

Darwin shows that when young, every part of a plant is in constant motion, the movement being usually not in a true circle (or rather, circular-spiral), but in the form of a more or less narrow ellipse, the long axes of the successive figures not being continually in the same direction, but intersecting each other at various angles. To take a hypothetical case, assuming that the organ is leaning over so as to point to the east, it gradually alters its position, so that in a short time it is directed to the west; it does not, however, in doing so pursue a rectilinear course (when projected upon a plane), but a more or less pronounced curve by the south; it then returns to the east, but by a line curved to the north. According to the definition of the curvature follows the degree of narrowness of the resulting ellipse. With stems, as we have seen above, the figure may simulate a true circle; while with leaves it is usually very narrow, often approaching the straight line. This is the movement reduced to its simplest form, but as a rule it is more complex, for the apex, while pursuing this general course, goes out of its way, as it were, to travel in a zigzag, or produces small secondary loops, which may disguise the shape of the ellipse. The very numerous diagrams of movement given in the book show clearly enough that there is, however, always one general direction which predominates. Just as in speaking of the shape of a leaf, the lesser lobation or serration can be disregarded, so in judging of the movements of the parts of plants, such minor eccentricities can be overlooked. As for the cause of the movement, it was at one time the custom to ascribe it to increased growth in varying positions, but it now appears probable that the motion has more to do with the varying degree of turgidity in the plastic cells of which the young growing part is built up.

The volume commences with an account of the movements of the different parts of the seedling plant, and it is in these earlier chapters that the most wonderful and unexpected results are recorded. The movement commences even before the seedling has appeared above the surface of the ground. The radicle, or primary rootlet, the first part of the plant to be developed, is the first to manifest movement. This it does from the moment it is protruded from the seed-coat. Through the sensitiveness of its tip, it bends downwards (geotropism); during its elongation it continually bends to and fro, and thus, by displacing the particles of earth, its penetration is rendered more easy; and having once penetrated the soil, it is fixed, it may be by the root-hairs, or by some special and occasionally striking contrivance, and thus a "purchase" is obtained which materially assists the further penetration of the rootlet. The tip of the radicle then, like the thin end of a wedge, pierces between the particles of earth, always with its circumnutating power ready to be manifested if, from any cause, the pressure on its sides is removed. Thus it will pass rapidly through a friable soil, and, if it finds a fissure, such as a worm-burrow, it can readily avail itself of it. At the same time, as Mr. Darwin shows by numerous experiments, the tip is sensitive to the smallest differential pressure (e.g., one two-hundredth of a grain), turning away at once from the most pressed side, and will, therefore, bend from any obstacle, and, as the author pointedly puts it, "thus follow with unerring skill a line of least resistance." As Sachs had previously shown in general terms, the radicle is sensitive to the direction of moist air, and this sensitiveness also Darwin shows to reside in the tip; but, unlike the irritation of pressure or injury, moisture causes a deflection towards its source,—a happy provision, which gives rise to what one feels tempted to call an *instinctive* power of seeking the dampest parts of the soil. The functions thus resident in the tip of the radicle may be fairly described as wonderful, this brief sketch only referring to a few of their most noticeable manifestations. The tip, in this way determining the course of the root, also transmits its sensations to the neighbouring parts; so that, with characteristic boldness, Mr. Darwin compares it to the brain of one of the lower animals, "receiving impressions from the sense-organs, and directing the several movements."

More readily noticeable are the properties of the stem portion of the seedling plant. Almost invariably it breaks through the surface of the soil in the form of an arch, while in its case also there is a tendency to circumnutate, kept in check by the pressure of the soil until after its appearance above the surface of the ground. The faintest ray of light acting strongly upon it, and in a manner the reverse of its action on a root, will direct the young stem along any chance fissure in the surface of the

soil, or, if the plant be already somewhat grown, through vegetation amongst which it may be hidden. The plant now develops organs of various kinds, endowed with various degrees of movement, while the external forces which are acting upon them act in different ways and to varying extent. With these generalised or localised movements, of the nature of what Mr. Darwin calls "modified circumnutation," the author deals in the second part of the volume. Here we meet with many old friends, such, for example, as the sensitive plant (*Mimosa pudica*), which to the botanist occupies almost the same position as the frog to the animal physiologist. The various phenomena of climbing and sleep, and the different actions of light and gravity, are here treated of in full. The author shows that, while growing, every part of the plant, "each shoot, petiole, sub-petiole, and leaflet is constantly describing small ellipses," and the clearly visible movements of many organs are only an exaggeration or modification of their primitive circumnutation, directed to some special end. While reading these chapters, one feels that here at last is the true poetry of motion, and that another world of active life has been included within the ever-receding horizon of human knowledge.

