acquainted with the Sisarum or Batata (p. 780), as he had described it in his "Stirpium adversaria nova," written in conjunction with Pena, and published in London in 1570. He there gives the name Battades, Ignames—Anglicé, Potades. The cut in illustration used in the "Herbal" is that on p. 482 of Tabernæmontanus, where the name used is Sisarum. So that we can account for the names used in the "Herbal" thus:—Sisarum because it occurs in Tabernæmontanus; Peruvanorum is perhaps not to be accounted for. Batata because L'Obel had used it, and Hispanorum because it was first made known to Europe by the Spaniards, who brought it (most probably) originally from the West Indian Islands. Potatus, or potatoes, because that was the Anglicised form of Batata. It is possible that Gerard may have wished to introduce the word Papus, and that L'Obel cut it out.

With regard to the "potatoes of Virginia," Gerard would perhaps have his own way. He thought so much of his having grown some received from Virginia, that in his portrait he has a branch of them in his hand. With regard to the cut used in illustration, we know at present nothing. It is not taken from any other source, and it does not occur anywhere but in this 1597 edition. In the 1633 edition by Johnson the cut from Clusius is used, while Parkinson, in 1640, uses the cut copied from Bauhin. It is one of the sixteen new cuts, but where it was made we do not know, still less do we know whether it was made from a plant growing in his garden.

This last consideration, where the plant grew which is here figured, is closely connected with the question, How did he come by the name papus? In the text Gerard says, under "The Place":—"It groweth naturally in America, where it was first discovered, as reporteth C. Clusius, since which time I have received rootes hereof from Virginia." And then, under "The Names," he says:—"The Indians do call this root papus (meaning the rootes), by which name also the common potatoes are called in those Indian countries."

Although there is no known publication of Clusius so early as this from which Gerard could be quoting, yet, as he had been thrice in England, there is the probability that Gerard and he were acquainted. It is easy to see then that he might easily have had, indeed most likely would have, the South American name papus direct from Clusius.

But did he have anything else from him—a figure, a full description, a dried specimen, or even a tuber? Clusius had two as early as 1588, eight years before Gerard's first catalogue.

We have seen—

(*a*) That Cieza, Acosta, and Garcilasso speak of papas as a common name in the north-west portions of South America.

(*β*) That Clusius and Bauhin speak of the "papas of the Spaniards" growing in Europe (which Bauhin recognised to be a Solanum) as the same plant the three mention.

(*γ*) That it was known in several botanic gardens in Europe before the time of Gerard's first catalogue.

(*δ*) That Gerard in some way received information from or through Clusius that the plant was first discovered in America. America here evidently means South America.

With Clusius's information we can hardly doubt Gerard would also get the name papus. There is no trace of papus being a name used in North America. Fernandez de Soto, who travelled in Florida [Evora, 1557], mentions Batata, but not papas Benzoni, 1572.

It has been a puzzle to some botanists that papas should have such a wide geographical distribution as from Virginia to South America. The puzzle has partly arisen on the assumption that papus was a Virginian name. As there is not a fragment of evidence it ever was, and as we have seen a way in which Gerard might have had it, that part of the puzzle may perhaps be regarded as entirely withdrawn. There are a sufficient number left in connection with the potato to tax ingenuity.

Can we as easily dispose of the cut in the "Herbal"? Are we on the strength of that cut to continue to believe that *S. tuberosum* was wild within the area known as Virginia? For, though we get rid of the name papas we do not get rid of the wide distribution of *tuberosum* if the plant itself grew wild in Peru and in Virginia? Possibly experts in wood-cutting or collectors of old cuts may be able to say whether the cut is English or Dutch. Sequier says the cuts are brass ["Bibl. Bot.," 1740, pp. 72, 73]. Haller says: "In 'Bib. Bodl.' icones dicuntur æneæ esse: sed ligneæ sunt undique" [1771, tome i. p. 389]. Such a point as this could probably be cleared up definitely.

It seems anomalous that we should base our belief that *S. tuberosum* is a native of Virginia, on a single cut about which we know nothing more than this: that it appears in conjunction with the name potatoes of Virginia; that it was placed there by the direction of a man against whom the charge of deliberate misstatement in his so-called scientific work has never been cleared up; that for some reason it does not appear in the second edition of the work. If it is charitably supposed that in this case Gerard did not intentionally mislead, still, if his reputation for being a muddler of other people's work is as well founded as it appears to be, he may have made some blunder. It is by no means a far-fetched assumption that his figure was from a Continental source, but that he thought it near enough to represent his Virginian "rootes." Apart from all other considerations it is difficult in at least one particular to reconcile the figure and the text. He speaks of "the temperature and vertues" of the potatoes, and says they are the same as of the common potatoes (*i.e.* his Sisarum). Unless this is a pure invention, many must have been eaten for this conclusion to have been arrived at. The size of the tubers is not greater than of fair-sized peas, and it would take the produce of half a hundred plants to furnish a single dish.

It is perhaps worth consideration whether an explanation of the catalogues different from that given by Mr. Daydon Jackson is possible. Is there any insuperable objection to their being read thus?—*Papus hispanorum* (the *P.h.* of Clusius, &c.), received from the Continent. *Papus orbiculatus* (for orbiculatus is a name of his own) received from Virginia. Sisarum—the "Skyrrits of Peru" (p. 780 "Herbal"), and that the common skyrrits were not mentioned in the catalogue. When he mentions papus in his "Herbal" he does not add either hispanorum or orbiculatus, and it might be he included both under papus there.

The important point however is whether that cut truly represents what he received from Virginia.

In close connection with this it cannot be overlooked that Bauhin gives openauk as a synonym. He also says, "Ex insula Verginea primum allata in Angliam, inde in Galliam aliasque regiones.' He had probably seen De Bry's edition of Heriot, and so obtained the name openauk. But his authority for the remainder of the sentence is not clear. Moreover it does not harmonise with his reference to Peru.

The question of the introduction of the potato is a very complex one, involving many other considerations besides those here referred to. The foregoing notes may, however, clear up the traditions about Ralegh and Drake, remove the difficulty about Gerard's use of the word papus, and perhaps lead to something more certain being known about that cut of Gerard's on which so much hangs.

The origin and change in the use of the *word* potato are subjects which, for their satisfactory elucidation, involve considerations that fall within the provinces of the philologist, the traveller, the bibliographer, the historian, the botanist, and, using the word in its wide sense, the geographer.

Potato is but the English way of pronouncing Batata.

But what is the word Batata? To what language does it belong? The first European knowledge of it appears to be traceable to Cuba, San Domingo, or some of the neighbouring isles at the time they were discovered by Columbus, 1492, &c. But then the sixteenth century writers on Peru also use it as if it were a common word there, and, if it were, it is at least interesting, if not strange, to find a word thus widely spread over and across districts where, it has been said, languages so vary with tribes that one cannot even understand another, though neighbouring, tribe. But first we have to consider is there any *contemporary* evidence that the West Indian natives did make use of a word which, when written by the Spaniards, appeared as *batata?* It would involve a special search among such materials as Navarette had at his disposal to decide that. Compilations are not to be trusted, and English versions are of no avail. What the actual word was, written by Columbus or his companions, is what is wanted. Then, if it were a true West Indian word, and introduced and known with some plant in Spain and Portugal in the early part of the sixteenth century, what is the probability that, at the middle of it, writers on Peru used it as a name that would be understood at home, even though not used by the South American natives. With regard to papas, it is distinctly stated by Acosta it was a native name in South America, but the writer does not know of any passage in which batata is said to be. It has been pointed out above how the mistake arose that papas has been considered a Virginian name, and it is possible batata may prove to be not a South American name at all. There is a Quichau word, Ascu, equivalent, apparently, to Papas, to which only Mr. Clements Markham among English writers seems to have drawn attention. At present, in English translations of travels in Peru, papas and batata appear often confounded.

Then in regard to our own use of the word batata, did we have it with roots through the Spaniards, or direct from the West Indies? The earliest use of the word does not yet seem to have been fully searched for. It may, however, be found earlier than in the list of literary quotations usually given. For example, it occurs in the account of Sir J. Hawkins's voyage, 1565: "Hennes, potatoes, and pines." The earliest description the writer has been able to trace of what the potato was is in the botanical work of 1570, published in London, Lobel's "Stirpium adversaria nova." A figure is given of the root of the Batata, and at the heading is "Anglice Potades."

But we might have had the word half a century before that through Spain, and the fact that Lobel introduces such a curiously-spelled form as the usual English one would imply it had been for some time in use among the common people. The mention of potatoes in the Hawkins voyage without any reference to what they were like would also imply that they were then as familiarly known as pines or hens.

The change of sounds from Batatas to Potades is curious. Why should the flat labial be changed to the sharp, and the sharp linguo-dental be changed to the flat, in the same word? Again—the question is not so undignified as may at first appear—when was the form "taters" introduced? It has no doubt been a gradual change, but as a fact country people of the Victorian era no more think of using the form potatoes than those of the Elizabethan era did of using batata. In 1596 the form potaton is met with. In 1627 and 1676 potadoes, and in 1655 pottato. Batata itself, by the Spaniards, seems to have been spelled indifferently batata or battata.

Then there is another curious point. How has it come to pass that for the same plant the Spaniards of to-day retain papas, while the Portuguese use batata, for the plant we *now* call the potato.

In speaking of questions in connection with our having changed the use of the word potato from one plant to another it is an advantage for preventing confusion to refer to the two plants by their present botanical names, the *Batatas edulis*, which belongs to the convolvulus "order," and the *Solanum tuberosum* (perhaps including the supposed different species, *Maglia*), our common potato, which belongs to the nightshade "order." Of the two it was *Batatas edulis*, called then, long before Linnæus's binomial system, simply Battata, that seems to have been first known in Europe.

The first European knowledge of the plant *Solanum tuberosum* (or *Maglia*) was under the name papas, by which it was known till Caspar Bauhin recognised that it was a Solanum in 1596. The date 1596, if not exactly that of his knowledge, is the date of his first publishing it in his "Φυτοπιναξ."

Then as to dates of introduction.

As already said, the first European knowledge of Battata was in 1494 or 1495, that is, assuming that it was among the valuable products of the West Indies Columbus sent home to his patron sovereigns to demonstrate the value of his discoveries. It is mentioned he sent home vegetable products as well as gold. He sent spices, dye-woods, fruits, and herbs, or intended to. In the history "Primer viage de Colon" (Navarette, cap. 1) is the passage,[1] "And besides there are trees of a thousand species, each having its particular fruit and all of marvellous flavour, so that I am in the greatest trouble in the world not to know them, for I am very certain they are each of great value. I shall bring some home *as specimens*, and also *some of the herbs*." Taking Washington Irving's inspection of Navarette's materials as reliable, Columbus knew the potato—the battata.

Then it is also probable, for here we have to deal with probability only, that the Solanum [under the name papas] was known in Spain soon after the conquest by Pizzaro [1527], when Cieza de Leon wrote [1532-50].

Both of these are at present but assumptions in respect to dates. The exact dates may perhaps be known in Spain. Possibly some people in England may know what is known, but the writer has been unable to trace anything more through the published second-hand statements.

We in England somehow knew the battata, pronounced and spelled potade or potate or potato, before the time of Hawkins's voyage, and before Shakespeare wrote his "Merry Wives of Windsor," where he uses the word. That Shakespeare's potato was the batata is clear from Gerard's reference to the confectioners using the battata as a basis for their sugar work (p. 781 of his "Herbal").

It was Gerard who called the papus (papus, as he chose to spell it, instead of papas) the Virginian potato, or bastard potato.

There in his work we have the word "batata," or patata, or potato, transferred to the papas, to Bauhin's *Solanum tuberosum esculentum.* Though Gerard does not use the word Solanum, his figure and description are sufficient identification. Somehow, though it does not seem possible to trace how, the word "potato" or "taters" has, as an English word, stuck to the *Solanum.* The "battata" has now dropped out of cultivation as an English root, and this no doubt has been the main cause of the transference of the word "battata" from the original battata to the "bastard" potato of Gerard—the Solanum.

The establishment of batata as a botanical name, its recognised description, and its admission into generic nomenclature have a curious history, but that is somewhat wide of the points more immediately under consideration.

The whole question is by no means yet worked out, but the above suggestions may draw attention to the subject.

W. S. M.

[1] Quoted second-hand through W. Irving's "Life of Columbus."

