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ARTICLE IV.

FINAL CAUSE OF VARIETIES.

BY P. A. CHADBOURNE, PROFESSOR IN WILLIAMS COLLEGE.

ACCEPTING the common definition of varieties in the organic kingdom, we regard them as forms produced by the *variation of species*. The cause of this variation has never been explained. Probably the only answer that will ever be given is: Such is the nature of species. It is a law written on the plant and animal, that in their development there shall be variation from the original stock, but only in certain directions. On this point we quote the language of a distinguished scientific man who has lately written much upon this subject. It would be difficult to find in the writings of any other author, all that we really know on this subject, condensed into so few words:

"The former [variation] has never yet been shown to have its cause in 'external influences,' nor to occur at random. As we have elsewhere insisted, if not inexplicable, it has never been explained; all that we can yet say is, that plants and animals are prone to vary, and that some conditions favor variations."¹

We thus confess our ignorance of the natural causes that produce variation. We propose to discuss its *final cause*. This implies that there is in it a purpose. If there is in the variation of objects in nature a purpose, that purpose must have relation to the objects themselves, or to some other beings connected with them or in some way related to them. In all arrangements merely for the good of the object itself, final cause may be denied. It may be said that the thing exists because it happens to have a constitution fitting it for the mode of existence in which we find it. We shall therefore confine ourselves, in this discussion, mainly to those contri-

¹ Prof. Asa Gray, in Silliman's Journal, May, 1863, p. 440.

vances that seem to have relation to something out of the object in which they are found. But our special object will be to show that all variation from original forms in the animal and vegetable kingdoms is not in general for the good of the object in which it occurs, but for the good of other objects in some way related to it. We think it will readily appear to any careful observer, that much of the variation in both of these kingdoms has special reference to man as an intellectual and moral being. But we shall confine our present examination mainly to plants. It would be most natural, perhaps, to commence with the mineral kingdom, had we time for a full discussion of the subject. And we might inquire: For what end is the beauty of the crystal? Certainly it is not for the crystal itself. We have great beauty in the primary crystal. But the law of secondary forms adds new beauty, by the variety it gives in modifying, with mathematical exactness, the faces and angles of the primary. We may be told that there is no final cause in all this arrangement of matter. It is so, is all that we can say. Because we admire the beauty of the crystal, and wonder at this law by which its beauty is increased, we are not to believe that the original beauty of the gem, or that the law of variation, was made for us, or with any reference to us. Nor are we to believe, necessarily, that they were *made* at all. *They are*—they always have been; and they would be the same they now are, were there no intelligent being in the universe to behold them. We may believe that they have a purpose, or not. If one doubts it, there is certainly little room for argument. When the facts are stated, different minds will be differently affected by them, and argument will have little effect on either class.

But when we study the kingdom of life, the facts that meet us are different in kind. There is here a succession of beings, descending one from another; there is a complicated machinery by which this succession is secured, and a different kind of machinery by which the individual is built up and preserved. It is certainly a legitimate inquiry: For what purpose is each part of these beings? For what purpose—

or, if any object to this word, for what *use* — are the various organs of the plant? To answer this question is the work of the botanist: he examines the root, the stem, the leaf, the flower, and the fruit. In this investigation he has been successful, so that most of the plant machinery is now understood in its relations to the individual plant and to the succession of plants. Who doubts the use of the root and leaf in taking up and elaborating nutriment for the plant? Who doubts the use of the anther in producing pollen, or of the pollen grains in fertilizing the seed? Although we may be uncertain about the use of some parts, it does not affect the certainty of our knowledge respecting those we have mentioned. Let us push our inquiries further, and see if we find in the structure of the plant any contrivances, or in its development any variations of form, not required by the economy of the plant itself. We omit for the present all discussion as to the method by which these were produced, or *how they came to be*, but simply inquire if there are such. Selecting a few from the many, we might inquire: For what purpose are the petals of the flower, the crown of beauty, to the plant? Certainly they are not absolutely essential in the production of seed, for many plants are without them. And if in any case they are deemed essential, certainly the beautiful pattern of the petal, its numberless modifications and delicate tints, adjusted with masterly accuracy, are not necessary parts in the economy of plants. Of what use to the plant is that row of sterile flowers that adorns so many of our Compositae, the Rudbeckias and Helianths; or that curious circle of sterile flowers bordering the cymes of Hydrangeas and some of our Viburnums? We may be told that they have no use, or that these apparently useless parts will at some time be found to be of importance in the economy of the plant, aiding directly or indirectly in the perpetuation of the species, as the honey of plants attracts bees, and thus secures the continuance of the species by the fertilization of the seed. We will go one step further, then, and ask: What end is subserv'd by double flowers? All