The volume is copiously illustrated, chiefly with diagrams of movement. Owing to the process of drawing adopted, these diagrams do not represent the exact nature and amount of the movement of the part. They serve only, as the author reminds us, to show that the part has moved, and in what general manner. It would have been acceptable if, in some few representative cases, the exact character of the movement could have been represented diagrammatically by a projection. In the diagrams, as they stand, the greater the obliquity of the movement the greater the distortion of the representative figure. In examining them, in order to get an idea of the actual extent and character of the movement, the reader has to go through much the same sort of mental process that would be necessary to enable him to recognise his own features, when viewed as reflected from the back of the bowl of a table-spoon.

It is a constant complaint that modern scientific work is almost entirely destructive, but with Mr. Darwin destruction and construction go hand-in-hand. While none more than he has laboured strenuously to break down the barriers of ignorance and prejudice which, like the "Sea of Ancient Ice," fence around the still unconquered pole of the biologist, with equal zeal has he laboured to build up clearer and, we would fain say, truer conceptions of what, in its diverse manifestations, life is. Whether we look upon his works as models of legitimate deduction, or merely as marvellous storehouses of facts, their value is the same. And equally in laborious accumulation of detail, in lucid exposition of fact, in cogent deduction, and in candid impartiality, the future historian of vegetable physiology will reckon *The Power of Movement in Plants* as the foremost of Mr. Darwin's botanical works.

THE DUKE OF ARGYLL ON NATURE AND THE SUPERNATURAL.*

THE essay which the Duke of Argyll has contributed to the January number of the *Contemporary Review*, under the somewhat misleading title of "The Truthfulness of Human Knowledge," will be generally felt, we believe, to be the most interesting of his present series. We hasten to declare the title out of harmony, in our opinion, with the substance of the article, because it appears to us to suggest, quite untruly, a kind of discussion which would have very little value, and thus to deaden the reader's interest in what is well worthy of it. Before we can discuss the truthfulness of human knowledge, we must have some other kind of knowledge to compare it with, some independent acquaintance with the subject-matter of human knowledge by which we might test its value. We can provide no guarantee for the trustworthiness of the faculties which are all we have to work with. As Dr. Newman says, we do not so much trust as use them. Moreover, it does not appear to us that *knowledge* is the appropriate word for the faculty which the Duke means to defend. The ordinary use of language would surely keep that name for men's unquestioned beliefs, those at least on which there is a consensus of opinion among all educated persons. We cannot but regret that he did not confine himself to the profoundly luminous suggestion as to the *limitation* of human knowledge which we lately noticed (a suggestion we feel much strengthened by the present

* *Contemporary Review*, January, 1881.

line of reasoning), without entering on strictly metaphysical ground, where he seems to us much less at home. However, this line of criticism does not appear to us the most important one which is suggested by these valuable essays. They contain one confusion on which we have already adverted in our notice of the first of the series, and to which we must return—a certain hesitation between two irreconcilable meanings of the word "Nature"—but much of the present essay is unaffected by this confusion, and we would preface our attempt to clear it away, by a short summary of the argument which we consider that it confuses, and somewhat weakens.