THE COLONIAL AND INDIAN EXHIBITION

THIS Exhibition was opened on Tuesday by Her Majesty in state. Science in one form or another will be prominent in nearly all of the sections. The Exhibition as a whole will be a geographical education in its widest sense. Not many can follow the example of Mr. Froude and Baron Hübner, and spend the best part of a year in visiting our scattered Empire. At South Kensington, in the course of a few days, however, we may learn even more of the products and people and geographical aspects of our colonies than we might do by an expensive voyage. Of course the main purpose of the Exhibition is to draw attention to the economical and commercial aspects of the colonies and India; but in doing so, necessarily the introduction of a considerable amount of science is involved. In nearly all the sections, for example, we find excellent large maps of the various colonies on the walls, besides the gigantic map of the world in hemispheres beside the gateway of Old London. Again, several of the colonies have sent specimens of their natives, and from India especially there is a considerable number of individuals of all ages representing the various races which form the heterogeneous population of that vast territory. So, from South Africa, we find Kaffirs, Hottentots, Zulus, and Bechuanas; Singhalese from Ceylon, and Malays from the Straits Settlements. In several of the sections, also, notably in India, do we find life-size models of natives; some of the finest of them are in the British Guiana Court, prepared by Mr. Im Thurn. Several of the colonies, again, have had large reliefs either of the whole or part of their territory prepared. Among the exhibits of the Indian Survey is a relief-map of the Peninsula from the Tibetan table-land to Cape Comorin, on the scale of thirty-four miles to an inch. One of the finest of these models is that of New Zealand by Dr. Julius von Haast, under whose care this Court is markedly scientific. He has brought over with him the skeletons of three large moas; mumerous specimens of flora, fauna, and geology, and the exquisitely beautiful skeleton of a ribbon-fish prepared after the method of Prof. Parker of Dunedin. Maori ethnology is also amply illustrated, though we believe no actual live specimen has been imported. One of the finest conservatories of native plants in the Exhibition will be that attached to the New Zealand Court. But such conservatories will be a marked characteristic of this Exhibition, and will be found attached to the Courts of the Cape of Good Hope, Queensland, Natal, and other colonies. India, of course, has much to show of interest to science, besides its numerous groups of life-size models of natives taken from actual casts. Under the care of Dr. Watt the botany is very fully illustrated. The Geological Survey has sent a fine exhibit; while the Topographical Survey will have a Court to itself. In all the Australian colonies geology is a prominent feature, at least in its economic aspects, and so we may say of botany, at least so far as timber-trees are concerned. In the Australian and several other colonies, moreover, large collections of natural history have been arranged in cases, while of course the numerous game-trophies will interest the naturalist. The trophy of trophies, however, will be the great jungle scene prepared by Mr. Rowland Ward, into which it has been attempted to compress the whole of the fauna of India. It is a triumph of arrangement; and we may refer to it in detail in a future article. An almost equally striking scene is the landscape in the South Australian Court, representing an actual piece of country near Lake Alexandrina. Of course, as in the jungle scene, we have *multum-in-parvo*,—features which in reality are spread over a wide area compressed into a few square yards. But everything is on the scale of nature, and nothing introduced that is not actually met with. We have natives at various occupations, including a woman and child under a rude shelter of branches; kangaroos, wallabies, eagles, and other animals deftly posed; characteristic vegetation and rocks, with mountains away in the background. The model of Hong Kong and the neighbouring coast may also be mentioned. The West Indian Court contains much of interest. The woods of Honduras are conspicuous; many curious land and water products from Trinidad; and a fine collection of Columbian pictures and relics, and several fine paintings and photographs of West Indian scenery. Indeed, in all the sections, pictures, and especially photographs, are among the most conspicuous exhibits, and have much geographical value.

Of course this Exhibition is one of many-sided interest, and we have mentioned here only a few of the points that will attract those interested in science. Its educational value is evident, and we hope that teachers will take advantage of so exceptional an opportunity of giving their pupils a practical lesson in physical geography and its economical and "political" developments. Most of the colonies will publish special hand-books, and in several of them we are glad to know that science will hold a prominent place.

NOTES

WE refer elsewhere to the opening of the Colonial and Indian Exhibition on Tuesday. It argues ill for the spirit in which this Show is to be conducted that the representatives of British science, on which the progress of England beyond the seas has so largely depended in the past and must depend in the future, were so conspicuous by their absence at the opening ceremony. Not even the President of the Royal Society was invited to be present, though tickets were liberally distributed to a large number whose prior claims we do not care to discuss.

SCIENCE was well represented by the President of the Royal Society at the Royal Academy dinner on Saturday. Prof. Stokes showed how in several ways science is capable of rendering service to art. The rules of perspective, he pointed out, involved clear geometrical conceptions; while a knowledge of chemistry and physics would keep the artist often from violating nature. Prof. Stokes illustrated the point by referring to the inverted rainbow picture, adduced as an example for a similar purpose in these pages some years ago. At the same time he admitted with justice that art was not without its uses to science. Especially useful was it, he pointed out, as a refreshing and invigorating change for the mind of the scientific student, apt to get clogged and dulled by too eager direction to one particular subject.

THE Fifty-sixth Annual Meeting of the British Association will commence at Birmingham on Wednesday, September 1, 1886. The President-elect is Sir William Dawson, C.M.G., F.R.S., Principal of McGill College, Montreal, Canada. Vice-Presidents: The Right Hon. the Earl of Bradford, Lord-Lieutenant of Shropshire, the Right Hon. Lord Leigh, Lord-Lieutenant of Warwickshire, the Right Hon. Lord Norton, K.C.M.G., the Right Hon. Lord Wrottesley, Lord-Lieutenant of Staffordshire, the Right Rev. the Lord Bishop of Worcester, Thomas Martineau, Mayor of Birmingham, Prof. G. G. Stokes, Pres.R.S. (nominated by the Council), Prof. W. A. Tilden, F.R.S., Rev. A. R. Vardy, Rev. H. W. Watson, F.R.S. General Treasurer: Prof. A. W. Williamson, F.R.S., V.P.C.S., University College, London, W.C. General Secretaries: Capt. Douglas Galton, C.B., F.R.S., A. G. Vernon Harcourt, F.R.S. Secretary: Arthur T. Atchison. Local Secretaries for the Meeting at Birmingham: J. Barham Karslake, Rev. H. W. Crosskey, Charles J. Hart, Council House, Birmingham. Local Treasurer for the Meeting at Birmingham: J. D. Goodman. The Sections are the following:—A. Mathematical and Physical Science—President: Prof. G. H. Darwin, F.R.S.; Vice-Presidents: Donald MacAlister, M.D.; Rev. H. W. Watson, F.R.S.; Secretaries: R. E. Baynes (Recorder), R. T. Glazebrook, F.R.S., Prof. J. H. Poynting, W. N. Shaw. B. Chemical Science—President: William Crookes, F.R.S.; Vice-Presidents: Prof. Carnelly, W. H. Perkin, F.R.S.; Secretaries: Prof. P. Phillips Bedson (Recorder), H. B. Dixon, F.C.S., H. Forster Morley, D.Sc., F.C.S., W. W. J. Nicol, Ph.D., C. J. Woodward, B.Sc. C. Geology—President: Prof. T. G. Bonney, F.R.S.; Vice-Presidents: Prof. C. Lapworth, F.G.S., H. Woodward, LL.D., F.R.S., F.G.S.; Secretaries: W. Jerome Harrison, F.G.S., J. J. H. Teall, F.G.S., W. Topley, F.G.S. (Recorder), W. W. Watts, F.G.S. D. Biology—President: William Carruthers, F.R.S., F.L.S.; Vice-Presidents: Prof. E. A. Schäfer, F.R.S., M.R.C.S., P. L. Sclater, F.R.S., F.L.S., Sec.Z.S.; Secretaries: Prof. T. W. Bridge, Walter Heape (Recorder), Prof. W. Hillhouse, W. L. Sclater, F.Z.S., H. Marshall Ward. E. Geography—President: Major-General Sir F. J. Goldsmid, K.C.S.I., C.B., F.R.G.S.; Vice-Presidents: Major-General Sir Lewis Pelly, K.C.B., K.C.S.I., M.P., F.R.G.S., Capt. W. J. L. Wharton, R.N., F.R.G.S.; Secretaries: F. T. S. Houghton, J. S. Keltie, F.R.G.S., J. S. O'Halloran, F.R.G.S., E. G. Ravenstein, F.R.G.S. (Recorder). F. Economic Science and Statistics—President: John Biddulph Martin, F.S.S.; Vice-Presidents: G. W. Hastings, M.P., F.S.S., Sir R. Temple, Bart., G.C.S.I., M.P., F.R.G.S., F.S.S.; Secretaries: E. F. Barham, Rev. W. Cunningham (Recorder), Prof. Foxwell, F.S.S., J. F. Moss, F.R.G.S. G. Mechanical Science—President: Sir James N. Douglass, M.Inst.C.E.; Vice-Presidents: W. Anderson, M.Inst.C.E.; W. P. Marshall, M.Inst.C.E.; Secretaries: Conrad W. Cooke, J. Kenward, Assoc.Inst.C.E., E. Rigg (Recorder). H. Anthropology—President: Sir George Campbell, K.C.S.I., M.P.; Vice-Presidents: Prof. W. Boyd Dawkins, F.R.S., Lieut.-Col. H. H. Godwin-Austen, F.R.S.; Secretaries: G. W. Bloxam, F.L.S. (Recorder); J. G. Garson, M.D., M.A.I., Walter Hurst, B.Sc., R. Saundby, M.D. The first General Meeting will be held on Wednesday, September 1, at 8 p.m. precisely, when the Right Hon. Sir Lyon Playfair, K.C.B., M.P., F.R.SS.L. and E., will resign the chair, and Principal Sir William Dawson, C.M.G., F.R.S., President-elect, will assume the Presidency, and deliver an address. On Thursday evening, September 2, at 8 p.m., a *soirée*; on Friday evening, September 3, at 8.30 p.m., a discourse on "The Sense of Hearing," by Prof. William Rutherford, F.R.S.; on Monday evening, September 6, at 8.30 p.m., a discourse on "Soap Bubbles," by A. W. Rücker, F.R.S.; on Tuesday evening, September 7, at 8 p.m., a *soirée*; on Wednesday, September 8, the concluding General Meeting will be held at 2.30 p.m.

THE first general meeting of the Congress of French scientific societies took place in the large hall of the Sorbonne on April 27 at noon. M. Bertrand, Director of the Archæological Museum of St. Germain was in the chair. For the first time a special section has been created for geography, of which M. Bouquet de la Grye is chairman. The section of sciences was presided over by M. Faye, and divided into several sub-sections. M. Lhoste presented a pointed cask, with the assistance of which he hopes to keep a balloon floating in the air for several days over the sea. M. Certes, President of the Zoological Society of France, explained the use of colouring matters for the histological and physiological exhibition of living animalcules. The meetings were concluded on Saturday, May 1, by an address by M. Goblet, the Minister of Public Instruction, in which he advocated the establishment of a secondary education from which Greek and Latin should be excluded, their place being filled by modern languages. A number of decorations were awarded to members of learned societies and academies. M. Berthelot was created "Grand Officier" of the Légion d'Honneur.

THE Department of Modern Ethnography in the British Museum being now arranged, the work of arranging the prehistoric section is being taken in hand by Mr. Franks. The three rooms immediately at the head of the western staircase, near the entrance, are devoted to this purpose. The collection will contain the Christy and Museum collections, which will be incorporated with each other, and also the Greenwell collection from British Barrows. The central room of the three will contain palæolithic objects from England and the rest of the world. The finds in the caves of the Dordogne will form an important and interesting part of these. These caves were excavated by the late Mr. Christy at his own expense, and the results added to his collection. The pictures were, at his wish, sent to France. The room on the left of the entrance contains Neolithic objects, arranged under the Stone and Bronze Ages, the objects from the various countries being arranged within the periods. Here Canon Greenwell's remarkable collection from the British Barrows (which will be maintained intact) will find a place. The special value of this collection is that the place and manner of finding of each individual object is known and recorded, and every circumstance connected with the discovery of each is known. The Barrows, from which the collection was made, are found mostly in Yorkshire, although other places are also represented. In the same room will also be placed the implements used in working flint quarries in prehistoric times, and other objects found there; there will also be some curious implements from countries where the Stone Age still exists, as it does, in a certain measure, in Madeira, Syria, and Iceland. The room on the right will be given up to iron objects, and those of an age which may be called semi-prehistoric, such as the Roman times in Britain.

A SUPERFICIAL examination of the ethnographical galleries in the British Museum shows that the American section is overcrowded. On the left are the American antiquities, which are of the greatest interest, but which do not seem to belong properly to ethnography at all, while the objects on the left, belonging to modern America, and which are certainly ethnographical, are crowded into a space which is quite insufficient. As much has been done as possible to arrange the objects, and there is no confusion, but it is quite impossible to examine the cases properly when they contain so much. Ancient Mexico, Peru, and New Granada crowd modern South, North-West, and Arctic America into a very small space. It is obvious that an attempt should be made to remove the American antiquities to some more suitable place, and to give up the whole of the gallery to American ethnography proper.