agree that one use of the flower is to produce seed. But the perfectly double flower loses the organs of reproduction. The rose unfolds its stamens and pistils into petals, and thus gains in beauty, till it becomes the perfection of a flower, but all at the expense of seed. What use, in the economy of the plant, does the flower subserve when it can no longer produce seed? It does not perpetuate the species, and it is a draft upon the nutriment that would otherwise go to build up the plant that produces it. By becoming double, the flower has ceased to be of advantage either to the species or the individual plant. But does Nature thus defeat her own ends, and provide for the destruction of some species by the very law of their growth? Not at all. In every plant which by cultivation is so far changed as to lose the power of producing seed, there is some other provision for the propagation of the plant, as by slips, by grafting, by bulblets, and the like. Nature seems thus to provide, in the structure of other parts of these plants, for the development of their flowers in the line of beauty at the expense of seed.

Let us examine another group of plants, belonging to the same natural order as the rose. For what purpose is the fruit of the apple tree, the pear tree, and the peach? Their seed is evidently for the propagation of the species. But still we ask: For what purpose are the *apple* and the *peach*? The germ is in the seed, or within the stone. The economy of the plant does not require that the covering of the seeds should be increased in quantity or heightened in flavor, for they come to their fullest development in the unchanged native fruit. If the improvement of size and flavor is not for the *seed*, it has no relation to the plant. And probably no candid person will contend that the change in cultivated fruits which renders them more valuable to man, has any more relation to the wants of the individual plant, or of the species, than the milk of the mother has to her own wants. If this change has any purpose at all, it is for something outside of the plant. The seed is not for the plant that produces it, but for the species. The change of covering, as

already indicated, is of no advantage to the seed. Its increase in size is therefore a draft upon the tree, without having any relation to the species. So far as the economy of the plant is concerned, it is a mistake. The machinery is out of order. There is an absolute throwing away of material and of vital energy.

We are now prepared to introduce and illustrate certain propositions, which seem warranted by plant development:

1. In some plants the *idea of beauty* is the most prominent idea, inasmuch as under the best cultivation the variation of these plants is always in the line of beauty. The beauty of the flower—the rose, for example—often increases at the expense of the reproductive organs, until the power of producing seed is lost.

2. In other plants, utility of *fruit* is the prominent *idea*, as in the apple and the peach. Such plants, under careful cultivation, produce larger and more delicious kinds of fruit, without increase of beauty in the flower.

3. From these two propositions another follows: that the plants best known to us from long continued cultivation can be readily divided into two great series, without reference to their botanical relationship, but according to their lines of development. In one series *utility of fruit* is the prominent idea; and in the other, *beauty of flower*; as under the best cultivation these series are developed in these two directions respectively.

The idea of utility is not manifested by fruit alone. The sugar of the sugar-cane constitutes its utility, while that of the Indian corn lies in its grain. These plants, so nearly allied botanically, are developed in these two directions, according to the leading idea in their products. The apple and the rose, already referred to, belong to the same botanical family; yet they are developed, in nearly all their variations, in opposite directions. The potato has, for its leading idea the formation of underground stems or tubers; while its brother, the tomato, has for its idea the production of a fruit corresponding in structure to the potato-grape.

