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Then be it ours to testify alike our gratitude and our faith by our efforts to Christianize the world. To whatever barbarous tribe the Anglo Saxon race shall carry their free and pure Christiaaity, their own homestead bears witness, that "*the wilderness and the solitary place shall be glad for them; and the desert shall rejoice, and blossom as the rose.*"

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## ARTICLE VII.

### THOUGHTS ON SPECIES.

By Professor James D. Dana, Yale College.

[PREFATORY NOTE.— The discussion with respect to the Unity of the Human race based on the study of Nature, is naturally divided into three sections:

1. Is man of one, or of several species.
2. If of one species, was he created on one only, or on different continents, or in other words, was there a plurality of original birth-lands.
3. If of one centre only, was there but one first pair, or a plurality of first pairs.

The plurality of species, of birth-lands, of parentage, are three distinct subjects of inquiry.

If man is of *more than one species*, the creation of man on more than one continent and of more than one pair must necessarily be admitted; and hence the inquiry as to unity of species is of the widest import. The course which scientific discussion has recently taken, makes this, in fact, the great fundamental question, involving all others. It is understood, that proving a plurality of species, is putting down all opposing arguments at a stroke; and this is, therefore, the point towards which attention is now especially directed. It is hence of the first importance, to those who would consider the bearings of science on the

grand topic, that this question should be profoundly considered.

In treating it, we might perhaps have made a more satisfactory argument to many minds, had we taken up the special results of observations on the distinctions and variations of species. But it is reasonable and profitable, first, to take a survey of the wide range of nature, and gather up the testimony which science in all her departments is bringing to light. These departments, although so diverse, are yet coördinate in their relations. Each sheds light into the precincts of the other, and all combine in harmonious exhibitions of truth. More than this, common ideas underlie the whole system of the universe, declaring a unity of nature, parallel with the unity of the Infinite Author. An appeal to general principles, is therefore an appeal to the deepest and widest range of knowledge.

Moreover, the argument from the direct study of individual plants and animals, is only in its incipient state of preparation; for we yet know little as to the limits of species and their laws of variation. Different investigators are at work on the subject; and until these and others have given it a long and thorough examination, it would be presumptuous to say with positiveness what the facts in this department of science do teach. We believe, that when fully worked out, they will only add force to the argument presented beyond.

The subject of unity of species is too often approached as if a hastily made observation were sufficient to settle it *pro* or *con*. It is sometimes treated with careless or flippant remarks, as though there were no general principles in nature bearing with mighty force on one side of the great question. The due appreciation of those principles will lead to more investigations and cautious scrutiny in the collection of facts, and more wisdom in weighing and using them.

Again, there is often impatience on the other side, that Science, in making its deductions should not draw support of the truth from the Bible. But to be of value to the

cause of truth, it must be an independent source of argument. If a word from the Bible is allowed to influence its reasoning, the testimony is simply the Bible for the Bible, and not science for the Bible; we should not forget that as surely as nature and the Bible are of the same All-wise Being, so surely will nature stand by the Bible, and fulfil its mission in shedding light on the sacred page.

The terms *species* and *genus*, although having precise significations in science, are not always interpreted in the same way by metaphysicians. A word of explanation may not therefore be out of place.

In classification, we rise from *Individuals* to *Species*; then to *Genera*, — and so on, in the following order; *Families*, *Tribes*, *Orders*, *Classes*, *Sub-kingdoms*, *Kingdoms*. In the subdivisions above *genus*, Botanists vary a little from this order, but that is of no importance here.

Individuals of a common kind we say are conspecific. Take for instance the *horse*. The horses domesticated over the world are of one *species*. There are various breeds; they exemplify the extent to which the species varies, and are called *varieties*, a grade of subdivision under species; the *varieties* breed indefinitely with one another, while the different *species* of horse do not. The material group of horse-like animals, characterized by having a simple solid hoof or single toe, no rudimentary toes behind, the same dentition (number and arrangement of teeth) as in the common horse, and some other peculiarities, constitute the *genus Equus*. If the dentition presented two distinct types (the teeth having a high importance in classification because they vary with the food and whole structure of the species), or the foot had other rudimentary toes, there would have been two genera of solid-hoofed (solidungulate) quadrupeds. But in fact there is only one, so that the *Family* of *solidungulates* has but one known *genus*; this includes as *species*, the *Horse*, the *Ass*, the *Hemione* of India, and the *Zebra*, *Onagga* (or *Dauw*) and *Quagga* of Africa, besides some extinct fossil species.