AFRICA does not seem so well represented in the Collection as it might be for a country which has sent its missionaries and travellers into every corner of the land. Two or three small South Sea Islands occupy about as much space as the continent of Africa. The only district well represented is that of the Upper Nile, the collection of Lupton Bey being specially noteworthy, as giving one a fair idea of the manufacturing industries of the people of these parts. South Africa is moderately well represented, and in a less degree northern West Africa. East Africa, Central Africa, and southern West Africa are all relegated to a small case and very poorly represented. A spear from one tribe lies beside a pipe or a dagger from another tribe a thousand miles distant. And yet in this enormous region there are tribes singularly expert as blacksmiths, potters, &c. No African tribe produces more beautiful spears than the Wa-Vira, more horridly barbed than those of Nyassa, or more remarkable than those of Maryema or of Masai-land; and yet good collections of all these are undoubtedly in the country. Owing to this meagre display the collection is not of much value for purposes of comparison or to illustrate the relative advancement of the various tribes in arts and manufactures, and yet in this respect there is as much difference between the most degraded of the tribes and the most civilised as there is between the latter and ourselves. The arrangement also leaves much to be desired. Articles manufactured by tribes totally distinct in race, degree of civilisation, and religion are thrown indiscriminately together. Take, for instance, northern West Africa. There one finds the fetishes, idols, and rudely-worked articles of the degraded and barbarous tribes of the Lower Niger figuring amongst the artistic and advanced productions of the Mohammedan and polished tribes of the Central Sudan, and nothing to indicate that they are not the work of one people. In the East African section, again, you find Somali weapons beside those of the Bantu tribes further south, such as the Wa-gogo. Some objects do not appear to be correctly named. Thus the backbone of a shield divested of the hide which it was intended to support now figures as a bow, a string having been stretched from point to point. The map to illustrate Africa is scarcely worthy of the British Museum. The Congo Basin is strikingly shown by an utter blank.

FROM the Royal Gardens, Kew, we have received a cheap, carefully arranged, and highly useful guide to Museum No. III. at that establishment, which is devoted chiefly to specimens of timber and other large articles unsuited for exhibition in the glazed cases of the other museum. Another extremely useful publication is a Route Map of the Royal Botanic Garden and Arboretum on a scale quite large enough to enable any visitor to find his way. The various sections of the gardens are clearly laid down, and on the back is an index to the various entrances, museums, houses, the arboretum, &c., corresponding to the sections in the map indicated by figures and letters.

A MICROSCOPICAL SOCIETY has been started in Glasgow with Dr. Dallinger as first President; over fifty members have been enrolled.

THE volcano of Smeru in Java is stated to be in eruption.

WE have received the first number of *The Indian Engineer*, published by Messrs. Newman and Co., Limited, Calcutta. This is a new publication, the object being to provide a representative organ for all branches of the Indian engineering profession, and to make it a creditable representative of the great engineering and scientific services of the country. The leading article appropriately gives a history of Indian engineering journalism. We are told that the first publication of the kind was made by the Corps of the Madras Engineers in the form of a series of papers, to provide a record of the experience of their members for future reference. Messrs. Newman and Co., twenty-eight years ago, followed this first attempt by publishing a paper called *The Engineers' Journal and Railway and Public Works Chronicle*. Since then several different papers have been issued with varying success. *The Indian Engineer* is nicely got up and well printed, and, to judge by the first number, will prove to be an interesting journal, containing as it does many very good articles on general Indian engineering, civil and mechanical. We trust it will receive general support, and in time become an acknowledged organ of the profession in India.

WE are pleased to see from the current number of the *Agricultural Students' Gazette* that the authorities of the Royal Agricultural College, Cirencester, have provided greater facilities for teaching the increasingly important branch of agriculture, dairy farming. A new working dairy has been erected and fitted with appliances of the most improved kinds. We notice also that further substantial accommodation has been made for out-students. The *Gazette* contains a description of the new buildings and an account of the College live stock; the dairy herd contains specimens of nine breeds, and the specimen flock of fifteen different breeds. An article by Mr. J. M. Muir-McKenzie, on cultivation in the Western Ghâts, gives a description of the prevalent method of cultivation in this part of the Bombay Presidency, by means of wood ash and *râb*; this style of native agriculture entails the destruction of much jungle and denudation of the hills to the detriment of the low lands; it raises various difficulties between the natives and the forest and other officials, and any attempt to grasp its scientific and economic bearings is worth careful attention.

UNDER the title of "Malvern Field Hand-book and Naturalist's Calendar," Mr. G. E. Mackie, Assistant Master in Malvern College, has published a little volume that will be useful both to residents and visitors. The Hand-book was originally begun for the use of the boys of the Malvern College Field Club, but has been much enlarged.

MR. THOMAS WARDLE, of Leek, has been to India to examine the cultivation of the silkworm (*Bombyx mori*) there, and the methods still in use of reeling the silk. Although the reputation of Bengal silk has gone down greatly during the last twenty-five years, yet microscopical examination satisfied him that the fibre of the Indian silk was quite equal to that of Italian, and that improvement in the machinery and method of reeling was all that was required. The length of thread, however, in each cocoon was very different, the Indian worm only spinning 150 metres, while the more highly-tended and selected Italian worm produced 650 metres. It is suggested that the Government should rear a limited quantity of cocoons, from which a careful selection of "seed" only shall be made, since much of the present inferior quality is traceable to want of discretion in the choice of breeding stock. A loss to the growers of 60 per cent. of their grubs through hot winds can be prevented by the use of mud huts instead of matted walls only. The profitableness of the business is shown by the fact that the zemindars have been able to exact the highest of all agricultural rents for land where the mulberry is grown for this purpose: more than twelve times the amount paid for land adjoining planted with rice. But they do not realise that such high rents are not practicable now silk is at only half its ordinary price.

MR. FORTESCUE, the Superintendent of the Reading Room in the British Museum, has just produced a catalogue which is new, as far as the Museum is concerned, in plan, and which will prove of the utmost benefit to all students, men of science included. It is a catalogue of all the works acquired during the years 1880-85 in all modern languages except Oriental, Hungarian, and Sclavonic, arranged according to subjects. At present the alphabetical system is that employed in the Museum Catalogue, and therefore, unless the student knows, or can ascertain, the name of his author, the Library and its Catalogue are of no use to him. With Mr. Fortescue's Catalogue one can tell at a glance what books have been published during the past five years in any given subject, or branch of a subject, in Europe, America, or the British Colonies. The work contains about 1000 pages, with from 50,000 to 60,000 entries. An analysis of one or two headings will best show the value of the Catalogue. To take "Chemistry," under the sub-head "General" we find, first, all important text-books, then elementary works, both grouped under the different languages; then follow Agricultural, Analytical, Arithmetical, Bibliography, Examination Papers, Inorganic, Medical (with cross-references to Materia Medica and Pharmacy), and, finally, Organic, with about 400 entries in all. This, of course, does not exhaust the subject, for under such heads as Acids, Alkalies, Alkaloids, and so on, throughout the book, we have also the titles of chemical publications. The subject Electricity is a remarkable one for the number of entries under it. They fill ten pages in double columns, and about half refer to the electric light. It is curious to notice, too, that fifty telegraph codes were published in the five years included in the Catalogue; these do not, of course, include the innumerable private and cypher codes.

A UNITED STATES digest of the Report of the British Commissioners on Technical Education by an eminent pioneer in the work has been issued as a Circular of Information by the Bureau of Education. In the writer's earlier days "apprenticeship was rapidly disappearing and home manufactures were giving place to large mills and factories, and yet the schools in which the young were to be specially fitted for their career in the new order of industries were in a large measure limited to the old in methods and principles"—and far too little has there been any alteration since! The British Commissioners' Report is reprinted and added on to the text of this Circular, but the latter is chiefly an account of the French, German, and Russian technical schools, to the latter of which the writer gives the palm of excellence. In these schools, however, a great deal more than teaching is done. In St. Petersburg material is handled in the most wholesale style, and in Moscow orders for specially difficult work are taken and executed. Valuable, however, as such trained ability may be where trained ability is scarce, it is not a solution of the problem before England and America, where the object is to teach every youth the principles which underlie his work. The average age of youths who enter such institutions is over seventeen, and the course extends over five or six years. The result of much of such training in the advanced manufacturing countries must naturally be, as in Germany already, an overflow of highly-trained polytechnic students seeking something above an intelligent mechanic's work. A specially complete set of schools for teaching the various trades at Chemnitz is described. In France the work of such schools in providing a substitute for the extinct apprenticeship system is so efficient that, it is said, "the effort to avoid teaching trades will not be very successful," and they are found already to revive drooping industries and to make new ones. A most important observation, if generally borne out, is that much of this technical work can be added to, not substituted for, ordinary school work.

WE learn from *Naturen* that a committee has been formed at Christiania to promote the long-projected establishment of a zoological garden in the Norwegian capital. The plan suggested by the promoters of the scheme is wisely adapted to the special collection of North European and Arctic animals, such as the Polar bear, reindeer, elk, and the numerous other members of the Cervus family to be found in high latitudes, while no attempt will be made to introduce animal forms belonging to tropical faunas, whose susceptibility to cold makes it difficult to maintain them in health even in zoological stations lying far south of Norway.

WE are sorry to learn that bad weather greatly interfered with the success of Herr Stejneger's explorations of the Behring Straits fauna and flora during his last summer's boating voyage. At the extremity of Komandor Bay he believes that he has identified the exact spot at which Behring and his unfortunate comrades were shipwrecked, and where he perished from the effects of exposure in the winter of 1741. Here Herr Stejneger found buried beneath the soil various relics of this memorable expedition, including a thin brass plate stamped with the Russian double eagle. The search for plants and insects was specially unsatisfactory, for the damp mildewed the few specimens collected, and ruined all the cases and herbaria, while it so thoroughly rusted every fragment of steel and iron that all the instruments intended for meteorological and other observations were made useless.

THE additions to the Zoological Society's Gardens during the past week include two Military Macaws (*Ara militaris*), a Red and Yellow Macaw (*Ara chloroptera*) from South America, presented by Mr. C. Clifton, F.Z.S.; two Ring Doves (*Columba palumbus*), British, presented by Lord Arthur Russell, M.P., F.Z.S.; a Jay (*Garrulus glandarius*), British, presented by Mr. R. Humphries; two Spanish Terrapins (*Clemmys leprosa*) from Spain, a Spotted Salamander (*Salamandra maculosa*), a Fire-bellied Toad (*Bombinator igneus*), six Axolotls (*Siredon mexicanus*) from Mexico, a Green Lizard (*Lacerta viridis*), European, presented by Mr. Alban Doran, F.R.C.S.; twenty Palmated Newts (*Molge palmata*) from Epping Forest, presented by Mr. G. A. Boulenger, F.Z.S.; a Collection of Sea Anemones, from British Seas, presented by Mr. W. L. Sclater, F.Z.S.; two Ring-tailed Lemurs (*Lemur catta*) from Madagascar, an Asiatic Wild Ass (*Equus onager* ♂) from India, deposited; a Ludio Monkey (*Cercopithecus ludio*) from West Africa, three Red-crested Finches (*Coryphosphingus cristatus*) from South America, two Rosy-faced Love-Birds (*Agapornis roseicollis*) from South Africa, a Shining Parrakeet (*Pyrrhulopsis splendens*) from Fiji Islands, a Vinaceous Amazon (*Chrysotis vinacea*), a —— Conure (*Conurus* ——) from Brazil, two Short-eared Owls (*Asio brachyotus*), a Magellanic Eagle Owl (*Bubo magellanica*), a Pudu Deer (*Pudu humilis* ♀) from Chili, purchased; a Hairy-eared

Rhinoceros (*Rhinoceros lasiotus* ♂) from India, two Punjaub Wild Sheep (*Ovis cycloceros*) from North-West India, received in exchange.

OUR ASTRONOMICAL COLUMN

THE INFLUENCE OF PHASE ON THE BRIGHTNESS OF THE MINOR PLANETS.—Dr. G. Müller gives an interesting discussion in the *Astronomische Nachrichten*, Nos. 2724-2725, of the variations in brightness of seven of the minor planets. The determinations of the magnitudes of these objects were made by means of a photometer, on Zollner's principle, attached either to the Steinheil telescope of the Potsdam Observatory, of aperture 135 mm. aperture, or to the Grubb equatorial of 207 mm. aperture. The result of these observations seems to show that there is a real connection between the phase of these planets and their apparent brightness, and that Lambert's law of phase brightness does not apply to them. Dr. Müller further divides the planets he has observed into two classes. In the first class, which embraces Vesta, Iris, Massilia, and Amphitrite, the changes in brightness are only perceptible as the planet approaches opposition; in the second, which contains Ceres, Pallas, and Irene, the changes in brightness seem to be co-extensive with the changes of phase. The planets of the first group thus correspond in their behaviour to the planet Mars, and Dr. Müller thinks we may fairly infer therefrom a similarity in their physical condition to that of the ruddy planet. The planets of the second class would appear, on the other hand, to give a light curve similar to that given by our moon, or rather perhaps by Mercury; it is therefore not improbable that they bear more resemblance in their physical constitution to that body.

COMET FABRY.—The following ephemeris by Dr. S. Oppenheim is taken from the *Astronomische Nachrichten*, No. 2722:—

For Berlin Midnight

1886	R.A. h. m. s.	Decl. ° ′	Log *r*	Log Δ	Brightness
May 3	5 1 16	7 33·1 S.	9·9351	9·2358	381·4
5	6 16 8	22 59·4	9·9617	9·4446	195·2
11	7 3 53	30 30·4	9·9877	9·5698	97·3
15	7 34 43	34 18·8	0·0130	9·6758	53·2
19	7 55 56	36 29 6	0·0373	9·7632	31·8
23	8 11 35	37 53·6	0·0606	9·8364	20·4
27	8 23 52	38 53·2	0·0828	9·8992	13·8
31	8 34 0	39 39·2 S.	0·1041	9·9528	9·8

The brightness on 1885 December 1 is taken as unity.