The aim of the essay, it appears to us, is a protest against the theory of scientific men, in our day, "That there is no mind in Nature having any relation with, or similitude to, our own, and that our fancied recognitions of intellectual operations like our own in the order of the Universe are delusive imaginations." Against this theory the author brings the testimony of those very students of Nature who make it their starting-point. It is impossible, apparently, to describe the facts of nature without borrowing the language of design. "When, for example, we are told that flowers are constructed in a peculiar manner, *in order that* they may catch the proboscises of moths. . . . nothing more may be intended by the writer than the statement that all this elaborate mechanism does, as a matter of fact, attain this end. . . . But this use of language is none the less an acknowledgment of the truth that the facts of Nature are best explained to the understanding by stating them in terms of the relation which they obviously bear to the familiar operations of our own mind and spirit." Language would break down under the cumbrous paraphrase which we should be driven to use, if we refused to contemplate the phenomena of Nature through the window of remembered purposes. "Those who struggle hardest to avoid the language of anthropomorphism in the interpretations of Nature, are compelled to make use of the analogies of our own mental operations as the only possible exponents of what we see." Mr. Herbert Spencer, for instance, tells us that life is the continuous adjustment of internal relations to external relations, and the Duke's criticism seems to us perfectly just,—an *adjustment*, he says, is "a purely anthropomorphic conception, conveying the idea of that kind of co-ordination between different powers or *elements* which is the result of constructive purpose." An even better illustration of the anthropomorphism of science, we think, would have been found in a quotation from the same author which has already appeared in these columns, on our conception of Force. Our notion of force, Mr. Herbert Spencer tells us, is "a generalisation of those muscular sensations which we have when we are ourselves the producers of change in outward things." We are able to think of heat, sound, light, as events in the outer world separate from and unlike the sensations which we call by that name because we can express them in terms of force, but when we come to the very element of our physical notions this power quits us; we think of them as varied manifestations of force, while force itself we think of, and must so think, as the physical correlate of Will. The initial notion of physical science, therefore, is a mere loan from the world of spirit, and at every stage the obligation has to be renewed. Those who do their utmost to avoid this anthropomorphism on the other hand, and insist on translating all assertions coloured by it into the dialect of purely physical conceptions, surrender all that is characteristic in the facts which they describe, and introduce abstractions which are intelligible to us only so far as we have independent knowledge of the realities to which they refer. Thus, the arguments for the validity of this anthropomorphism may be derived from the language of those who set themselves most earnestly to oppose it. If we cannot intelligibly describe the phenomena of Nature except by assuming them to be the result of will, does it not seem more probable that they are the result of will? Can we suppose that we are driven, by the mere necessity of giving a simple account of things, to a view of them which is false?

The argument which we have endeavoured to summarise would lose more than half its force, if it were supposed to be original. As long as men of science, looking on the world of Nature, declare themselves to discern no traces of a ruling Mind, there is nothing for it but to bring forward, again and again, the proofs derived from their own language that the phenomena of Nature admit of no description, unless on the assumption of Mind somehow involved in producing them. If

the initial conception of Nature be unintelligible, except through our own consciousness of *effort*—if the elaborate processes by which the higher forms of Nature are produced be unintelligible, except through our own consciousness of *contrivance*—shall we not allow that Will and Purpose, that is, Effort and Contrivance, apart from the limitations with which they are associated in our experience of them, are really there? The argument admits of endless illustration. But while the denial which it has to meet remains unchanged, no alteration in its substance seems to us possible, and it is no censure on the essay before us, therefore, to say that its line of reasoning is, in outline, familiar to the reader. It would have little value for its purpose, if it were not so.

The reader's satisfaction, however, is continually disturbed by a sense of entanglement with issues, partly irrelevant, and partly, we cannot but think, hostile to the argument. Some part of this entanglement would appear the result of mere haste on the part of the writer. Surely it is by accident that he has, in a parenthesis, suggested the eternity of matter as a probable article of belief. It is a belief which has been held by some of the most devout and earnest of human thinkers, and many puzzling problems might be, perhaps, moved further off by its adoption; but even if it were so, we cannot see that it really concerns any question here followed out, and surely it was a pity to bring in so gigantic an interpolation unnecessarily, suggesting, as it does, views which we are certain the Duke does not hold. However, this is not the confusion on which we would now dwell. What we feel wanting to give distinctness and force to the argument throughout, is a clearer conception of the very meaning of the word "Nature." There is a continual hesitation between making Nature mean the sum of existence, and making it mean that linked series of phenomena, bound by laws of physical causation, which stops short of all will, and, therefore, of all personality. The signs of will appear to be sometimes confused with will itself. "We are all quite accustomed," the Duke says, "to think of man as not belonging to Nature at all, as the one thing or being which is contradistinguished from Nature. This is implied in the commonest use of language, as when we contrast the works of man with the works of Nature." Yet, if we have rightly understood the drift of a large part of these essays, that drift is to protest against this fundamental distinction, a protest apparently not put forth as an expression of individual opinion, but as an important link in the argument here unfolded. We believe, on the contrary, that the identification of Man with Nature which is here suggested is an interruption, not a link, in the chain of inference which would discover the unity of Nature in its relation to a central Will. And we cannot look upon this as a question of words. The use of Nature as a synonym for the whole of being seems to us no mere choice of inconvenient phraseology, but an obliteration of the most radical distinction with which the mind can come in contact, as well as that on which depends its power to recognise in the outward world a principle analogous to that by which its own works are produced. This power is inseparable from the contrast of the human and the natural world. To discern that anything is like the work of man, we must have a background to the work of man distinct from itself. What we saw everywhere, we could recognise nowhere. The Universe is a unique phenomenon; we cannot generalise concerning its production, except so far as we trace in it the resemblance to other works familiar to us; and resemblance implies difference. There is an interesting passage in Sir John Herschel's "Discourse on the Study of Natural Philosophy," lately quoted in the same *Review* in which the Duke's essays appear, by Mr. Justice Fry. Sir J. Herschel argued, with a conviction which, whatever we may think of its grounds, we cannot say that the course of thought since his time has justified, that no student of Nature could continue to deny a directive mind in Nature, since in the last resort the initial conceptions of the world of Nature all bore the aspect of design. Atoms, he says, have all the character of *manufactured work*. We will not inquire into the force of the argument, though it seems to us considerable, but we would point out that it is a specimen of a kind of reasoning which becomes impossible, if we lose the contrast of Nature and Art. We cannot trace resemblance, if we begin by assuming identity.