But there are other hoofed or *Ungulate* species of quad-

rupeds, as the sheep, deer, hog, elephant, constituting a large group. They are very distinct from *Unguiculates* or clawed species, like the Lion, Cat, Bear; from the Monkey-tribe or *Quadrumania*; from the Whales and Walrus which swim and have no hind feet, and are hence called *Mutilates*; from the group of bats, or *Cheiropters*; from the *Insect-eaters*, as the mole and hedgehog; from the *Rodents* or gnawers, like the mouse and squirrel; from the sloth and armadillo group called from their half toothless mouths, *Edentates*; from the *Marsupials* or pouched animals, like the opossum and Kangaroo. The large group of *Ungulates*, embracing the elephant, hog, sheep and related animals along with the horse, is thus a natural division of quadrupeds, and is called an *Order*; — the *other orders* being those just mentioned, the *Quadrumania*, *Unguiculates*, *Mutilates*, *Cheiropters*, *Rodents*, *Insect-eaters*, *Edentates*, and *Marsupials*.

Now the *order* of *Ungulates* is naturally divided into two *tribes*; one having an *even* number of toes like the sheep, cow, hog, or *Pari-digitates*; the other, an *odd* number of toes, like the horse and Rhinoceros, or the *Impari-digitates*. This is seemingly a characteristic of little value; and yet it is so fundamental, that an even-toed *Ungulate* when horned, has its horns in even pairs, one either side of the middle, while the odd-toed have, if any, a single horn on the *middle* line of the head, or if two, one is in advance of the other.

The several *orders* mentioned are orders of the *Class* of *Mammals* under the *Vertebrate subkingdom*, and *Animal Kingdom*. To complete our explanations we repeat what is touched upon in another number of this Journal. The animal kingdom has its *four* subkingdoms, or four distinct plans of structure: — 1st. The *Radiate* or lowest subkingdom, having a flower-like or star-shaped structure, as the star-fishes, jelly-fishes; 2nd. The *Molluscan* subkingdom, having a soft jointless body not radiate, as the oyster, snail; 3rd. The *Articulate* subkingdom, having a jointed body, with the articulations formed in the skin, and no internal jointed skeleton as insects, lobsters, worms; 4th.

The *Vertebrate* subkingdom, having vertebra, or an internal jointed bony skeleton like birds, fishes, quadrupeds. Again, the *Vertebrate* type is adapted to the different conditions of life afforded on the globe, and hence come the four *classes*: The Class of *Fishes*, of *Reptiles*, of *Birds*, of *Mammals*, the last embracing the quadrupeds, and characterized by the species suckling their young.

From this survey it is seen that the horse belongs to the Animal *Kingdom* — *Vertebrate subkingdom* — *Class* of *Mammals* — *order* of *Ungulates* — *Tribe* of *Impari-digittates* — *Family* of *solidungulates* — *Genus*, *Equus* — *Species*, *Equus Caballus*.

We have barely glanced at this subject, in order to explain its elements, and show the relations of species to the higher groups, and not to present a philosophical exhibition of the principles of classification. It is simply an example of the method of subdivision in each department of nature. It should be understood, moreover, as explained in another Article in this volume, that the groups are not arbitrary cuts, but *natural* groups or types. They are sometimes quite distinct from the groups, as in the case of the genus *Equus*; and often when shading into one another, it is much like the coalescing of two radiant centres by their borders, each group having in general, its central idea or type structure. The Kingdoms of nature are literally Kingdoms: there is throughout an order and beauty of System, in which the wisdom and power of the Creator is displayed even more wonderfully than in the creation of a world or any one of its living species.

With these introductory remarks, we pass to the subject of our Article.]

WHILE direct investigation of individual objects in nature is the true method of ascertaining the laws and limits of species, we have another source of suggestion and authority in the comprehensive principles that pervade the universe. The source of doubt in this synthetic mode of reaching truth consists in our imperfect appreciation of uni-

versal law. But science has already searched deeply enough into the different departments of nature to harmonize many of the thoughts that are coming in from her wide limits; and it is well, as we go on in research, to compare the results of observations with these utterings of her universality.

We propose to present some thoughts on species from the latter point of view, reasoning from central principles to the circumferential, and if we mistake not, we shall find the light from this direction sufficiently clear to illumine a subject which is yet involved in doubts and difficulties.

The questions before us at this time are :

1. What is a species ?
2. Are species permanent ?
3. What is the basis of variations in species ?

1. *What is a species.*

It is common to define a species as a *group* comprising such individuals as are alike in *fundamental* qualities; and then by way of elucidation, to explain what is meant by fundamental qualities. But the idea of a group is not essential; and moreover it tends to confuse the mind by bringing before it, in the outset, the endless diversities in individuals, and suggesting numberless questions that vary in answer for each kingdom, class, or subordinate group. It is better to approach the subject from a profounder point of view, search for the true idea of distinction among species, and then proceed onward to a consideration of the systems of variables.

