continuous upward or downward movement, but by a succession of small ellipses or by zig-zag lines—that is, by a circumnutating movement which is preponderant in some one direction. The climbing movement of plants like hops is simply an exaggeration of the primitive circumnutation of their modest youth. Tendrils, which are only modified leaves, sweep wide circles; whilst ordinary leaves usually circumnutate nearly in the same vertical plane. In like manner, flower stalks when converted into tendrils have their circumnutating powers greatly increased. The "sleep of plants" is a second class of circumnutating movements modified through external agencies. In this case the daily alternations of light and darkness are the cause of these extraordinary complex movements. It is not darkness itself which excites them, but the difference in the amount of light which they receive during the day and night; for with several species, if the leaves have not been brightly illuminated during the day they do not sleep at night. They also inherit some tendency to move at the proper periods, independently of any change in the amount of light.

What purpose is served by the "sleep" of the sorrel, the clover, the false acacia, and the numerous other species in which it has been noticed? Mr. Darwin proves, we think very clearly, that at least one of the uses is to prevent the plant being injured by cold during the night. For no matter how diversified may be the arrangement, the blade is always placed in such a position at night that its upper surface is exposed as little as possible to full radiation, and it has been proved that leaves exposed to a clear sky, with their blades compelled to remain horizontal, "suffered much more from the cold than others which were allowed to assume their proper vertical position." In some species the leaf-stems rise up greatly at night, and so bring the leaflets close together, thus ronflering the plant more compact, and leaving exposed a much smaller surface to radiation. "Heliotropism," or the movement of plants towards that side which is most brightly illuminated, is a kind of modified circumnutation. In some aërial plants, like various tree orchids, the roots show a desire to avoid the light, but this is comparatively rare. "Diaheliotropism," or the tendency which leaves have to extend during the day more or less transversely to the direction of the light, is also modified circumnutation. "From the fact of leaves and cotyledons (seed leaves) frequently rising a little in the evening, it appears as if Diaheliotropism had to conquer during the middle of the day a widely prevalent tendency to apogeotropism"—that is, a sensitiveness as to coming near the earth. Lastly, the leaflets of some plants, in order not to be injured by too much light, use the power of circumnutation in order to direct their edges towards the light when the sun shines too brightly on them. Some seedlings are so excessively sensitive to light that the seed-leaves of phalaris became curved towards a distant lamp, which emitted so little light that a pencil held vertically close to the plants did not cast any shadow which the eye could perceive on a white card. In brief, Mr. Darwin shows, in a manner so clear and attractive that the reader feels it would be ungrateful to question the accuracy of his conclusions, that circumnutation is concerned in almost every movement of the plant; and in the chapter on Heliotropism he demonstrates plainly that "apogeotropic and geotropic, and probably diageotropic, movements" are all modified forms of circumnutation. By modified circumnutation Mr. Darwin means that light, or alternations of light and darkness, gravitation, slight pressure, or other irritants, and certain innate or constitutional states of the plant, do not directly cause the movement; "they merely lead to a temporary increase or diminution of those spontaneous changes in the turgescence of the cells which are already in progress." But why a touch, slight pressure, or any other irritant, such as electricity, heat, or the absorption of animal matter, should modify the turgescence of the affected cells in such a manner as to cause movement the author confesses that he has not yet been able to ascertain.

Such, in a necessarily condensed form, are the main conclusions at which the great English naturalist writes in this remarkable and, even to a layman, most interesting volume. There is little in it bearing directly on the hypothesis with which Mr. Darwin's name is associated, and hence it may be read with equal pleasure by those who oppose and by those who favour his doctrines. As a model of sound, scientific work, of observations sagaciously devised and judiciously carried out, it has no superior. Nor are the literary powers displayed in the narration of the various experiments inferior to the scientific knowledge and acumen manifested in their origination. There is no dogmatism, no blinking the truth; for the master, unlike some of his pupils, does not love truth less than his theory. A thread of philosophy runs throughout the whole volume, and this is, that the distinction between the lowest animals like anemones, and plants is even less than we have hitherto supposed, and that the latter are physiologically—we shall not say psychologically—not much, if anything, inferior to the former. Circumnutation will never be as popular a word as "Natural Selection." Nor is the "Movements of Plants" capable of being classed with "The Origin of Species." But as one of the many appendices, amplifications, and sequences of that notorious work it will take a high place in the very first rank of Scientific Literature.

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MR. DARWIN ON WORMS.*

The celebrated author of the Darwinian theory is now in his seventy-third year, and might, without any imputation on his industry, accept some respite from his labours. Yet this interesting work is the second which he has published within twelve months, and in freshness, literary grace, and the other qualities which distinguish Mr. Darwin's minute observations, is inferior to none of its many predecessors. During a long lifetime wholly devoted to science, Mr. Darwin has made excursions into nearly every field of natural history, and from all of them has returned with booty ample enough to afford a wealth of reputation to any one less famous than the Squire of Down. Yet, unlike the majority of specialists, he has the power of almost immediately divesting himself of the surroundings of his studies, and, what is even rarer among those who spend their days and nights among the minutiæ of some little corner of knowledge, of arranging his various discoveries with almost unerring perspective in regard to those of other observers, even when those writers are his avowed opponents. The young naturalist who promulgated the theory of coral reefs seemed to have little in common with the geologist of the same name who, the year before, described so lucidly the Pampas of the Plata and the volcanic rocks of Ascension. Nor, unless we knew that both authors were identical, could we guess, from even the slightest allusion to their common work, that he who penned the charming treatise on the fertilisation of orchids is the same Charles Darwin who so many years before had compiled that laborious and perfectly unimaginative monograph in the Cirripedia. In like manner, the

* "The Formation of Vegetable Mould, through the Action of Worms, with Observations on Their Habits." By Charles Darwin, LL.D., F.R.S. With Illustrations. John Murray, 1881.

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