We are the more surprised to find this confusion in the Duke's writing, because his earlier work on the "Reign of Law," so far as our memory serves, contained a just and admirable discernment of the distinction between what is natural and

supernatural. However, the course of thought between the publication of that volume and its present successor perhaps explains his change of view. When a doctrine like that of Evolution is in the air, when it is made the theme of constant allusion by almost every one, and those who hardly know the meaning of the word are yet familiar with the group of associated ideas which it suggests, and still more which it excludes, the belief itself gets tangled, even in the associations of logical thinkers, with many others which have no logical connection with it; and in this case we believe that the sweep of Evolution has taken an illegitimate but very natural extension, by which this root-distinction has been obliterated. "The success of science in tracing the unity of Nature, and showing step by step how its laws and their results can be brought more and more into *direct relation with the mind and intellect of Man*," may be easily interpreted as the success of science in analysing the mind and intellect of man into a mere product of the laws of Nature. But wherever this happens, we are sure that it will be vain to extract from the messages of Nature any testimony to a higher than herself. Only on the hypothesis of our own kindred to the higher Being can we trace his will in her laws; if we are their mere result, we cannot get beyond their scope, so as to judge of any inference from them. "The word 'supernatural,'" says the Duke, "implies that we know all that Nature contains, and can pronounce with certainty on what can and cannot be found there;" and though he goes on to give an alternative, it is evident that this is his own view. We protest against such an assumption. If I am told of some new effect of one substance on another, and make reply, "This must be some kind of chemical action, for evidently no merely mechanical principle accounts for the effects," do I assume that I have nothing to learn concerning mechanical laws? Surely not. I assert that you are informing me of a new *kind* of relation between one material and another, not that I have catalogued one set of relations, and know that they do not include your fact. Nature exhibits at every transition in her ascending scale of laws that increment of relation which Nature herself, as a whole, exhibits in her relation to the supernatural. You tell me that every particle of matter attracts every other inversely as the square of the distance, and then you hold a magnet over a needle, and the slip of steel ignores the neighbourhood of the vast earth, and rises to meet the tiny bar. Was your statement, then, not universally true? It expresses a tendency which is invariable as a tendency, but which may be set aside for the time by other agencies, belonging to a different sphere. It has always appeared to us (and we do not know that the thought has been anywhere better expressed than by the Duke of Argyll, in the volume mentioned above) that this relation of one sphere of natural law to another is the prophecy of the relation in which Nature herself stands to the Supernatural. The sphere above Nature, just as much and just as little exhibits the laws of Nature, as magnetism exhibits the laws of gravitation. It does not abrogate them. But something else is there, which renders them for the time invisible to human eye. If I believe the narrative told of one who was said to heal the sick with a touch, to feed hungry thousands with five loaves, to bid a dead man rise and live, I do not need to have catalogued the possibilities of Nature to say that these events are supernatural. I recognise another kind of causation from that with which I am familiar in the kingdom of Nature. If these events were explained as the result of some new natural law, they would cease to be a manifestation of that *moral* power, their embodiment of which is and was the express ground of the belief in them.

