There is nothing more trying for a master's patience—and I speak from experience—than this persistent and short-sighted adherence to what has gone before, just as if the world (the agricultural world particularly) had to jog on to the end of time in the self-same fashion.

Whatever united action, therefore, may be taken by our leaders in science for bringing about a more healthy feeling on this subject, for scattering science and a love for it in every household, depend upon it the readiest and surest way will be to urge on Government to introduce, nay, force, the subject freely and universally into all schools, so that it may grow up with the rising generation, and become a part of their very existence. The task is Herculean, no doubt. An enormous amount of prejudice will have to be overcome, but

> Sedit, qui timuit ne non succederet; esto:
> Quid? qui pervenit fecitne viriliter?

Lectures on science will thus be not merely listened to as now, but understood and appreciated. Superstition, the child of Ignorance, will be dispelled, and a nation of reasoning and thinking men and women inaugurated as the glorious and inevitable consequence.

THOMAS FAWCETT

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Preponderance of West Winds

I HOPE you will publish this reply to Mr. Laughton's letter in NATURE of May 4, on the Prevalence of West Winds.

He maintains from statistical evidence that west winds occupy a greater portion of the earth's surface than east winds; that their force is greater; and that in the upper regions of the atmosphere the preponderance of west winds is still more decided than at the earth's surface; so that on the whole the atmosphere moves round the earth from west to east.

It is in my opinion certain that this is on the whole proved. I do not question Mr. Laughton's facts but his inferences from them. He thinks this rotation points to some force acting from without—some cosmical cause of a nature quite unlike the sun's heat. I maintain, on the contrary, that all the phenomena of the great atmospheric currents, of which the trade-winds are a part, are to be accounted for by the heat of the sun as the motive power, combined with the rotation of the earth as a modifying influence.

In discussing the question of whether the phenomena point to such a cause as that suggested by Mr. Laughton, the motion of the upper strata of the atmosphere is quite unimportant. It is only the currents at the surface of the earth that can in however infinitesimal a degree increase or diminish the velocity of the earth's rotation; and if the circulation of the atmosphere is due to the sun's heat as its motive power, it cannot have the slightest effect on the earth's rotation; while if it is due to any mechanical force acting from without, as Mr. Laughton thinks—if the Cartesian theory is true, and the circulation of our atmosphere is part of a cosmical vortex—the earth's rotation must be accelerated by its friction. This follows from the simplest dynamical principles. It is true that the acceleration which could be produced in such a way would at the greatest be far too small for us to detect; but it is quite possible for us to ascertain whether or not the currents of air that sweep over the surface of the earth are by their united action capable of affecting its rotation; or, to state the problem more definitely, whether or not the effect of west winds in accelerating the rotation is balanced by the effect of east winds in retarding it. I maintain that such evidence as we have tends to the conclusion that the effects of the two are so balanced.

The separate effect of any wind covering a given area on the earth's rotation = the east and west component of its force × the radius of the parallel of latitude. The latter factor gives leverage. An east wind near the equator has more effect in retarding the rotation of the earth than a west wind of equal extent and force at a higher latitude has in accelerating it, just as a weight at the end of the long arm of a lever outweighs an equal weight at the end of the short arm. Now, the east winds, under the name of trade-winds, are chiefly to be found in the lower latitudes, and for the reason just given they are able to balance the west winds, which are certainly more forcible, and according to Mr. Laughton, occupy a greater area, but being at higher latitudes act at a disadvantage. If it can be shown—and the facts certainly point to it—that the total mechanical effect of the winds is not such as to produce any effect on the earth's rotation, this goes very far to prove that they have no motive power except the sun's heat.

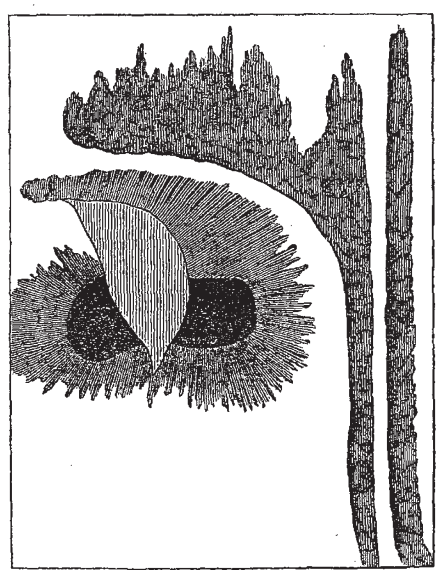
But how is the motion of the upper strata of the atmosphere from west to east to be accounted for? The answer to this will involve the entire theory of the great currents of atmospheric circulation. There is always a current of air towards a heated place along the earth's surface, like the draft towards a fire, and a compensating current of air away from it in the upper regions of the atmosphere. The equatorial latitudes being the hottest, there are currents to them from the higher latitudes, which bring with them the smaller velocity due to the rotation of the higher latitudes, and thus move less rapidly than the earth in those lower latitudes to which they flow. Moving with a less velocity than the earth is the same as moving from the east, and thus are the trade-winds constituted; they are from north-east in the northern hemisphere and from south-east in the southern. This is generally understood and believed; what follows is less generally understood, though I claim no originality for it.

The air rises up over the equatorial regions like a column of smoke over a fire, and flows off towards the poles. Coming from the latitudes where the velocity of the earth's rotation is greatest, it carries that greater velocity with it, and spends the energy of its motion in the form of the west winds of the higher latitudes. The reason, then, that the upper strata of the atmosphere (in all latitudes except on the equator) have a motion round the earth from west to east, is simply that they are at the same time moving from latitudes where the velocity of the earth's rotation is greater to latitudes where it is less.

JOSEPH JOHN MURPHY

Remarkable Sun-spots

THE accompanying sketch shows in a rough way the umbræ and a small portion of the penumbra of a sun spot that I observed on the 6th and 7th of this month, and which was made remarkable by the presence of a reddish-brown object like a cloud, that seemed to hang over the nucleus of the principal umbra, apparently dividing it in two. Could this object be seen without the intervention of the dark glass, it would doubtless show a bright red instead of a reddish-brown colour; and from its fog-like aspect, though it was well defined in outline and acuminated at both ends, the impression was inevitable that it hung at a certain altitude above the spot. However, it evi-



dently had no motion distinct from the latter, as on the 7th it occupied the same position as on the day before, but it was much reduced in size. On the 8th it was seen no longer, and the nucleus was now in one, seeming to show pretty clearly that its previous apparent division in two was really caused by the intervention of the brown cloud suspended over it, and that the phenomenon did not consist of two distinct neuclei with the brown object lying between them. I am not aware that anything like this was observed before.

J. BIRMINGHAM

Millbrook, Tuam, May 18