BARNARD'S COMET.—The following ephemeris by Dr. H. Oppenheim (*Astr. Nachr.*, No. 2714) is in continuation of that given in NATURE for April 1, p. 518:—

Ephemeris for Berlin Midnight

1886	R.A. h. m. s.	Decl. ° ′	Log *r*	Log Δ	Brightness
May 6	1 41 34	39 23·5 N.	9·6858	9·8894	155
10	1 50 59	36 42·5	9·7087	9·8125	199
14	2 8 29	31 42·6	9·7429	9·7266	253
18	2 35 41	23 16·9	9·7828	9·6374	318
22	3 13 3	10 16·3 N.	9·8242	9·5619	371
26	3 58 59	6 32·5 S.	9·8648	9·5291	359

The brightness on 1885 December 5 is taken as unity.

THE APPLICATION OF PHOTOGRAPHY TO ASTRONOMY.—In Appendix III. to the "Washington Observations for 1882," Prof. Harkness, U.S.N., commenting on the difficulty of preventing the solar rays from disturbing the adjustments of a meridian instrument employed in observing the sun, points out that photography seems to afford an escape from the difficulty. He suggests that a transit-circle might be so constructed that its eye-piece could be readily removed, and a sensitive photographic plate inserted just behind its wire system. Then with the eye-piece in position stars can be observed, and the instrumental constants determined in the usual way; while at noon a photographic plate can be inserted, and an instantaneous exposure will suffice to give an image of the sun with the transit and declination wires of the instrument imprinted upon it. The position of the sun's centre relatively to these wires having been measured, this, together with the instrumental constants, the circle-reading and the sidereal time of exposure will give an exact determination of the sun's right ascension and declination. As the instruments will be exposed to the sun's rays only for a few thousandths of a second, no disturbance of its constants can, Prof. Harkness thinks, arise from that cause; and the results, in his opinion, would probably be superior in accuracy to any hitherto obtained by the usual methods.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 MAY 9-15

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on May 9

Sun rises, 4h. 20m.; souths, 11h. 56m. 16·3s.; sets, 19h. 33m.: decl. on meridian, 17° 25′ N.: Sidereal Time at Sunset, 10h. 43m.

Moon (at First Quarter on May 11) rises, 9h. 12m.; souths, 16h. 58m.; sets, 0h. 36m.*; decl. on meridian, 16° 37′ N.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	3 46	10 19	16 52	5 51 N.
Venus	3 0	9 4	15 8	0 0
Mars	12 40	19 34	2 28*	9 52 N.
Jupiter	14 21	20 39	2 57*	2 50 N.
Saturn	7 1	15 13	23 25	22 50 N.

* Indicates that the setting is that of the following morning.

Occultation of Star by the Moon (visible at Greenwich)

May	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
15	θ Virginis	4½	2 42	3 36	93 309

May	h.	
13	16	Jupiter in conjunction with and 0° 25′ north of the Moon.

Variable Stars

Star	R.A. h. m.	Decl. ° ′			h. m.	
ζ Geminorum	6 57·4	20 44 N.	May	9,	21 30	*m*
			,,	14,	21 40	*M*
S Cancri	8 37·4	19 27 N.	,,	12,	22 56	*m*
R Ursæ Majoris	10 36·6	69 22 N.	,,	12,		*M*
δ Libræ	14 54·9	8 4 S.	,,	9,	2 30	*m*
U Coronæ	15 13·6	32 4 N.	,,	13,	21 17	*m*
R Draconis	16 32·4	67 3 N.	,,	10,		*m*
U Ophiuchi	17 10·8	1 20 N.	,,	10,	11 58	*m*
			and at intervals of		20 8	
X Sagittarii	17 40·4	27 47 S.	May	12,	2 20	*m*
			,,	15,	0 0	*M*
W Sagittarii	17 57·8	29 35 S.	,,	11,	2 30	*m*
R Lyræ	18 51·9	43 48 N.	,,	13,		*M*
T Aquarii	20 43·9	5 34 S.	,,	15,		*m*
δ Cephei	22 24·9	57 50 N.	,,	10,	21 30	*m*

M signifies maximum; *m* minimum.

Meteor Showers

Amongst the secondary radiants active at this time are the following:—From Lynx, R.A. 123°, Decl. 40° N.; near δ Libræ, R.A. 223°, Decl. 10° S.; from Delphinus, R.A. 304°, Decl. 7° N.; near ζ Cygni, R.A. 320°, Decl. 18° N.; near κ Andromedæ, R.A. 354°, Decl. 41° N.

BIOLOGICAL NOTES

THE HYMENOPTERA OF THE HAWAIIAN ISLANDS.—In the *Proceedings* of the Literary and Scientific Society of Manchester (vol. xxv. pp. 123-183) is a valuable contribution on the Hymenopterous insect-fauna of the Hawaiian Islands, by the Rev. T. Blackburn, B.A., who resided there for many years, with a short introduction and annotations by Mr. P. Cameron. Eighty-four species are catalogued or described, but Mr. Blackburn says he has taken over 100. The greater part of the species appear to be strictly autochthonous. Of the *Anthophila* (or bees) there are 14 species (excluding the introduced honey-bee), and it is curious that 10 of these belong to 1 genus—*Prosopis*. Of the *Fossores* there are 35 species, and here again there is a paucity of genera, for 19 are included in *Odynerus* and 11 in *Crabro*. Of *Heterogyna* (ants) are only 10 species; and about 25 species of the various parasitic and hyper-parasitic groups. No indication of any of the phytophagous forms occurs in the paper. Before Mr. Blackburn went to the Hawaiian Islands the insect-fauna was almost unknown, so far as what may be termed the more occult (and therefore the chief) portion of it. Most of what had hitherto been discovered resulted from the casual visits of entomologists (not always trained to the subject). In Coleoptera alone he discovered about 430 species, of which nearly four-fifths appear to be strictly endemic, which is certainly noteworthy in considering the fauna of an insular group of volcanic origin. The minority of more recent "introductions" look largely in the direction of Western North America, with a sprinkling of Polynesian or Australian forms. The Rev. Mr. Blackburn's Hawaiian discoveries in entomology have an important bearing on the selection of naturalists to accompany exploring and other expeditions. A trained observer knows where and how to look, even if in doubt as to what he may find, and is always rewarded by new discoveries. An untrained hand scampers over the country, and, with every desire to distinguish himself, comes back and complains of the barrenness of the land.

VEGETABLE PARASITES OF CODFISH.—Some years ago Prof. Farlow called attention to the presence of a red fungus which was destructive to the dried codfish of the American fisheries (NATURE, vol. xxiii. p. 543). Since then Dr. E. Bertherand has given an account of poisoning which had occurred among the French troops at Algiers, caused, it was believed, by eating dried codfish, which had a vermilion hue owing to the presence of a fungus described by M. Mégnin in the *Revue Mycologique* (vol. vi. p. 114) as *Coniothecium bertherandi*. Specimens of fish with the same colour were also met with at Bordeaux and Dieppe, these latter presumably from Newfoundland. It would appear probable that Mégnin's fungus is the same as that originally described by Farlow as *Clathrocystis roseo-persicina*, Cohn.[1] In addition to this species, however, Farlow has described another parasitic form on the cod, *Sarcina morrhuæ*, which name had to yield in priority to *S. litoralis* of Poulsen, found on mud near Copenhagen, and which has lately been recognised by Saccardo and Berlese as occurring on codfish from Algiers. These botanists seem to think the *Coniothecium bertherandi* identical with *Sarcina litoralis*, and this latter to be but a condition of *Beggiatoa roseo-persicina*; but although they are found in company Farlow sees no good reason to think they belong to the same species. It is curious the form should occur in regions so far apart as New England, Algiers, and salt-marsh mud in Denmark, and it suggests the idea that salt may be the means by which the disaster is spread. Still another species, called *Oidium morrhuæ* by Farlow, by forming small brown spots on the surface of the dried codfish injures its sale, and has been found not only in New England, but also at Algiers.—(W. G. Farlow, *Bull.* U.S. Fish Commission, i. p. 1, February 8, 1886.)

SUPERIMPOSED STAMENS.—Mr. Thomas Meehan suggests a new interpretation for the appearance of superimposed stamens. Stamens are by most, if not by all botanists, regarded as exogenous lateral outgrowths from a caulome, in which latter there has normally been an arrest in its axial development. Stamens, however, occasionally will spring from the inner base of petals, and Mr. Meehan would account for this by taking the petal as the analogue of a leaf on an elongated branch, and the stamen as the development of an axial bud to the petal. "Branching and articulated stamens are frequent in those families that have these organs springing as it were from an axial bud at the base of the petal, as in a diminution or suppressed secondary branch we might expect them to do." In illustration of this idea Mr. Meehan refers to the flowers of *Mahernia verticillata*, Cav., a well-known Byttneriaceous plant from the Cape of Good Hope. The genus is separated from Hermannia chiefly by a cup-shaped gland at the middle of the stamen. A comparison with the axial development of the inflorescence shows the stamen to be formed on precisely the same plan, Mr. Meehan thinks, as the biflowered peduncle. This latter is simply a diminutive branchlet; after forming one node the longitudinal development becomes nearly arrested, and there is a short pediceled flower, then the bud in the axil of the bracteolate leaflet pushes up and over this, giving rise to the longer-stalked flower. So in the development of the stamen, a bud arises in the axil of a petal, the common peduncle is represented by the filament, and the cup-like gland at the middle stands for the bracteole of the bipedicels. Here one of the flower-buds wholly disappears, the innermost becomes the upper part of the filament, the real node may be at the connective, and then the theoretical floral leaves proceed to form the anther. The incised bract is reduced to the fringed cup-like gland from which the stamen proper springs, and he concludes from a survey of the whole subject that in many cases superimposed stamens are the development of theoretical axial buds at the base of the petals, and not the result of an interposition of an extra whorl of leaves for which there seems no warrant in phyllotaxy. It will be seen that even on this explanation the true stamen is phyllomic; the fact that foliage leaves often have stipules ought not, in a consideration of this interesting subject, to be overlooked. Mr. Meehan's observations may throw some light on the herotaxy of the floral organs.—(*Proc. Acad. Nat. Sci.*, Philadelphia, 1886, p. 9).

[1] *Bacterium rubescens*, Lank.

STRUCTURE OF LINGULA PYRAMIDATA.—From a very important memoir on the structure of this species by Dr. H. G. Beyer, we condense the following. In 1870, when Mr. Dall was studying the species of Lingula, he separated those species which he found provided with raised fulcra for the attachment of certain muscles, forming a median septum or one or two divaricating septa on the other valve, and formed for them the genus Glottidia. All of the known species (four to six in number) are exclusively to be found in American waters, while not a single species of Lingula has been found to occur in America. While the true Lingulas are almost always attached to a fixed rock or stone, Glottidia attaches itself, if at all, only when adult, and usually to a very small pebble or bit of shell. As to the structure of the shell, the author confirms in great measure the observations of Gratiolet, but describes the cuticle as a thin homogeneous layer, and immediately beneath it, sometimes aggregated in clusters, sometimes arranged in linear series, and at other times again irregularly scattered, he found a series of little round bodies, staining with hæmatoxylin, homogeneous, and without nuclei; these are regarded as homologous if not analagous to the bodies occurring within the organic septa in the shell of the Testicardine Brachiopods. Immediately adjacent to the cuticle and this layer of bodies comes a broad layer of horny substance and internally a thin calcareous layer, and these horny and calcareous layers alternate with each other in a number varying with the age of the animal. Towards the periphery the cuticle and horny layer alone are found, and these join the supporting layer of the mantle margin. A very intimate structural relationship exists between the body-wall, the mantle, and the peduncle. It seems doubtful whether the structures described by Vogt, Owen, Hancock, and others as muscles are in reality muscular in character. All the true muscles are smooth muscle-fibres, but other so-called muscles seem to be rather mesenchymatous supporting substance, lacking contractility, but perhaps possessing elasticity. The author's observations on the vascular system confirm rather the views of Shipley, Schulgin, and Morse than those of Hancock, and no central propelling organ over the posterior slope of the stomach was on transverse sections found. The number and division of the nervous ganglia indicated by Hancock for Waldheimia seem to be the same in Lingula, though Hancock's views have lately been criticised by Van Bemmelen. Hancock's details as to the reproductive organs are in great measure confirmed. Three excellent plates of anatomical details accompany this memoir.—("Studies from the Biological Laboratory, Johns Hopkins University," vol. iii. No. 5, March 1886.)

THE CUCKOO.—In the note on the cuckoo in the Biological Notes of April 1 (p. 519, line 6 from bottom), *January* was inadvertently printed for *June*.

NOTE ON EARTHQUAKES IN CHINA[1]

I HAD prepared for presentation to the Seismological Society of Japan a tabulated account of earthquakes that have been recorded in Chinese annals for the past thirty-seven centuries, but it was destroyed by fire during a riot last winter, and with the paper were destroyed also the works from which the seismic facts were derived. Perhaps, however, some general remarks which those records suggest may not be devoid of value.