The distinction against which the Duke protests, important as it was always, has in our own day acquired a new importance, by the light of the great, preponderating doctrine we have noticed. This doctrine may be believed in two senses. As Evolution is generally understood by scientific men, we presume it is regarded as an exhaustive account of the origin of things. According as we adopt or reject it in this sense, must we regard it as hostile to the most cherished of the primary beliefs that have hitherto been maintained by mankind, or as entirely indifferent to them. When you say that the process by which the world attained its present development was a gradual change from an indefinite, incoherent homogeneity, to a definite, coherent heterogeneity, do you mean that this is the way in which an *idea* became a *fact*? Or do you mean that this is the account of the coming into existence of the whole Universe of being? If Nature means the sum of existence, we must adopt the last view, for unquestionably evolution must stand or fall as a complete account of the development of *Nature*. No doubt this is the ordinary view of scientific men, but it cannot be called the teaching of science, for it refers to matters of which science knows nothing. We must, it is true, somewhat modify the definition of evolution, if we believe that the process from a condition of indefinite, incoherent homogeneity to a condition of definite, coherent heterogeneity was itself the result of will, for the homogeneity from which we start appears then, from one point of view, as the most entire heterogeneity. Spirit and matter, at the dawn of creation, were contrasted, if then both existed, as they have never been contrasted since. But all the subject-matter of physical science remains untouched by this modification. Spirit has been evolved from its material framework because the material framework is the product of spirit, but the process of evolution, so far as it concerns the material framework, remains unchanged. And the belief that it is a part of the doctrine of Evolution to decide on its own limits is a part of that identification of the offices of Philosophy and Science, which seems to us one of the most disastrous intellectual confusions of our day.

It would appear, to us that largely as the idea of Creation is modified when it is transferred to this domain, and many as are the individual cases of design which have to be surrendered as fallacious, a truly spiritual philosophy finds a much more congenial atmosphere here than within the circuit of the old ideas of special and separate acts of Creation. Evolution, so far as we know, is not a word used in any other sense than that in which it is so familiar to us. But surely when we use the verb "to evolve," what is suggested is an agent who does evolve. What is unfolded was first folded. The directing principle of evolution cannot be the product of evolution. And if we once conceive of this directing principle as separate from Nature, is it impossible to believe in a participation in this separateness being communicated to a being standing in a closer relation to the Creator than does the rest of the Creation? It seems to us that only thus is the belief in a moral world possible. So far as man is a mere product of Nature, he is incapable of sin. Of course, his acts, like the events of Nature itself, may be matter of regret. There is disaster in the course of Nature, and man, so long as he remains bound within that course, may be a channel of such disaster. But the world into which we enter when we speak of right and wrong does not exist, unless we look on man as being in some sense related to the Supernatural. Only so far as man partakes in the creative energy to which he owes his being, only so far as he has the power of deciding that something shall begin to be, or shall cease to be—a decision wholly without parallel in any natural event—can man either yield to temptation, or triumph over temptation. There is no sin, and there is no virtue, in the natural world.

Evolution, the Duke reminds us, while binding man in the closest connection with the creatures below him, is not supposed to admit of any link between his own inmost being and anything above him. The creatures below us, prophesy us, they show in faint gleams our reason and our moral nature, as well as our bodily structure (and this we think the Duke hardly puts strongly enough), but we image forth no such foreshadowing of a higher Being. The time will come, we believe, when it will be felt strange that those whose lot it was to declare to our generation the great parable of the unfolding of Nature were so profoundly ignorant as they were of its meaning. Can it be that from the seaweed and the worm every created being is a symbolic prophecy, except man? We will not say, as the Duke does, that such a question is answered when it is stated, for those who have given a lifetime to the study of evolution find it yield no hint of such an answer as we would give. But we are confident that when once the doctrine of evolution is lighted up from the spiritual side, when once it is felt that man, in tracing his relationship to the creatures below, gains a clue to his relations to a Being above him, the theory will acquire a coherence and a unity which will make it seem discovered anew. It will be like changing a hemisphere to a sphere. The mind will not learn a certain rhythm, to break it off at the moment the strain is richest. The relations that Nature exhibits will gain an interest now unsuspected, when they are seen to be faint foreshadowings of the relations between that which is within Nature, and that which lies beyond it.