

These are, however, only the necessary key to what follows in the most interesting observations upon the first appearance of each familiar flower, the maiden song of each sweet warbler of the grove, the arrival of summer visitants, such as the swallow, swift, corn-crake, or cuckoo, and the emergence of insect, reptile, fish, or hibernating mammal from winter's sleep.

The student is provided with a series of 365 pages, fittingly and instructively introduced, one being devoted to every day in the year. Each page is numbered both prospectively and retrospectively, showing not only the number of days or pages from the beginning, but to the end. These pages are partly blank, and upon the left-hand side the reader is told what to look for in the vegetable or animal kingdom, what flower may be expected to raise its head, or, as the season advances, what fruit may be expected to ripen. We are almost all of us keenly alive to the interest of watching the unfolding season, and a book of this kind embodying information already obtained, and inviting the reader to record his own observations on the same points, must commend itself to a large class of persons. Take as an example p. 133, or the 133rd day of the year, May 13, and we find that we should on this day "look out" for the green hair-streaked butterfly, the light tussock and rivulet moths, and the egg of the lesser whitethroat; we may also look for the spindle-tree in flower and the common mallow, although somewhat before their usual times. The blossom of the white-thorn, which is always known as "May," has been seen at Marlborough on April 30, and again has not been seen till June 4, information which is thus succinctly set forth, "*Cratægus oxyacantha*, 120-155, Hawthorn, Whitethorn, May," the figures indicating the earliest and latest days of the year upon which this favourite flower has been known to bloom.

There appears, indeed, to be no limit to the kind of things which an earnest student of Nature might not pleasantly note as affording material for his *Naturalist's Diary*. And so wide is now the net thrown, and so extraordinary are the correlations of science, that no fact need be passed over as unworthy of notice. For example, we are told in the introduction that "closely connected with the subject of migration, and equally deserving of systematic observation, is the congregation or flocking of birds in the autumn and winter months, as it is probably correlated with hibernation of fishes and reptiles." So that watching the loves of doves, and packing of partridges, listening to the early soft cooings of pigeons, or the crow of the pheasant, chronicling the advent of the cuckoo, or of "sweet Philomel complaining," or listening to the first strains of that "rapture so divine" which the immortal Shelley ascribed to our most sustained songster—in each case we may by accuracy of observation add a drop to the ocean of facts slowly developing into universal knowledge. Such a task could not fail of being attractive. Possibly it may tend to dissipate the sweet and more dreamy influences which steal over us insensibly while experiencing the gradual unfolding of Nature—the feeling so tenderly expressed by Longfellow in his exquisite prelude to the "Voices of the Night"; but this awakening from the poetic dream appears to be the fate of communities as well as of individuals, and we must, we suppose, resign ourselves to it. It is the province of science

to ransack, to dissect, to arrange, to chronicle, and not to "babble o' green fields" only, as Dame Quickly said of poor Sir John Falstaff lying a-dying.

Downton, May 12

JOHN WRIGHTSON

OUR BOOK SHELF

Scientific Results of the Second Yarkand Mission, based upon the Collections and Notes of the late Dr. F. Stoliczka. "Araneida." By the Rev. O. P. Cambridge, M.A. (Published by order of the Government of India, Calcutta, 1885.)

WE have already on several occasions noticed the memoirs published by the Government of India on the collections made during this expedition to Yarkand. The spiders were placed in the very capable hands of the Rev. O. P. Cambridge for description. The collection cannot be considered as fairly representing the fauna of the extensive region traversed during the expedition, an area which Mr. Hume thinks might be subdivided into five well-marked regions, but which the author, judging from the collection of Araneida, conceives might have been well considered as but two: that is, (1) from Murree to Cashmere, including the latter as well as the former; and (2) the whole of the rest of the area travelled over by the Expedition, and comprising the neighbourhood of Leh, the route from Tantzé to Chagra and Pankong Valley, and from Yarkand to Bursi, as well as Yarkand and neighbourhood, Kashghar, the hills west of Yarkand, and the Pamir.