Nothing can be inferred anent the relative frequency and destructiveness of earthquakes in ancient and modern times from Chinese history; from the earliest recorded earthquakes of Mount Tai in Shantung 1831 B.C. to the commencement of the

[1] Communicated to the Seismological Society of Japan by D. J. Macgowan, M.D.

Han dynasty 200 B.C., only twelve are recorded; tradition and written archives noting those only that presented extraordinary features; a bald list merely mentioning a disturbance of the rivers of the I. and Lo Hanan, 1808 B.C.; Wei, Chin, and So in Shensi, 778 B.C.; the formation of long chasms in the loess, 345 and 206 B.C. From the Han period, notices of the phenomena of course increase, accompanied betimes with a few details relating mainly to loss of life, and the succour afforded to survivors. Geographically considered, earthquakes in China may be grouped as insular, littoral, and inland.

On the island of Formosa earthquakes are hardly less frequent than in Japan, while on Hainan they are comparatively of rare occurrence. These islands form a portion of the great volcanic chain that girdles the coast of Eastern Asia; the Chinese portion rises from the submarine plateau that overlooks the profound abyss of the Pacific Ocean.

Insular earthquakes affect the mainland but seldom, and to a slight extent, which is noteworthy from the proximity of Japan, the least stable portion of the earth's surface, which seemed inexplicable until Prof. Milne's statistics showed that a large majority of earthquakes in Japan originated beneath the Pacific.

The absence from Chinese and Korean annals of notices of earthquakes in that peninsula long inclined me to regard Korea as comparatively exempt from seismic action, and recently, I addressed Consul E. H. Parker, of H.B.M.'s service in that country, for information, who obtained from the prefect of Chemulpo a communication on the subject, the purport of which is, that earthquakes are so infrequent and harmless that records are not made of their occurrence. It is more than ten years since an earthquake was experienced in that kingdom, and on that occasion no one was injured, nor were buildings thrown down. No information is obtainable on the subject from Manchuria, where presumably earthquakes are uncommon: there is, however, a record of a volcanic eruption having occurred about a century ago in that portion of the empire.[1]

The only existing volcanic action on islands of this coast is on the north of Formosa, near Keelung, where three solfataras are in ceaseless ebullition, affording large supplies of sulphur, and emitting during earthquakes so much hydro-sulphuric gas as to occasion a degree of *malaise* to the residents, and to discolour the white paint of ships.[2]

Facts respecting Formosan earthquakes are so scanty that the following from a Chinese writer is worth citing. It relates to an earthquake that occurred in Northern Formosa in the fifth month of 1693. "During that month the earth shook without cessation. A tract of country in which three villages were situated caved in; the inhabitants, however, had time to escape." Three years after that submergence, the narrator, a mandarin, who was on his way to procure sulphur from the solfatara "could see in a lakelet, where the water was shallow, tops of bamboos and other trees of those villages. While near the solfatara he heard for a day and night noises that resembled a cataract precipitated from a lofty cliff; the sound seemed to be near and all about, but no evidence of the cause of the noise was discoverable. When, however, he arrived at the solfatara the mystery was explained, he there heard the same sounds like a rushing of subterranean waters."

Another active volcano is named in a Chinese account of Formosa. It is in Téngshan district in the southern portion of the island at Red Hill, near the Tanshin Creek, on a plateau. Probably it has not been in open action since Formosa was opened to trade, as it does not appear to be known to foreigners.

Formosan seismic action occasionally causes tremors to be felt on the mainland, which is due to the ordinary direction of earthquakes on that island, which are generally from south to north or the reverse. The Liuchiuan group is the centre of seismic force that does not appear to extend beyond those islands.

Submarine disturbances not unfrequently attend the insular earthquakes; the sea sometimes rises on the Formosan coast sixteen feet above the usual height. Independently of the terrene commotions of Formosa, its adjacent waters appear to be subject to submarine agitations occasioning what records of the mainland style "third" or supplementary tides; but these are of rare occurrence. The "tide-rips" that have attracted the attention of hydrographers are notable phenomena, but the following, from a local gazetteer, seems to indicate the existence of phenomena that cannot be referred to tidal action:—"Peculiar noises of the sea are sometimes heard which are commonly regarded as indicative of change of weather, sounds from the north foreboding rain, those from the south being followed by wind. Hissing noises are heard, at times they are low, at others loud; when low, they resemble the beating of a drum or the dropping of beans on that instrument; now, the sounds are near; anon, they are distant; stopping suddenly or continuing for hours. When the noise is loud, it is more noisy than the voices of a hundred thousand men, and the sea bubbles up; in very protracted cases the noises continue day and night for half a month; and when of short continuance the sound lasts three or four days. Coast landers err in supposing that these noises have connection with the weather. They are absent during rains and in drought, in winds and in calms. . . During the sounds, the sea is agitated by fearful billows and furious waves." If that extraordinary seething and roaring of the ocean were synchronous with earthquakes, the fact could not have escaped observation: indubitably that graphic description applies to submarine volcanic action; to which the submarine plateau of eastern Asia is subject, and to which also I attribute the supplementary tides of the adjacent coast. Some thirty years ago an island was thrown up by a submarine volcano on the south of Formosa; the pumice which is cast on the northern shores of that island is evidently a submarine production.[1]

As proximity to the belt of volcanic islands seldom disturbs the mainland of the northern littoral, so the adjacent coast of Southern China and Annam enjoy like exemption from insular throes: Chehkiang and Fuhkien are sometimes slightly visited by Formosan shocks, and even the Canton coast slightly, but Philippine earthquakes never affect Annam.

Earthquakes on the coast of China are frequent, but slight and harmless. Their harmlessness is evinced by the tall slender pagodas that adorn the hills and valleys, and they are generally very limited in area, with great diversity of direction, but a majority being from south-west to north-east.

The southern provinces of China, and yet more Indo-China, appear to be comparatively exempt from earth throes, which, however, may be due to lack of information from those regions, but there is evidently no seismic zone in tropical or sub-tropical eastern Asia such as exists in our mid-latitudes.

The tremors that are experienced in Chehkiang, Kiangsu, and coterminous regions to the west, are sometimes followed by the appearance on the ground of substances that in Chinese books are styled "white hairs." When I first called attention to records of that kind that are found in local gazetteers, I suggested that they might be crystals precipitated by gaseous emissions, such as were once reported as occurring after an earthquake in the south-west of the United States; from later descriptions of these "horsetail-like" substances I incline to the opinion that they are organic, perhaps mycillium.

In the summer of 1878 the vernacular press gave an account of the occurrence of the phenomena at Wusoh, a city on the grand canal, thirty miles north of Suchau. "At noon, June 12th of that year, shocks of an earthquake were experienced, which lasted several minutes (*Sin.* 'for the space of time taken in swallowing half a bowl of rice'); the motion was so great that sitting or standing was difficult, but no harm was done. Two days later at night there was a severer shock, after which, within and without the walls of the city, white hairs resembling a silvery beard, about three inches in length, were found, which boys pulled out of the ground, gathering handfulls in a short space of time." My list of Chinese earthquakes for the past two thousand years having been destroyed by fire I am unable to indicate the regions in which earthquakes were followed by the emission of "hairs," but my impression is that all, or nearly all, are alluvial valleys.

The chief foci of inland earthquakes are Yunnan, Szechuan, Shensi and Kansuh—and less frequently Shansi, Chihli, Shantung, and the central provinces, where they are more violent than in other portions of the empire, and frequently present continuous or protracted action, for example:—

A series of earthquakes occurred at Taiyuan, the capital of Shansi, in 1882, followed by shocks at brief intervals for a year. An earlier series occurred in the province of Chihli; the district

[1] Perhaps the following may be explained as a result of volcanic action far distant from Peking. In the month of June, 1465, during a gust of wind at the capital a sound was heard as of hail falling on the ground, when pellets the size of cherries were picked up. On breaking them open they emitted a sulphurous odour. The writer says he could not have regarded such a phenomenon as credible had he not himself witnessed it.

[2] "Head-dizziness" is said to be an occasional accompaniment of earthquakes on the mainland. Slight shocks that occurred at Weichang, November 3, 1885, are described in the *Shen-pau* as exhibiting that phenomenon.

[1] For accounts of the volcanic region of Northern Formosa see Taintor's "Imperial Maritime Customs Report, 1865," and Hancock, 1881.

city Chüchow suffered most, not a house remained standing, many lives were destroyed; frequent shocks occurred for a year after. The province of Szechuan is also liable to continuance of seismic throes, one of these commenced in the fourth month, 1462, and continued eleven months—there were in all 375 shocks.

In the loess formation of Northern China (discovered and described by Baron Richthofen) the land is not unfrequently riven by earthquakes forming long narrow chasms of unknown depth that gradually disappear on account of the vertical cleavage and unstratified nature of loess.

In the first decade of the fourth month, 1828, an earthquake caused a fissure over three miles in length, twenty to thirty feet broad, from which a vapour issued that proved fatal to many: people, animals, houses, and tombs were ingulfed. About two months later, during heavy rain, the chasm gradually filled up.

The chief earthquake region of China lies in a great seismic zone, which extends from near the gulf of Chihli to the shores of the Caspian—including Turkestan and the Aralo-Caspian depression. In Eastern Turkestan they present a periodic character (five per annum with remarkable regularity). Yet there are few portions of the world so far removed from active volcanoes. Recent Russian exploration has discovered that the supposed Tienshan volcano is merely a solfatara, or an ignited coal-field.

Observations of officers appointed by the Emperor Chienlung to examine the newly subjugated territory in reference to these "firefields," are several. They say: "Three days travel to the east of Okishu and to the south of the hill at Palikeh there are several firefields. The ground is of a red colour, and a number of variegated stones are piled upon each other in the neighbourhood; from the middle of which flames upward of a foot in height are emitted: they are alternately extinguished and lighted up, while the smell is so strong as to render a near approach to the place impossible. For a distance of about 100 *li* not a blade of grass, not an inch of wood, nor a drop of water can be seen. From the peculiar smell of the fire thus raised, it is imagined that the soil must be strongly impregnated with sulphur."

The same work represents earthquakes as so common in Eastern Turkestan and the desert, that to the inhabitants "they are not considered strong; four or five occur every year; even when violent, they merely cause the doors and windows to rattle, but on account of the firm and adherent character of the soil, and thick walls and light roofs in common use, the houses are never thrown down."

A recent English traveller[1] makes a similar statement respecting Mid-Asian earthquakes generally. At Tashkend they generally average five in a year, but so slight, as not to be noticed by anybody. In that part of the world earthquakes appear to be most frequent at the close season. In the western portion of the seismic zone, they are of greatest frequency and violence in mountain regions.

Anent the opinion of M. Perrey, that a maximum of earthquakes is coincident with the moon's perigee, I submit the following statistical fragment that escaped the loss referred to: it is partially confirmatory of Prof. Milne's observations, that cold weather furnishes the maximum of frequency.

Lists of 738 continental shocks:—

1st month	65	5th month	46	9th month	56
2nd ,,	82	6th ,,	63	10th ,,	43
3rd ,,	72	7th ,,	70	11th ,,	65
4th ,,	49	8th ,,	70	12th ,,	88

(The first day of the first month occurs about February 6th, or at the new moon which falls nearest to the point when the sun is in the fifteenth degree of Aquarius.) In their seismic records the Chinese seldom designate the day of the month (moon) when earthquakes occur. Yet a considerable number may be found. Seventy-two cases show twice as many in the first and second as in the third and fourth quarters of the moon's phrases: forty-eight in the former period, and twenty-four in the latter; of that number fifteen occurred at the syzygies. The 6th day shows the largest number, twelve. None took place on the 2nd, 5th, 13th and 14th; one occurred on each of the following, 4th, 7th, 17th, 20th, 22nd, 23rd, 24th, 28th, 29th. Hours are rarely given; so far as they go, they show that a large majority are nocturnal.

[1] Lansdell's "Russian Central Asia," 1885.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The following list of lectures and classes in Natural Science has been arranged for the summer term:—

Physics.—In the Clarendon Laboratory Prof. Clifton lectures on Instruments and Methods employed in the Study of Optics. Practical instruction in Physics is given by the Professor and by Messrs. J. Walker and A. L. Selby. At Christ Church, Mr. Baynes lectures on Electro-Kinematics and Dynamics, and has a class for practical instruction in Electric and Magnetic Measurements. At Balliol Mr. Dixon lectures on Elementary Electricity and Magnetism. At Trinity the new Millard Laboratory will be opened for instruction in Mechanical and Electrical Engineering under Mr. Frederick Smith.

Chemistry.—In the Chemical Department of the University Museum Dr. Odling lectures on Some Special Points in Organic Chemistry. Mr. Fisher and Dr. Watts continue their courses on Inorganic and Organic Chemistry respectively. Mr. W. R. Dunstan lectures on Organic and Pharmaceutical Chemistry. Practical instruction is given in the laboratories by Messrs. Fisher, Watts, Baker, and Marsh. At Christ Church Mr. Vernon Harcourt has a class for Quantitative Analysis, and Mr. Dixon for Gas Analysis.