Let us look first to *inorganic* nature. From the study of the inorganic world we learn that each element is represented by a specific amount or law of force; and we even set down in numbers the precise value of this force as regards one of the deepest of its qualities, chemical attraction. Taking the lightest element as a unit to measure others by, as to their weights in combination, oxygen stands in our books as 8; and it is precisely of this numerical value in its compounds: each molecule is an 8 in its chem-

ical force or law, or some simple multiple of it. In the same way there is a specific number at the basis of other qualities. Whenever then the oxygen amount and kind of force was concentrated in a molecule, in the act of creation, the species oxygen commenced to exist. And the making of many such molecules instead of one, was only a repetition in each molecule, of the idea of oxygen.

In combinations of the elements, as of oxygen and hydrogen, the resultant molecule is still equivalent to a fixed amount, condition, or law, of chemical force; and this law, which we express in numbers, is at the basis of our notion of the new species.

It is not necessarily a different amount of force; for it may be simply a different state of concentration or different rate or law of action. This should be kept in mind in connection with what follows.<sup>1</sup>

The essential idea of a species, thence deduced, is this: a *species* corresponds to a *specific amount or condition of concentrated force, defined in the act or law of creation.*

Turn now to the organic world. The individual is involved in the germ-cell from which it proceeds. That cell possesses certain inherent qualities or powers, bearing a definite relation to external nature, so that, when having its appropriate nidus or surrounding conditions, it will grow, and develop out each organ and member to the completed result, and this, both as to all chemical changes, and the evolution of the structure which belongs to it as a subordinate to some kingdom, class, order, genus and species in nature. The germ-cell of an organic being develops a specific result; and like the molecule of oxygen, it must cor-

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<sup>1</sup> When we have in view oxygen and the elements, we are apt to think of their molecules as distinguished by a different *amount* and *kind* of force. But when we consider the many different compounds that may be made of the same elements (as carbon and hydrogen), in the very *same* proportions, we are led to conceive of these as differing molecularly in a different *law* of the same force or forces. When, again, we see the same element under conditions as diverse as any two compounds, as in cases of allotropism, we are still better satisfied with adopting, for the present, the most general expression — a different law of action or condition of molecular force.

respond to a measured quota or specific law of force. We cannot apply the measure, as in the inorganic kingdom, for we have learned no method or unit of comparison. But it must nevertheless be true, that a specific predetermined amount, or condition, or law, of force is an equivalent of every germ-cell in the kingdoms of life. We do not mean to say that there is but one kind of force; but that whatever the kind or kinds, it has a numerical value or law, although human arithmetic may never give it expression.

A species among living beings, then, as well as inorganic, is based on *a specific amount or condition of concentrated force defined in the act or law of creation.*

Any one species has its specific value or law of force; another, its value; and so for all: and we perceive the fundamental notion of the distinction between species when we view them from this potential point of view. The species, in any particular case, began its existence when the first germ-cell or individual was created; and if several germ-cells of equivalent force were created, or several individuals, each was but a repetition of the other: the species is in the potential nature of the individual, whether one or many individuals exist.

Now in organic beings, — unlike the inorganic, — there is a cycle of progress involving growth and decline. The oxygen molecule may be eternal as far as anything in its nature goes. But the germ-cell is but an incipient state in a cycle of changes, and is not the same for two successive instants; and this cycle is such that it includes in its flow a reproduction, after an interval, of a precise equivalent of the parent germ-cell. Thus an indefinite perpetuation of the germ-cell is in fact effected; yet it is not mere endless being, but like evolving like in an unlimited round. Hence, when individuals multiply from generation to generation, it is but a repetition of the primordial type-idea; and the true notion of the species is not in the resulting group, but in the idea or potential element which is at the basis of every individual of the group; that is, the specific law of force, alike in all, upon which the power of each as an

existence and agent in nature depends. Dr. Morton presented nearly the same idea when he described a species as a *primordial organic form*.

Having reached this idea as the starting point in our notion of a species, we must still, in order to complete and perfect our view, consider what is the true expression of this potentiality. For this purpose, we should have again in mind, that a living cell, unlike an inorganic molecule, has only a historical existence. The species is not the adult resultant of growth, nor the initial germ-cell, nor its condition at any other point; it comprises the whole history of the development. Each species has its own special mode of development as well as ultimate form or result, its serial unfolding, inworking and outflowing; so that the precise nature of the potentiality in each is expressed by the line of historical progress from the germ to the full expansion of its powers, and the realization of the end of its being. We comprehend the type-idea only when we understand the cycle of evolution through all its laws of progress, both as regards the living structure under development within, and its successive relations to the external world.