In the former of these more than half of the whole number of spiders were collected—69 out of 132. The leading character of these is European, with a few more distinctly tropical and sub-tropical species. The character of the latter region is also European, but with decided sub-Alpine features, and scarcely a trace of any even sub-tropical form; and of the 69 species met with in the former three only were found in the latter, and only one, *Drassus dispulsus*, occurred throughout.

Of the 132 species, 23 seem identical with European species already described, leaving the large proportion of 109 as apparently new to science. Even this number cannot be supposed to represent the new species in the fauna of this region. The season of the year was very much against the success of the collection, and the hands of the collector were very much engaged with other branches of natural history; and there can be no doubt that a large harvest awaits the explorer of the southern slopes of the mountain regions of Cashmere, where the tropical character of the forms will become more marked; and probably a still greater diversity in the species will be found in those from the more central regions of India. For comparison upon these points the author regrets that there exist no materials, for almost nothing has as yet been published about the spiders of tropical India.

Two quarto plates with 21 figures of the more important new species accompany this Report.

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.]

The Thomson Effect

I AM indebted to Dr. Everett for calling my attention to the confusion which has crept into § 193 of my book on "Heat." I had not noticed it; but, happily, it can easily be removed. Take to the end of the section the statement quoted by Dr.

Everett; and delete the word "Thus" in the sentence which, at present, (wrongly) follows instead of preceding it. This change is obviously called for by the context:—for the reader has just been told how far *theory* had guided Thomson as to certain "absorptions," &c., of heat; and, of course, expects next to be told what additional information, as to these "absorptions," &c., Thomson obtained by *experiment*.

Still, confused as it is, the passage could not (except possibly from the point of view of history) embarrass a reader of § 196; for the nature of the Thomson effect is there *again* clearly stated, and even illustrated by a diagram. [A much more serious case of confusion is to be found at p. 366, line 15; where (by the omission of a few words) my copyist has made absolute nonsense of a quotation from Clerk-Maxwell.]

The statement quoted by Dr. Everett obviously requires to be restricted, as follows:—

An electric current, passing from cold to hot in copper, behaves as a real fluid would do:—i.e. it tends to reduce the gradient of temperature. In iron, under the same circumstances, it tends to increase the gradient.

It is clear that this statement has nothing to do with the general nature of the Thomson effect:—i.e. "absorption" or "disengagement" of heat:—for this would depend upon the temperature of the fluid spoken of. It raises the question of the excess of Thomson effect in one locality, over that in another, at a lower mean temperature but with an equal gradient.

Dr. Everett seems to forget that, though the water-equivalent of a metal may be treated as sensibly constant through moderate ranges of temperature, the "specific heat of electricity" cannot so be treated. Using his notation, (with the proviso that θ is absolute temperature) we have $\sigma = k\theta$, and the equation he quotes from Thomson is

$$\frac{d\theta}{dt} = -\frac{k\theta}{c} \frac{d\theta}{dx}.$$

Happily, this can be integrated, so that we have

$$\theta = F\left(x - \frac{k}{c} t\theta\right). \dots \dots (1)$$

Now suppose the gradient of temperature to be uniform and positive along x positive (the direction of the unit current); when $t = 0$ we have

$$\theta = ex.$$

Generally, therefore,

$$\begin{aligned} \theta &= e\left(x - \frac{k}{c} t\theta\right), \\ &= \frac{ex}{1 + \frac{k}{c} et}. \end{aligned}$$

Thus the gradient becomes less steep:—i.e. there is a tendency to reduce temperature differences, when k is positive, as in copper. In iron, where k is negative, the tendency is to make the gradient steeper:—i.e. to exaggerate differences of temperature. Of course, as in all these thermo-electric matters, reversal of sign of the gradient reverses the thermal effect.

The general integral (1) denotes a process of continued *simple shearing*, not *translation*, of the "temperature curve." Were it not for heat-conduction, harmonic waves of temperature would tend to become *breakers*. But it is idle to speculate farther.

How much of this is Thomson's I don't certainly know; and I am for the present too busy to enquire. But it would be difficult to overestimate his services to Thermo-electricity.