Animal Morphology.—In the Morphological Department Prof. Westwood lectures on the Haustellated Orders of Winged Arthropodous Animals. Prof. Moseley lectures on the Mammalia, Mr. Baldwin Spencer on Embryology, and Mr. J. B. Thompson on the Osteology, Distribution, and Odontography of Birds and Mammals. Practical instruction is given by Prof. Moseley and by Messrs. Robertson and Spencer. In Human Anatomy Mr. A. Thomson lectures on the Vascular and Respiratory Systems, and gives demonstrations on Topographical Anatomy. Daily instruction is also given in Practical Anatomy.

Physiology.—In the Physiological Department Prof. Burdon Sanderson lectures on the Chemical Processes of the Animal Body, and on Elementary Physiology. Mr. Dixey lectures on Histological Methods. Practical instruction is given daily.

Botany.—At the Botanic Garden Prof. Balfour lectures and gives practical instruction in Vegetable Morphology and Physiology. Prof. Gilbert gives four lectures on Rural Economy.

Anthropology.—Dr. Tylor lectures on the Origins of Civilisation.

Geology.—Prof. Prestwich lectures on the Secondary and Tertiary Series as illustrated by the geology of the neighbourhood of Oxford. Each lecture is followed by a geological excursion.

CAMBRIDGE.—The Special Board for Biology and Geology have recommended the following grants from the Worts Fund:

(1) 50*l.* to Mr. W. Bateson, of St. John's College, to assist him in investigations into the fauna of lakes in the neighbourhood of the Sea of Aral in 1886, and an additional 50*l.* if he continues his investigations into the summer of 1887. Mr. Bateson's investigations into the development of Balanoglossus in the Southern United States have, it is well known, been of great value.

(2) 60*l.* to Mr. A. C. Seward, of St. John's College, to assist him in studying and collecting fossil plants in Belgium and France.

(3) 35*l.* to Mr. Hans Gadow, of King's College, to assist him in exploring the ossiferous caves of Portugal, which he has already partly explored during two former visits. Prof. Boyd Dawkins strongly recommends the continuance of these explorations.

(4) 25*l.* to Mr. C. Potter, of Peterhouse, to assist him in elucidating the life-history of the alga parasitic on the water-tortoise in Portugal.

In the list of lectures issued by the Board of Physics and Chemistry for the present term we note that Dr. Ruhemann, assistant to the Jacksonian Professor, will lecture on Gas Analysis, and also on the Aromatic Bodies. The other chemical courses repeat the usual advanced and elementary courses.

In Advanced Mathematics Mr. Forsyth lectures on Thermodynamics, Mr. Glaisher on Theory of Errors, Mr. Webb on Dynamics of a System. The latter course will be continued during the Long Vacation, when also Prof. Darwin will lecture on the Theory of Attractions, Potential, and Figure of the Earth.

In Geology Prof. Hughes lectures on Stratigraphy and Cambridge Geology, Mr. Marr on Advanced Palæontology, especially the Graptolites, Mr. Harker on Microscopic Petrology.

In Botany Dr. Vines is lecturing on the Cryptogams; Mr. F. Darwin on Physiology, and Mr. Potter on Advanced Systematic Botany.

In Zoology, Mr. Sedgwick continues the courses of Elementary Biology, and the Anatomy and Embryology of the Vertebrata; Mr. Gadow gives a summary Course on the Palæontology of the Vertebrata.

In Physiology, beside Prof. Foster's Elementary Course, we have advanced lectures by Dr. Gaskell, Dr. Hill, and Mr. Langley.

Prof. Macalister lectures on the Variations in the Skeletal, Muscular, and Nervous Systems of the Races of Mankind.

The Special Board for Physics and Chemistry report to the Vice-Chancellor on the new Mechanical Science Tripos:—

In consequence, the report states, of the Grace passed March 11, 1886, confirming their report, dated December 14, 1885, the Board have drawn up regulations for the New Tripos in Engineering, Physics, and Chemistry, for which they would propose the name "Mechanical Science Tripos." They do not think it desirable that the University should examine in subjects for which the University does not or may not easily provide adequate teaching, and have therefore made the examination in Engineering mainly an Examination in Mechanical Engineering. They have included, however, in it such elementary portions of Civil Engineering as can be taught in Cambridge and such as may often be advantageously studied by those who are intending to become Mechanical Engineers. With respect to the Engineering papers in Part II. of the Examination one paper would test the ability of the candidates to indicate how a given design should be carried into execution; another would include questions on steam and the steam-engine besides other prime movers, and also on boilers and furnaces; a third would include questions on bridges, roofs, arches, abutments, elementary hydraulics, strength of materials, and elementary building construction. In the Examination in Physics in Part II. the papers would contain questions on the application of dynamics to physical phenomena; gravitation; attractions; hydrostatics and hydrodynamics; properties of matter, including elasticity, capillarity, diffusion, and viscosity; heat; kinetic theory of gases; radiation; light, including the application of the undulatory theory to the problems of geometrical optics; mineralogical physics; acoustics; meteorology; cosmical physics; electricity and magnetism; reduction of observations. The Practical Examination would extend over two days, the Examination on the first day being of such a nature as would test the knowledge of the candidates in the general methods of laboratory work; on the second day a list of experiments would be given, one or more of which each candidate would be expected to complete.

SCIENTIFIC SERIALS

Bulletins de la Société d'Anthropologie de Paris, tome 8eme, 4me fascic., 1885.—On the facial and cranial muscles of a young gorilla, by M. Chudzinski. The subject of this post-mortem examination, a young male, was 98 centimetres in height. The muscles of the head and face were the same in number as in the human species, but in form and dimensions they exhibited certain differences, being combined into a single fleshy mass, which covered most of the face.—M. Pozzi laid before the Society various anatomical characteristics with reference to the comparative constitution of the muscles of the Negro and the white races.—M. Folley drew attention to the greater anastomosis of the subcutaneous abdominal veins of the Negro, and the importance of this peculiarity in giving to the organism a greater power of resisting the action of rapid variations of atmospheric or aqueous pressures.—On the common origin of Malays and Vedahs, by M. Beauregard.—On the universal language of F. Sudre, by M. Gajewski. The basis of the system proposed fifty years ago by M. Sudre is the musical nomenclature of the vocal notes, *do*, *re*, &c., and from these he elaborated a language which claims to be equally capable of expression by means of musical instruments and the voice. The defects and impracticabilities of Sudre's proposed musical language were considered at length by MM. Kerckhoffs, Dally, and Dehoux.—Suggestions for the modification of Broca's method of determining the direct absolute cranial capacity, by M. Topinard. The points chiefly insisted on are the different results yielded by fresh, and often-used, lead, the latter being valueless after 100 cubage determinations.—On the cause and nature of the vitrification observed in tumuli, and other ancient structures, by M. Manouvrier.—Report of the recent Anthropological Exposition at Buda-Pesth, by Dr. R. Blanchard.—On the dimensions and location of the dolmens of St. Nectaire, by Dr. Verrier.—History and anthropology, by Dr. Fauvelle. The writer draws attention to the tissue of errors which works intended for the instruction of the young continue to promulgate, as exemplified in the current historical explanations of the origin and usages of earlier races.—On the Gallic habitation of Mané Gohenne, Carnac, by M. Gaillard. The finds, which consisted principally of flints and pottery, included a string of twenty-three green serpentine beads cut into various forms.—On certain unique objects shaped like fishes, found in the Mammoth Cave in Varsovia, by M. Zawisza, and supposed to have been employed as fetishes by sorcerers.—On the significance of certain strongly marked impressions on the inner surface of a skull, by M. Manouvrier. Such impressions have been regarded as an evidence of imperfection in the cerebral convolutions, and of consequent mental deficiency.—On man of the age of Palæolithic pottery in the Lozère district, by MM. Martel and L. de Launay. The local finds attest the co-existence there of man and the cave-bear, and the fabrication of pottery at the time.—On the flint implements of Croix Fringant, near Cognac, by M. Germain.—On the calcareous islets of Taled Sah, in the inner sea of the Samsans, in the Malayan peninsula, and the natives who dwell in natural caverns and are engaged in collecting edible swallow-nests, by M. Macey.—On the displacement of the brain in accordance with the different attitudes assumed by the body, by M. Bonnard.—On the form of the hand and figure of Asiatics, by Dr. Mugnier.—Anthropometric and other observations of three Australians now being exhibited in Paris, by M. Topinard.—On the development of the cranium in the gorilla, by M. Deniker. It is found that, while the frontal region is developed, like other parts of the cranium, as rapidly in the gorilla as in man from the middle of fœtal life to the eruption of the milk molars, different relations supervene after the latter period, the cranial development of the gorilla becoming much more strongly marked in the posterior and inferior than in the anterior regions. At the same time the upper maxillary rapidly acquires its characteristic prognathic form. An almost equal degree of prognathism is observable in the adult Negro, or Australian, and in the infant gorilla, but with its growth the latter acquires a facial angle which is smaller than that of any human cranium.—Ethnographic observations on the cerebral function, by M. Fauvelle.—On a case of an hermaphrodite, by M. A. de Mortillet.—Notes on the post-mortem appearances of an imbecile, by MM. Doutrebente and Manouvrier.—Report, by M. Letourneau, on the Godard Prize Essay of M. de la Calle (1885) on the earliest attempt at speech in infants. M. de la Calle attempts to draw a parallel between the first enunciation of the vowel-sounds *a*, *e*, *o* by infants, and the monosyllabic character of certain languages belonging to various peoples of the far east of Asia, which have scarcely yet entered upon the more advanced stage of lingual agglutination.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 15.—"Dynamo-Electric Machines." By John Hopkinson, D.Sc., F.R.S., and Edward Hopkinson, D.Sc.

Omitting the inductive effects of the current in the armature itself, all the properties of a dynamo-machine are most conveniently deduced from a statement of the relation between the magnetic field and the magnetising force required to produce that field. This relation given, it is easy to deduce what the result will be in all employments of the machine, also the result of varying the winding of the machine in armature or magnets. The magnetic field may be expressed algebraically as a function of the magnetising force, or more conveniently by a curve (*Proceedings* of the Institution of Mechanical Engineers, April 1879, p. 246). Amongst the empirical formulæ which have been proposed to express the electromotive force of dynamo-machines in terms of the currents around the magnets, we may mention that known as Fröhlich's, where $E = \frac{ac}{1 + bc}$, E being the electromotive force of the machine at a given speed, c the exciting current, and a and b constants. For some machines this hyperbola is said to express observed results fairly accurately. In our experience it does not sufficiently approximate to a straight line in the part of the curve near the origin, and gives too high results for large values of c.

One purpose of the present investigation is to give an approximately complete construction of the characteristic curve of a dynamo of given form from the ordinary laws of electromagnetism and the known properties of iron. Let n be the number of convolutions on the magnets, c the current round the magnets, l_1 the mean length of the lines of force in the iron of the armature, A_1 the area of section of iron in the armature, l_2 the distance from iron of armature to iron of pole pieces, A_2 the area of the magnetic field in which the wires move corrected for its extension round the edge of the pole pieces, l_3 the total length of the magnet cores, A_3 the area of the magnet cores, l_4 the mean length of lines of force in the yoke connecting the magnet limbs in machines of the type on which we have principally experimented, A_4 the area of section of the yoke, l_5 the mean length of the lines of force in each pole piece, A_5 the main area of section of pole piece, I the total induction through the armature when no current passes in the armature, and νI the total induction in the magnet cores; and, finally, let the relation between the magnetic force (α) and induction (a) (*vide* Thomson, "Electrostatics and Magnetism," p. 397, and Maxwell, "Treatise on Electricity and Magnetism," vol. ii. p. 24) be represented by the equation $\alpha = f(a)$, then the characteristic curve is—

$$4\pi nc = l_1 f\left(\frac{I}{A_1}\right) + 2l_2\frac{I}{A_2} + l_3 f\left(\frac{\nu I}{A_3}\right) + l_4 f\left(\frac{\nu I}{A_4}\right) + 2l_5 f\left(\frac{I_5}{A_5}\right).$$

If the relation between α and a be given in the form of a curve, this formula indicates at once a perfectly simple graphical construction for the characteristic. Taking the curve of magnetisation determined by one of us for wrought iron, and constructing a characteristic in this way, we have obtained a theoretical curve which agrees over a long range with the actual results of observation on a dynamo-machine more closely than any empirical formula with which we are acquainted.

To determine ν, a wire was taken once round the middle of one magnet and connected to a ballistic galvanometer, a known current was then either suddenly passed round the magnets or short-circuited, the elongation of the galvanometer being noted. A similar observation was made with the same current, the galvanometer being connected to a single convolution of the armature in the plane of commutation. The ratio of the two elongations is the value of ν.

The distribution of the waste field $(\nu - 1)$I was roughly ascertained in a similar manner.

The currents in the fixed coils round the magnets are not the only magnetising forces applied in a dynamo-machine. The currents in the moving coils of the armature have also their effect upon the resultant field. In well-constructed machines the effect of the latter is reduced to a minimum, but it can be by no means neglected. This introduces a second independent variable, viz. C, the current in the armature. The effect of the current in the armature depends upon the lead given to the brushes. Denote this by λ, which we may also regard as an independent variable, as it is subject to arbitrary adjustment.