They show this in all their variations. In the pine tree the leading idea is wood, and in the mint, essential oil. But in such plants as do not readily produce varieties, the line of development is determined with difficulty.

4. Some plants in their native state give indications of the kind of change likely to take place in them by cultivation. The rose, for example, by its large corolla in comparison with the fruit, shows that change of flower is most likely to take place. In the apple, the large fleshy fruit indicates a tendency to variation and improvement in that direction. The Viburnum Opulus, the Hydrangea, and other plants, by the circle of sterile flowers, much larger than the fertile flowers, indicate change in the direction of beauty. These beautiful circles of sterile flowers in some of our native shrubs, and the neutral rays of some of our Compositae, may be regarded as ornaments, rather than as of use in the economy of the plant. When, therefore, a new plant is brought under cultivation, there is little doubt in what direction it will vary, if at all. The increase of beauty in the flower by doubling, and the increase of the fruit in size, beauty, and flavor, are of no advantage to the plant itself, nor to the species; but in some cases they are a draft upon the plant for no purpose in its own economy.

5. Those plants that by variation lose the power of producing seed can always be propagated in other ways, as by slips or bulbs. Nature, as though careful for the preservation of the species, never allows any plant, by its own law of growth, to lose the power of producing seed, unless she has given to it means other than the seed for the perpetuation of its kind.

6. Variation is most common and rapid in those plants which are most useful to man for cultivation, and which must go with him over most of the earth. It may be said that they are most useful because they happen to vary. But their readiness to vary, certainly was not the cause of their first cultivation. They were selected for some particular good, as for fruit, or for beauty of flower, or some other

useful property. The characteristic for which each one was first selected, was the leading idea of the plant, and in that direction all its variations under cultivation have tended. The rose, in all its varieties, is to-day cultivated for the same reason for which it was first cultivated—for its beauty; the apple tree for its fruit, the sugar cane for its sweetness, and so on through the list of cultivated plants. We might multiply propositions and examples, if our space allowed. As they would not differ in kind, they are not needed for the argument. Apparent exceptions to the propositions already stated, may undoubtedly be pointed out, for it is well understood by naturalists that Nature does nothing *per saltum*. Hardly a group of plants can be examined in which there will not be found one or more that the family description will not embrace in all particulars. There are also some plants so valuable for several purposes, that it would be difficult to determine in every case the leading idea. They are made for a double purpose, and may develop in either direction. The apple tree with double blossoms, or the tomato with tubers upon it, would not therefore, with any candid person, affect the bearing of the propositions. If a law of nature is really discovered, all exceptions are either merely apparent, or if real, are found to be special provisions for some wise purpose. It is the general law of variation that we now wish to present for consideration in the propositions just enunciated. If these propositions have any significance, to what do they tend? Certainly to show that the vegetable kingdom is not an end to itself. Men and animals do not make use of plants because they happen to be what they are; but the plants are constituted as they are for the sake of the animal kingdom, and many of them with a direct reference to man as an intellectual and moral being. It is by the law of variation that they are most perfectly fitted for these high purposes.

In almost every department of plant-life the changes can be referred primarily to the good of the plant itself, and thus it is easy to say, and no doubt easy for some to believe, that

there is in them no purpose other than the continuance of the species, if any purpose at all. The cereals — wheat, rye, barley, Indian corn, and rice — furnish the great bulk of food for the human race. We have no doubt that most men will believe they were made for this purpose, and not that they happened to be what they are, or that the primary object in importance was that they might propagate their kind, and that the support of animal life was no part of the plan, but accidental or subsidiary.