This will, I hope, meet with Dr. Everett's approval. As to his letter, I would say (in Scottish legal phrase) "*Quoad ultra*," denied." P. G. TAIT

May 28

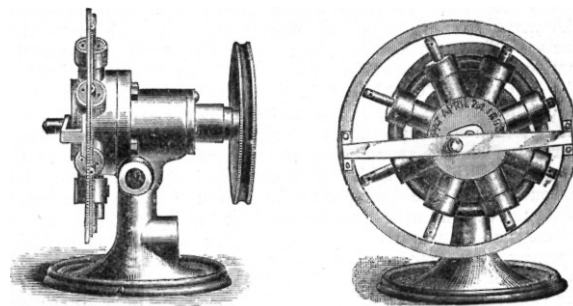
Power in Laboratories

IN connection with the admirable devices for the distribution of driving-power in laboratories, illustrated in NATURE, vol. xxxiii. p. 248, the description of a novel and very effective form of water-engine, with which I have been experimenting for several months, will be of interest.

One of these motors is set up in the cellar of our science hall, where it is supplied with aqueduct-pressure of sixty pounds to the square inch, and the power is transmitted from it by means of rubber belting led over "idle pulleys" to the upper stories of the building, where a small engine-lathe and dynamo are

driven. A word will suffice to explain the very simple construction of the motor—a system of radial cylinders, with their bases at the centre of the motor, through which runs the driving-shaft. The pistons in these cylinders are single-acting, and the water is admitted to them in succession by the rotary valve which forms part of the main shaft. The pistons, thus, in pressing outward, exert their force against a strong ring, to which is bolted a cross-bar which engages the crank of the main shaft. Thus the ring, in turning the shaft, has the vibratory motion of an eccentric, and returns the opposite pistons to the bases of the cylinders, at the same time exhausting the water through the interior of the rotary valve. Three pistons are thus constantly exerting a thrust upon the ring, whatever its position, and this thrust being always tangential to the arc of revolution of the crank, there is no "dead centre," and the uniform pressure at right angles to the crank at every part of its arc insures an even rotary motion and obviates the necessity of a balance-wheel. The ends of the piston-rods are slotted, and contain anti-friction rollers which bear against the ring, and this latter is grooved all round, so that, in addition to its simple and rapid motion as an eccentric, the ring is free to perform a slow motion of revolution independently of its work of driving the crank, and the wear of the interior face of the ring is thus equalised and becomes inappreciable.

The supply-pipe for this motor has a diameter of $1\frac{1}{2}$ inches, and it gives an equivalent of nearly 2 horse-power. The flow of water is regulated by means of a balanced valve, under control from every point where the power is used. As the use of the power is, for the most part, discontinuous, like that in lathe-work, I find it better to start and stop the motor as often as desired than to use the ordinary device of shifting a belt off and on a loose pulley. All possible economy of water is assured, as



Side View.

Front View.

none of it runs to waste without giving its equivalent of power at just the time when it is required. It will be seen that this form of motor is specially adapted to such uses, as there is no fly-wheel whose inertia has to be overcome; and as the motor has no "dead centre," it readily starts from any position, overcoming a maximum resistance.

Where continuous running is required, at an invariable speed, a centrifugal governor is attached to the belt-wheel, and acts upon the amplitude of vibration of the ring, diminishing the stroke of the pistons when the resistance is removed. The governor thus gauges the water-supply exactly proportional to the resistance to be overcome, and makes the motor a very effective driving-power for dynamos and all sorts of machines and apparatus in which a uniform speed is necessary, while the resistance is variable.

The difficulties barring the economic use of water as a motive-power, owing to its weight and incompressibility, seem to have been successfully overcome in this form of motor, with which unexampled speeds have been attained, and more than 80 per cent. of the theoretical power of the water derived. The little cut annexed shows the smallest size of these motors—it stands about 10 inches high, and uses a $\frac{1}{2}$ -inch supply, consuming less than six quarts of water in 100 revolutions. I frequently run it at a speed of 1000 revolutions to the minute, and at the manufactory I have seen the same motor attain double this velocity. The motor runs equally well with compressed air (or with steam, if the piston-packings are changed), and with either of these media even higher speeds are attainable.

I find that the constant readiness of the motor for the immediate development of power, the little care it has required (only occasional oiling), and its economical consumption of water, are