If $I = F(4\pi nc)$ be the characteristic curve when no current passes through the armature, then

$$I + \frac{\nu - 1}{\nu} 4\lambda m C \frac{A_2}{l_2} = F\left(4\pi nc - \frac{4\lambda m C}{\nu}\right),$$

where m is the number of convolutions in the armature. Here we omit the comparatively unimportant portion of the magnetic force in the core of the armature and the pole pieces. From this formula it is not difficult to deduce a geometrical construction for the characteristic surface (*vide* "Practical Applications of Electricity," lectures delivered at the Institute of Civil Engineers, 1882–83, p. 98). The equation may be thus expressed in words, if λ be such that the coils at commutation embrace the whole or nearly the whole induction. The effect of the current in the armature upon the difference of potential between the brushes of any machine, is the same as that of an addition to the resistance of the armature proportional to the lead of the brushes, and to the ratio of the waste field to the total field, combined with that of taking the main current $\frac{m\lambda}{\nu n}$ times round the magnets in a direction opposite to the current c. Many consequences can be deduced, of which we may notice the following:—In a series-wound dynamo C is equal to c, and if c be increased beyond a certain point, I must attain a maximum and then diminish; this has been frequently observed. We now see that it depends upon the existence of a waste field. Secondly, let the coils of the magnets be entirely disconnected, and let λ be the negative; if the armature be short-circuited through a small resistance and be run at a sufficient speed, a large current may be produced in the armature. This latter deduction we have verified by direct experiment.

The efficiency of the type of dynamo-machine upon which the experiments before indicated have been made, has been accurately determined by the device of coupling two similar machines, both mechanically and electrically, so that one should act as a generator of electricity, driving the other electrically, whilst the latter acted as a motor driving the former mechanically; the loss of power required to keep the whole combination in movement being determined by direct dynamometric measurement, and the power passing electrically from the one machine to the other being measured by ordinary electrical appliances.

The whole of the experiments were carried out at the works of Messrs. Mather and Platt, to whom we are indebted for the exceptional opportunities we have enjoyed of putting theoretical conclusions to the test of experiment on an engineering scale.

Zoological Society, April 20.—Prof. W. H. Flower, F.R.S., President, in the chair.—Mr. O. Salvin, F.R.S., exhibited a living specimen of a foreign worm (*Bipalium kewense*), found in a garden in Sussex.—The Secretary read an extract from a letter addressed by Mr. R. A. Sterndale, F.Z.S., to Sir Victor Brooke, concerning a case of hybridism between *Ovis hodgsoni* and *O. vignei*.—Mr. J. Bland Sutton, F.Z.S., read a paper in which he gave an account of some of the investigations he had made during the past twelve months into the diseases affecting the mammals living in the Society's Collection.—A communication was read from Dr. O. Finsch, C.M.Z.S., describing a new species of wild pig from New Guinea, which he proposed to call *Sus niger*.—Mr. Smith Woodward read a paper on the relations of the mandibular and hyoid arches in a Cretaceous shark (*Hybodus dubrisiensis*, Mackie).—A communication was read from Prof. R. Collett, of Christiania, C.M.Z.S., containing an account of the hybrid between the willow-grouse (*Lagopus albus*) and the black grouse (*Tetrao tetrix*), which occurs occasionally in Norway, Sweden, and Northern Russia, and of which the author had examined altogether thirteen specimens, most of them of the male sex.—Mr. G. A. Boulenger, F.Z.S., gave the description of a new Iguanoid lizard living in the Society's Gardens, for which he proposed the name of *Ctenosaura erythromelas*. The exact locality was unknown.—A second paper by Mr. Boulenger contained remarks on specimens of a scarce European frog (*Rana arvalis*) exhibited in the Society's Menagerie.

Royal Meteorological Society, April 21.—Mr. W. Ellis, F.R.A.S., President, in the chair.—Mr. L. J. Petre and Mr. G. B. Wetherall were elected Fellows of the Society.—The following papers were read:—The climate of Killarney, by the Ven. Archdeacon Wynne, M.A., F.R.Met.Soc. The climate is determined partly by its geographical position, and it has the benefit of proximity to the south-west coast, with all the modifying influence of the Gulf Stream. The temperature, however, is locally modified, and a decided difference is found to exist between that of Valencia and of Killarney. The author shows that Killarney is colder than many other places in Ireland, and this he attributes to the fact that it is in a great irregular basin surrounded by mountain ranges for about a third, and by hilly ranges elevated some hundreds of feet above the lakes on most of the remaining two-thirds of the circle.—Note on the probability of weather sequence, by Lieut.-Col. C. K. Brooke, F.R.Met.Soc.—Account of the cyclone of June 3, 1885, in the Arabian Sea, by Capt. M. T. Moss. The author, who was in command of the s.s. *Inchulva*, while on a passage to Bombay had, when near Aden, the misfortune to encounter a most furious storm on the above date. This storm, which was apparently not of very large dimensions, was exceedingly severe, and was accompanied by an immense wave which caused several fine steamers to founder.—Results of solar radiation observations in the neighbourhood of Birmingham, 1874–84, by Rupert T. Smith, F.R.Met.Soc.—Results of meteorological observations made in the Malay Native State of Selangor during 1884, by A. W. Sinclair, L.R.C.P. These observations were taken at four stations, viz. Kwala Lumpor, Klang, Kajang, and Kwala Langat. The mean temperature of the district is about 80°, and the rainfall about 90 inches.

Dublin

University Experimental Science Association, March 16.—The following communications were made:—Prof. J. E. Reynolds, on action of silicon tetrabromide on thiocarbamide. —Mr. H. L. Crosthwait, the Forth Bridge.—On the melting-points of minerals, by J. Joly, B.E. An account of experiments with the meldometer, in which the temperature of the platinum strip, acting as the stage of a microscope, was determined in terms of its resistance according to Siemens's formula. It was mentioned that the order of fusibility assumed in Van Kobel's scale is erroneous. The true order seems to be: (1) stibnite; (2) natrolite; (3) adularia; (4) actinolite; (5) bronzite; (6) almandine. The blowpipe being a powerful chemical agent, may evidently mask the phenomena of fusion with secondary effects. Fair comparison is impossible with it, the shape and conductivity of the specimen used affecting the result. Comparison on the meldometer is not open to these objections. It is very advisable that a scientific scale of fusibility should be adopted for the use of mineralogists. If this scale rested on the melting points of easily-prepared salts, it would then always be easy to determine by comparison the melting-point of a mineral. Approximate determinations could thus be readily effected on very minute quantities of matter. In the author's experiments the substances are reduced to a fine powder, the phenomena attending fusion being observed with a 1″ object-glass. These phenomena are often very characteristic and beautiful.

Paris

Academy of Sciences, April 27.—M. E. Blanchard in the chair.—On the quantitative analysis of the organic carbon contained in soils which absorb free nitrogen, by M. Berthelot. The author's researches on the direct absorption of free nitrogen by various argillaceous soils through certain minute organisms have led him to seek some other measure capable of indicating the proportion of these organisms in the ground. It being apparently impossible to isolate them, some idea of their abundance may still be formed by a quantitative analysis of the carbon entering into the constitution of their tissues. Hence the present inquiry, which promises to raise some new and extremely delicate problems.—Observations relative to the proportion and quantitative analysis of the ammonia present in the ground, by MM. Berthelot and André. The experiments conducted during the last four years by the authors at Meudon on the general growth of vegetation and on the formation of nitric compounds, both in plants and in the soil, have led to certain observations here communicated on the processes employed in the quantitative analysis of the ammonia and the starchy compounds. It is inferred generally that the analysis of the ammonia present in the soil should be made without any desiccation, and that arable ground, when watered, tends continually to liberate the ammonia of the ammoniacal salts contained in it.—On the nitric substances contained in rain-water, by MM. Berthelot and André. A process is explained for determining by analysis the exact quantity of nitric substances conveyed to the earth by meteoric waters.—On the movements of meteorites in the atmosphere, by M. Faye. These remarks are made in connection with M. Daubrée's essay on "Meteorites and the Constitution of the Terrestrial Globe," recently presented to the Academy by the author.—Discourse pronounced at Montdidier on the occasion of the celebration of the Parmentier centenary, by M. Chatin.—Note on the meteorological observations made at the Montpellier School of Agriculture since last summer with the registering actinometer, by M. A. Crova. The results already obtained for the variations of solar radiation in summer require to be modified for the autumn and winter seasons. In autumn the oscillations diminish in amplitude, the two maxima of heat intensity tending continually to approach each other and gradually merge together about noon in winter. —Note on M. Lœwy's formulas for the reduction of the circumpolar stars, by M. Gruey. A process, at once simple and easily remembered, is given for establishing all M. Lœwy's formulas without any sacrifice of accuracy.—Remarks on the appearance of Fabry's comet in April 1886, by M. G. Rayet. The comet, observed at Bordeaux on April 7, 13, and 21, exhibited a very long continuous spectrum from the extreme red to the violet, corresponding with the light of the nucleus and of the three ordinary bands of cometary spectra.—Note on the equilibrium of a fluid mass in rotation, by M. H. Poincaré. Some explanations are offered in connection with M. Matthiessen's note inserted in the *Comptes rendus* for April 12.—On the magnetic rotatory power of the crystalline bodies, by M. Chauvin. Iceland spar and some other birefractive crystals, supposed by Faraday and others to be inactive, are shown to possess the property of magnetic rotation.—Action of alcoholic potassa on urea, sulpho-urea, and some substituted ureas; inverse reaction of the artificial urea prepared by Wöhler's process, by M. Alb. Haller.—Note on two properties of the urethanes of the fatty series, by M. G. Arth.—On the abnormal secretion of nitric substances in yeast and mould, by MM. U. Gayon and E. Dubourg.—Remarks on *Polystigma fulvum*, Tulasne, a new disease of the almond-tree, by M. Maxime Cornu.—Propagation of the luminous sensation to the non-excited zones of the retina, by M. Aug. Charpentier. From his optical experiments the author concludes that, in the phenomenon of successive luminous induction, the nervous action which gives rise to the sensation is really transmitted to the parts of the percipient medium lying near the excited part. —An attempt at a physiological explanation of the phenomenon of complementary colours, by the late M. Trève.—Heliophotography and the magnetic perturbation of March 30, 1886, by M. Ch. V. Zenger.—Observation of an aurora borealis at Rolleville, Seine Inférieure, coincident with the magnetic perturbation of March 30, by the Abbé Maze.

Berlin

Physical Society, February 19.—Dr. Pernet reported on the part he had taken in the labours of the International Commission which had for their object the comparative determination of the normal metre. After recounting in a brief historical survey the undertakings carried out in Paris at the end of last century by an International Congress, which, after theoretically determining on the kilogramme and the metre as normal units, produced a normal metre and normal kilogramme of platinum, the speaker discussed the events which in 1878 led to a new international agreement, in consequence of which a new normal metre of platinum-iridium of X-form was prepared and compared with the metre of the Archives. A series of national standards was also compared with the normal metre. The speaker described in a searching manner the arrangements of the Bureau in which the comparisons were undertaken, the contrivances for securing the several comparing rooms against outward disturbances, the means adopted for insuring constant temperatures, and the methods employed in the comparisons, as also in the determination of the expansion coefficients of the rods used. Finally he gave a sketch of his own labours, which had for their object the comparison of a series of normal metre rods of different metals with the metre of the Archives, and the determination whether repeated heatings and coolings between 50° and 0° C., whether concussions, and whether time caused any perceptible changes in the lengths of the rods. As the result of these investigations it was found that the compared national standards, together with their divisions, were exact up to one-thousandth of a millimetre; that, with the exception of steel, which, on account of its changes in hardness, readily yielded modifications of volume and length in the rods made of this material, all the metals out of which the standards were made—namely, platinum-iridium, platinum, and brass—furnished material suitable for normal metre rods; and that repeated heatings and concussions induced no changes passing beyond the limits within which observation fails.—Herr C. Baur described experiments he had made with water-jets, which, issuing from a conically-pointed tube in parabolic curves, were acted upon by certain musical tones so that at some distance from the mouth of the tube they showed a rotation, and that the jet, though broken up into drops behind the apex of the parabola, contracted into a continuous jet. The thinner was the jet the higher must be the tone towards which it was sensitive; the thicker the jet the deeper the tone. Herr Baur had instituted further experiments with water-jets, which he caused to fall on plates. Under certain circumstances there thus arose quite pure tones, which continued as long as the jet hit on the plate. The experiments succeeded best with a Weissmann apparatus, when the jet issued under a pressure of 10 cm. water from a lateral opening of 4 mm. in diameter without tube. Thin window-glass plates and metal plates, which, resting on pedestals, had free movement of vibration, were best suited as receiving-plates. The tone was most certain of occurrence when the node lines of the plates were supported. In the jet itself appeared nodes and ventral segments at some distance from the opening; they were most distinct and regular at its middle; away in the direction of the plates they again became indistinct. If the metal plate and the water acidified beforehand were connected with a galvanic cell and a telephone, then no interruptions of the current could be recognised during the time of the sounding. The contact of the water-jet with the plate must necessarily therefore be continuous. Herr Baur deemed this mode of excitation very well adapted to the purpose of studying the vibrations of plates. In the discussion following this address it was pointed out from various sides that more than twenty years ago Prof. Tyndall and after him Magnus had instituted experiments respecting the action of tones on water-jets, and that Prof. Tyndall had at the time shown his experiments to the Physical Society in Berlin.