Yet there is much that seems to favor the theory that all the machinery of fruiting is for the continuance of the species alone. If the germ fails to be fertilized by the pollen, no sugar nor starch nor gluten is stored up in the seed for man. But when the pollen has touched the germ, there is power of independent life, and from that moment all the energies of the plant are taxed to store the kernel with food; but food for what? For whom? For the young plant, all agree. It puts in the seed the food which that germ needs for its support, till its roots and leaves are large enough to collect from the earth and air the crude materials and elaborate them for use. For what purpose is the starch garnered up in the potato, and the sugar in the beet, the carrot, and the parsnip? We shall be told that they are stored up for the plants themselves, to supply the great draft made upon them in producing fruit. We cannot deny it, nor do we wish to do so. We love to contemplate the parent plant providing for every one of the thousand plantlets folded in its seeds, destined to beautify the earth when its own withered stalk has passed away. Would that men might learn a lesson from it, and provide for their offspring enough, and only enough, for their wants till able to provide for themselves. We can hardly help admiring the seeming prudence of the honest beet and parsnip, that industriously gather stores of food the first year for the flowering time, when both roots and leaves would fail to supply their wants. In all these things we have been compelled to recognize a wisdom and a skill that thus arranged this machinery of the plant.

But in the very arrangement for the plant itself there seems to shine forth a higher and nobler purpose. In the multitude of germs, an apparent waste of energy, there seems to be a provision for their legitimate destruction by a higher creation. And if the grain of wheat fails to fill unless the germ is there, who does not see that it is better for man that it should be so? It is best for him that every grain of wheat should represent both so much food, and also a certain centre of new plant-life. With what uncertainty would the husbandman sow his field, if perchance only one in a thousand of the precious grains scattered on the furrow would give the green blade, and, in time of harvest, the full ear! He who regards the support of animal life as the highest use of the vegetable kingdom, must also see that certainty of propagation is of prime importance in the plants already mentioned.

But we have, perhaps, too far prolonged this discussion on this lower phase of plant-life — the production of food. We readily grant that in the majority of cases the food for animals is produced in a way that seems primarily for the benefit of the plant as an individual or species. To some it may appear to be prepared solely for the plant. To this, however, we think there are plain exceptions; and among them we mention our soft fruits, which are the envelop or mere accompaniment of the seed. The seeds need a covering, it is true. But why should the covering of the apple seed give the thousand kinds of this delicious fruit, of every tint and flavor and varied time of ripening? Why do the pear and peach vie with the apple in the diversified forms and flavors they offer? Why does the strawberry enlarge its receptacle into that most delicious fruit? Why does the grape bury its seeds in such a luscious pulp, and sometimes form the pulp without the seed? That the perfection and variety of the soft portion of such fruits play any part in the economy of the plant, no one will probably contend. The pulp of the grape represents to man so much food. If it forms without seed, it is the cause of no indirect injury,

as the filling of wheat grains without the germ would be, because it never represents new plant-life. If the soft fruits have no purpose except to cover the seed, their increase in size and improvement in flavor are a mistake. The native apple, in all its harshness ; the frost grapes, which the animals allow to fall, with their seeds, untouched, unless driven to eat them or starve ; the peach, in its hard covering, and the button pear, which no cooking can fully conquer — all these are for the plant the perfection of fruits. They perfect and protect their seeds. But our Black Hamburgs and Sweetwaters, our Pippins and Bartletts, are mistakes, and evidences of imperfection and want of design in such plants, if they have no end out of themselves ; for all these variations from the original stock either weaken the seed or invite to its destruction. Because they are of no advantage to the plant, must we grant that they are a mistake or without significance ? By no means. Nor do we think it possible for the majority of men ever to believe that we have not here a direct provision for the animal kingdom as a whole, and for man in particular ; a provision that shows wisdom, though through it plant-life is made entirely secondary. The continuance of the species must be provided for by some means, or its creation would be a failure. This being done, sometimes by one method and sometimes by another, all the remaining parts of the plant may be modified for the benefit of this higher kingdom. It seems to us that all these modifications indicate this ulterior purpose, to which the interests of the plant, so to speak, are made to yield. This follows certainly, if our first and fifth propositions are accepted. We have no doubt, indeed, the three kingdoms of nature are all arranged with reference to man, especially as an intellectual and moral being. We have already referred to crystallography, and we might enter with profit into the consideration of chemical equivalents and chemical combinations, but they would open a wide field, and are not required for our present brief discussion. We never could see how the plan of structure, the whole science of homologies in

the animal and vegetable kingdoms, could be fully comprehended by any one without the recognition of a direct provision for man as an intellectual being. Animals and plants are constructed with parts apparently for no other purpose than to show their true place in the organic kingdom. We believe that they are thus linked together by homologous parts that they might be comprehended by man, that he might more surely trace the plan of the Great Architect. We believe this, also, without reference to the question whether these parts came to be as they are through secondary causes or by direct creation.

In the provision made for the increase of beauty in the flower by doubling, there is certainly no reference to the welfare of the plant, for beauty increases at the expense of the seed, the final cause, or one use of the flower, as all will allow. When we see this tendency to variation in such a multitude of flowers; when we see it confined to those plants having methods of propagation other than the seed; when we see this tendency conferring no possible benefit upon the individual plant nor upon the species; when we see what a source of enjoyment this law is to man in his highest cultivation, we might say, how necessary for that highest cultivation — can we doubt for what purpose this law of variation was given? Who can fail to feel that the plant is not for itself; but so far as it seems to be for itself, it is that it may exist; but it exists for a higher kingdom; and that *the final cause of plant variation is found mainly in the wants of man, not only as a physical, but as an intellectual being.*

There is another significance of varieties, besides their adaptation to these wants of man, although to some it may seem a mere accident. We refer to the conditions thus presented to man for continual progress. In consequence of this wonderful law of varieties, there is opened the possibility of continued improvement; to reach the limit of this possibility is impossible. Were it true that each species produced from age to age the same identical forms without variation, whenever each species was secured, all would be

done that could be done in that direction. We have but one species of apple. From this have been produced hundreds of distinct kinds. There might, indeed, have been as many distinct species created in the beginning. But even then, all that could be done, would be to secure the kinds created. In consequence of this wonderful law, the same end is reached as in the creation of numberless distinct species, and in a manner far better for man. From one species have sprung unnumbered forms; the next year may produce others still more desirable, and the next year others, and so on forever. It is impossible for man to say that he has now the most delicious apple, peach, or pear, or the most beautiful rose, or the most prolific variety of corn possible. The next year a better apple, a more beautiful rose, a more prolific variety of corn may be produced; and this shall be true forever. There is thus laid in this law of the animal and vegetable kingdoms the surest conditions of continued progress in man. The possibility of better forms is ever saying to him, Onward! Upward!

In thus viewing the law of variation in all its manifestations, we have forced upon us the conviction that, while it sometimes has reference undoubtedly to the plant or animal itself in the preservation of the species, in its higher manifestations, especially in the vegetable kingdom, it is for something out of the plant, and for a higher creation — the animal kingdom; above all, for man as a rational creature. If all these things were created by an infinitely wise Being, this is what we should expect. If they were created directly, we should expect it; *if through secondary causes operating through myriads of years, we should expect the same.*

And so at this point we are ready to say that we do not see the atheistic tendency of the so-called development theory at all, except so far as it has a tendency to remove us further from God in nature, and in this way makes it easier for men to forget him or doubt his existence. What difference can it make in our belief in the existence, the wisdom, or the power of God, whether he created the first oak as a