Physiological Society, March 12.—Dr. Gad reported on the experiments he had made on the subject of hæmorrhagic dyspnœa which he had referred to in his last address. If by opening a cannula inserted into the aorta a large supply of blood were taken from an animal, dog or rabbit, then dyspnœa at once ensued, and that in the form of increased inspirations, such as showed themselves in all cases of dyspnœa induced by insufficient conduction of oxygen to the respiratory centre. These heightened inspirations proceeded side by side with a conspicuous sinking of the blood-pressure, and were denominated by the speaker "pneumatorectic" respirations. This respiration was distinguished from normal respiration by regular deep inspirations of unchanged frequency, inspirations in which the middle attitude of the thorax removed farther from the expiratory than was the case in normal respiration. The curve of respiration either then passed over into the normal, or convulsions set in, in which case the blood-pressure rose and the respiratory curve grew altogether irregular. After repeated heavy discharges of blood, the pneumatorectic passed into the "syncoptic" respiration, which was characterised by deep inspirations of very infrequent occurrence, during which the attitude of the thorax after expiration approximated ever nearer to that which it held in a dead body, till the last breath, and so the death of the animal, occurred. These two kinds of respiration, the pneumatorectic and the syncoptic, were perfectly regular and typical; the former showed itself immediately after a heavy discharge of blood, the latter before death. Between these two extreme forms there passed a series of others in an inter-current manner. Of these there was first to be mentioned a very frequent superficial respiration, which was inadequate to the necessities of the organism, and had the name "hypokinetic" applied to it. If the animal recovered out of this stage, the hypokinetic passed into the pneumatorectic and the normal respiration, otherwise it was followed by the syncoptic respiration and death. The transitional process from the hypokinetic into the pneumatorectic respiration might be experimentally brought about in a perfectly regular manner by the injection into the venous system of warm physiological solution of common salts. With the increase of the blood-pressure the alteration in the form of respiration at once asserted itself, the respiration becoming sufficient. Even at the stage of syncoptic respiration a transition into the pneumatorectic respiration might occasionally, though not always, be induced by injection of solution of common salt, and in that way the life of the animal be rescued. Another form of respiration following heavy bleeding was that which showed itself in periodical increasings of the amplitudes in respiratory movements. These and diminishings of amplitudes ran parallel to the Traube-Hering periodical oscillations of the curves of blood-pressure, though with displacement of the phases. The periodical oscillations in the amplitude of respiration referred to formed a transition to the Cheyne-Stokes phenomenon. The speaker recounted the explanations of the Cheyne-Stokes respiration, and took sides with the older theory, according to which it was to be conceived as a rhythmus of activity on the part of the central organs having periods of a higher order than had the simple rhythmus of respiration. In conclusion Dr. Gad drew from his physiological experiences a series of practical consequences having respect especially to the suitability of transfusions of common salt after heavy bleedings, particularly at the stage of hypokinetic respiration.—Prof. Zuntz spoke of the nature of the stimulations regulating the normal respiratory movements. The every-day experience that increased muscular activity produced an increased respiratory activity, dyspnœa, had suggested simultaneously to the speaker and to Dr. Geppert the idea of investigating whether the gases of the blood, which were universally assumed to be the sole stimulations of respiration, were adequate to the explanation of this dyspnœa. The experiments respecting which the speaker delivered a report were instituted in common. From the carotid artery of an animal habituated to regular work—a draught dog—were taken quantities of blood which sufficed for the purpose of analysing the gases of the blood. The quantities of blood referred to were taken on one occasion while the dog was in a state of rest, lying comfortably at his ease in his cage; or on another occasion while the dog was at work pulling a loaded car in his usual manner. By an ingenious contrivance, which the speaker described, the discharge of blood was rendered possible without the dog noticing anything of the matter. In a similar manner, by special apparatus, without molesting the dog in any way, they were enabled to measure the quantity of the air breathed in a given time, and to take away small quantities of the exhaled air to be subjected to analysis. The examination of the blood-gases showed that the arterial blood during work contained less carbonic acid and more oxygen than it did during a state of rest. During work the blood contained about 39 per cent. CO_2, and in a state of rest about 40 per cent.; the amount of oxygen, on the other hand, was about 18 per cent. during work, and about 12 per cent. in time of rest. The respiratory activity was, however, during work considerably increased. The quantity of exhaled air during work increased to threefold that exhaled in time of rest, and, corresponding with the increased respiratory activity, the air exhaled during work showed a less increase of CO_2 and a smaller loss of oxygen than in time of rest. The increased respiration during work could not now be caused by the blood-gases, seeing that the contents of the arterial blood in CO_2 were less, and in oxygen considerably more, than during a state of rest. Another stimulus must accordingly act on the central organs of respiration during work. It was possible to imagine that, along with the voluntary excitation of the muscles of the body during work, the respiratory muscles might likewise be stimulated, or that from the corporeal muscles contracting themselves during work a stimulus proceeded reflexively exciting the respiratory centres. The following experiment, however, was against both of these possible assumptions. The spinal marrow of an animal was intersected at the top of the thoracic vertebra, and the paralysed lower extremities tetanised while the anterior part of the body remained at rest. Notwithstanding, however, that all nervous connection between the working muscles and the respiratory centre was cut off, the dyspnœa of work still ensued, and disappeared when the tetanus ceased. From this fact the speaker drew the inference that in the active muscle some product or other was generated which arrived with the blood at the respiratory centre and excited it. The accuracy of this conclusion was further confirmed by the following experiment. The abdominal aorta of the animal with intersected spinal marrow was, during the tetanus of the posterior extremities, strongly compressed through the abdominal integuments. The respiration now continued unchangedly normal, nor did any dyspnœa ensue so long as the compression lasted. Dyspnœa showed itself, however, the moment the compression was removed. Even when the aorta was left free after the tetanus was ended, increased respiration still occurred. The speaker conceived therefore he had conclusively established that a substance, still unknown, forming itself during the muscular activity, proceeded with the blood to the respiratory centre and excited it. He conjectured that, in other active organs as well, such an efficient substance developed itself as respiratory stimulus, a substance which operated along with the gases of the blood even in the normal respiration. In the discussion following this address, Prof. Zuntz mentioned that Dr. Lehmann had made some experiments respecting the effect of acids on the respiratory centre, and had found that the acids excited this centre. This excitation was of course not powerful enough to justify the conclusion that the acid produced during the muscular contraction was the respiratory stimulus in the dyspnœa of work.

Meteorological Society, April 6.—Prof. von Bezold, the newly appointed Director of the Meteorological Institute in Prussia, which is to be reorganised, explained the principles in accordance with which the reorganisation in question would be undertaken. He first gave a short survey of the history of meteorological observations, setting forth how, first, the disciples of Galileo in the Academia del Cimento made use of the newly invented instruments for the observation of temperatures and atmospheric pressure; how, next, as early as the beginning of the eighteenth century, several investigators of nature had arrived at the knowledge that meteorological observations of any comprehensiveness could be successfully instituted only through the association of a considerable number of observers; and how, more than a hundred years ago, the Societas Palatina in Mannheim had organised an extended network of stations of observation, at which observations were instituted with instruments of the same construction, according to the same plan, and at the same times, and were collected at the central office, and published in a manner which would be deemed exemplary even if issued at the present time. This work was prosecuted till the French Revolution put a termination to it. In Prussia the suggestion of a meteorological institute was made by Alexander von Humboldt, and was crowned with success only in 1847, when, on Humboldt's proposal, Mahlmann was made the first Director of the Meteorological Institute, which was connected with the Statistical Bureau. In 1849 Dove succeeded Mahlmann as Director of the Institute, and held the post till his death in 1879. Meanwhile, however, the necessity of a complete transformation of the Meteorological Institute came to be recognised. Formerly, simple average values for the different stations were calculated, and for these no special stress was laid on the single observation, in consideration that mistakes balanced one another. Now, however, when it was a question of preparing synoptic maps and of obtaining exact maps of the meteorological conditions prevailing at a determinate time over a large area, the value attached to the single observation was a much higher one, and it was of the greatest importance that all the data should be as free from error as possible. It would accordingly be the first task of the Institute to provide all stations of the second and third order with good instruments, carefully to see they are maintained in good order, and to collect the materials of observation. The network of stations of observation would have to be completed and equally distributed, and there were about 200 stations of the second and third order, besides some thousands of subordinate stations, in contemplation. The subordinate stations should be equipped with rain-gauges, and make observations on precipitation, thunderstorms, and such like. A second problem of the Institute was the exact determination of the course of the meteorological elements for the day, the month, and the year, by uninterruptedly continuous observations not only of the climatic factors—temperature, atmospheric pressure, moisture, &c.—but also of the phenomena of the earth's magnetism and electricity. This work would be done by the Observatory, which was completely separated from the Meteorological Institute. The Observatory, under a special direction, was transferred to Potsdam to the Astro-physical Observatory. Two similar Observatories of the first rank, one in Breslau, perhaps, and one in Bonn—at all events, in University towns wide apart from each other—were in contemplation. While the Observatory prosecuted its observations in the quiet of Potsdam, the Meteorological Institute should have its seat in the midst of Berlin, in the edifice of what was formerly the Building Academy, and continue in connection with the lively intercourse of the capital. Irrespective of the service for weather warnings to be introduced perhaps at a later date, which would require to be in proximity to the head telegraph office, the central position should be readily accessible to the different observers who came from the provinces to the capital. The Institute, moreover, should be easily available for all students of science and experts who were in need of meteorological data: such, for example, as agriculturists, physicians, persons engaged in hydraulic labours, &c. The Meteorological Institute should, finally, have as its main function that of being a teaching institute for the scientific training of meteorologists. Its function in this respect should not be merely confined to lectures at the University, but should especially consist of practical work done, under the guidance of assistants, by students and young observers in the Meteorological Institute, similar to what is carried on in chemical, physical, and other laboratories. With this programme in hand, the new Director hoped very soon to bring the Meteorological Institute to the degree of efficiency attained by similar institutes in neighbouring countries, and particularly by the teaching thus imparted to cultivate a new field fruitful of good results for science.—Dr. Weinstein, with reference to his paper recently read to the Society, made some further communications respecting disturbances of the earth's currents which had occurred on January 9 and March 30. On March 30 the disturbances were so great that in the course of the forenoon telegraphic communication in Germany was stopped. Even with currents of 60 Daniells no signs could be forwarded by the telegraph wires. The magnetic elements in Wilhelmshaven showed great simultaneous disturbances, and from the direction of these magnetic disturbances it was inferred that the disturbances of the earth's electricity were the primary, the oscillations of the earth's magnetism the secondary.—In connection with these observations of Dr. Weinstein, Prof. Spörer stated that from March 26 to April 4 a very remarkable and numerous group of spots had been observed on the sun. On March 30 Dr. Less had observed squalls, accompanied with remarkable oscillations of temperature and of atmospheric pressure, and Dr. Assmann read several reports on North Light phenomena which had been perceived on March 30 in Eldena, Greiffenhagen, Magdeburg, and Nordhausen.—Dr. Weinstein further communicated that Prof. Förster had entered into an arrangement for having reports of disturbances observed in the earth's current at once forwarded to the Astronomical Observatory that the state of the sun might be simultaneously examined.

BOOKS AND PAMPHLETS RECEIVED

"Journal of the Statistical Society," March (Stanford).—"Earthquakes and other Earth Movements," by John Milne (K. Paul).—"Transactions of the Institution of Engineers and Shipbuilders in Scotland," 1885–86 (Glasgow).—"The Forest Flora of South Australia," part 7, by J. E. Brown (Spiller, Adelaide).—"Jahrbuch der k.k. Geologischen Reichsanstalt," Band xxxvi. Heft 1 (Hölder, Wien).—"Archives Italiennes de Biologie," tome vii. fasc. 11 (Loescher).—"Sea-Weeds, Shells, and Fossils," by Peter Gray and B. B. Woodward (Sonnenschein).—"A Treatise on Nautical Astronomy," by J. Merrifield (S. Low).—"Birds of Cumberland," by H. A. Macpherson and W. Duckworth (Thurnam, Carlisle).—"Handbuch der Palæontologie," Abtheil. 1, Band 11, Leif. 5, "Myriopoda, Arachnoidea, und Insecta," by S. H. Scudder (Druck, München).—"Handbuch der Palæontologie," Abtheil. 11. "Palæophytologie," Leif. 4, "Coniferæ und Monocotylæ," by Dr. A. Schenk (Druck, München).—"Letters and Journal of W. Stanley Jevons" (Macmillan).—"Solid Geometry," 3rd edition, by P. Frost (Macmillan).—"Recherches sur l'Instabilité des Continents et du Niveau des Mers," by J. Girard (Leroux, Paris).—"Johann Kepler," by C. Anschutz (Prag).—"The Management of Athletics in Public Schools," by G. Fletcher (Lewis).

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