tree or as a germ, that through secondary causes — the sunlight, the air, and the rain — should expand into the oak? The microscopic germ, with this force lodged in it, that determines the growth of the oak, the form and strength of every fibre, the outline of every leaf, the outward sculpture and inward structure of every acorn that shall cover it for a thousand years, is as much a proof of infinite wisdom and almighty power as the oak in its perfection. If one fails to be proof, the other must. If, to go further, we were to suppose a single germ to be placed upon this globe, which, with untold ages for its development, should give rise to all the myriad forms of vegetable and animal life, with all their wonderful relations to each other, as the germ of the oak develops the woody fiber, the root, the stem, the leaf, the flower, and the fruit, all unlike, but having a relation to each other — if we could believe that from one such germ all life upon our globe had sprung, would it shake our belief for one moment in God, or alter our conception of his character? Do we look upon the trees and the animals around us — upon our own bodies — as any the less the work of God, or evidence of his existence and illustrative of his character, because produced through secondary causes, than they would be if they came full grown from the hand of God, as we believe that Adam came? Not at all. If one looks at his own body, and fails to see so much of purpose there as to imply a designer, then he would fail to see it if he were created full grown. There is a certain kind or degree of scepticism for which there is no cure : it is an incapacity to weigh proof. This may exist in connection with great learning and great power of scientific investigation. Where this defect exists, all labor spent in accumulating proof is labor lost. When you have presented one object to a man in clear sunlight and he cannot see it, you know he is blind, and no accumulation of objects will enable him to see. This principle was forcibly illustrated by our Saviour when Abraham says : "If they hear not Moses and the prophets, neither will they be persuaded though one rose from the dead."

We consider the scientific discussion as to how animals and plants came upon this globe to be a matter of investigation as to facts. How that question will be ultimately decided we have no doubt. Biologists can throw light upon many dark points, but it is upon geology that we must mainly rely for facts. We have not yet seen any strong argument made out, nor do we believe that geology has yet given one whisper of satisfactory testimony in favor of the development theory. And if we are threatened with the authority of great names, we will not be dismayed while we have on our bookshelves the works of the same great men, in which the opposite view is most ably maintained. We can afford to wait, certainly, till they have refuted their own arguments, unless we get new light in other directions. When the proof comes, we are not only bound to receive it, but are ready to do so. And it will have no more to do with the argument for the existence and attributes of God, than the discussion before an aged oak whether it were created as a tree or sprung, like ordinary oaks, from the germ within an acorn. We welcome all the labors of the development theorists, and feel thankful for them. We welcome them as contributions to science. We never read a more convincing work on natural theology than Darwin's book on the fertilization of orchids. We have no doubt that he and his co-laborers are accumulating weapons that will yet batter down his philosophy and the leading theory upon which it rests. "We heartily adopt," says a distinguished scientific man, "the science of Darwin, but not his philosophy." The distinction is a just one; and such a spirit will guide us safely. The subject of variations, which we have been discussing, has given rise to the development theory. We accept the facts of variation and the influence of "natural selection," but not the inferences that are drawn from them. We see the need of variation for the best good of the world, for man himself. If provided for in the creation of certain species, and those species most useful to man, we see in this a mark of wisdom as much as in the adaptation of the parts

of our bodies to each other, or of our bodies to the external world. We regard, then, the law of variation as a means of preserving the species under certain circumstances, and as a means of better fitting created things for their various uses, and not as the creator of the thing, nor in any sense the originator of the species. Variation is the quality of a species, and not its producer. We see nothing yet to shake this belief; but if the lessons we have learned from geology and living forms are to be modified or proved to be mistakes, we will welcome the new light. It will not be hard to change opinion in such goodly company.

ARTICLE V.

EXAMINATION OF PHILIP. III. 11 AND REV. XX. 4.

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THE first of these passages, as found in our common version, reads thus: "If by any means, I might attain unto the resurrection of the dead." That the general resurrection of mankind, both good and bad, is not here referred to, appears quite evident from the context, which represents it as an object of the apostle's greatest concern to secure personally for himself. To share in the general resurrection, he had only to live and die as a heathen man or an unbelieving Jew; but to attain to the resurrection here spoken of, he must "know Christ, and the power of his resurrection, and the fellowship of his sufferings, and be made conformable unto his death." Even then, possessed of all these high spiritual attainments, there is an *eiπως* (*if possibly, if by any means*), which, connected as here with the indicative mood, implies indeed no uncertainty of result, but nevertheless emphasizes most strongly the great difficulty of the achievement.