## 2. *Permanence of species.*

What now may we infer with regard to the permanence or fixedness of species from a general survey of nature?

Let us turn again to the inorganic world. Do we there find oxygen blending by indefinite shadings with hydrogen or with any other element? Is its combining number, its potential equivalent, a varying number, — usually 8, but at times 8 and a fraction, 9, and so on? Far from this; the number is as fixed as the universe. There are no indefinite blendings of elements. There are combinations by multiples or submultiples, but these prove the dominance and fixedness of the combining numbers.

But further than this, fixed numbers, definite in value and defiant of all destroying powers, are well known to characterize nature from its basement to its top-stone. We

find them in combinations by volume as well as weight, that is, in all the relations of chemical attraction; in the mathematical forms of crystals and the simple ratios in their modifications, — evidence of a numerical basis to cohesive attraction; in the laws of light, heat, and sound. Indeed, as we have elsewhere said, the whole constitution of inorganic nature, and of our minds with reference to nature, involves fixed numbers; and the universe is not only based on mathematics, but on finite determinate numbers in the very natures of all its elemental forces. Thus the temple of nature is made, we may say, of hewn and measured stones, so that, although reaching to the heavens, we may measure, and thus use the finite to rise toward the infinite.

This being true for inorganic nature, it is necessarily the law for all nature, for the ideas that pervade the universe are not ideas of contrariety but of unity and universality beneath and through diversity.

The units of the inorganic world, are the weighed elements and their definite compounds or their molecules. The units of the organic are *species*, which exhibit themselves in their simplest condition in the germ-cell state. The kingdoms of life in all their magnificent proportions are made from these units. Were these units capable of blending with one another indefinitely, they would no longer be units, and species could not be recognized. The system of life would be a maze of complexities; and whatever its grandeur to a being that could comprehend the infinite, it would be unintelligible chaos to man. The very beauties that might charm the soul would tend to engender hopeless despair in the thoughtful mind, instead of supplying its aspirations with eternal and ever-expanding truth. It would be to man the temple of nature fused over its whole surface and through its structure, without a line the mind could measure or comprehend.

Looking to facts in nature, we see accordingly everywhere, that the purity of species has been guarded with great precision. It strikes us naturally with wonder, that

even in senseless plants, without the emotional repugnance of instinct, and with reproductive organs that are all outside, the free winds being often the means of transmission, there should be rigid law sustained against intermixture. The supposed cases of perpetuated fertile hybridity are so exceedingly few as almost to condemn themselves, as no true examples of an abnormality so abhorrent to the system. They violate a principle so essential to the integrity of the plant-kingdom, and so opposed to nature's whole plan, that we rightly demand long and careful study before admitting the exceptions.

A few words will explain what is meant by perpetuated fertile hybridity. The following are the supposable grades of results from intermixture between two species:—

1. No issue whatever— the usual case in nature.
2. Mules (naming thus the issue) that are wholly infertile whether among themselves or in case of connection with the pure or original stock.
3. Mules that are wholly infertile among themselves, but may have issue for a generation or two by connection with one of the original stock.
4. Mules that are wholly infertile among themselves, but may have issue through indefinite generations by connection for each with an individual of the original stock.
5. Mules that are fertile among themselves through one or two generations.
6. Mules that are fertile among themselves through many generations.
7. Mules that are fertile among themselves through an indefinite number of generations.

The cases 1 to 5 are known to be established facts in nature; and each bears its testimony to the grand law of purity and permanence. The examples under the heads 2 to 5 become severally less and less numerous, and art must generally use an unnatural play of forces or arrangements to bring them about.

Again, in the animal kingdom, there is the same aversion in nature to intermixture, and it is emotional as well as

physical. The supposed cases of fertile hybridity are fewer than among plants.

Moreover, in both kingdoms, if hybridity be begun, nature commences at once to purify herself as of an ulcer on the system. It is treated like a disease, and the energies of the species combine to throw it off. The short run of hybridity between the horse and the ass, species very closely related, reaching its end *in one single generation*, instead of favoring the idea that perpetuated fertile hybridity is possible, is a speaking protest against a principle that would ruin the system if allowed free scope.

The finiteness of nature in all her proportions, and the necessity of finiteness and fixedness for the very existence of a kingdom of life, or of human science its impress on finite mind, are hence strong arguments for the belief that hybridity cannot seriously trifle with the true units of nature, and at the best, can only make temporary variations.

It is fair to make the supposition that in case of a very close proximity of species, there might be a degree of fertile hybridity allowed; and that a closer and closer affinity *might* give a longer and longer range of fertility. But the case just now alluded to seems to cut the hypothesis short; and moreover it is not reasonable to attribute such indefiniteness to nature's outlines, for it is at variance with the spirit of her system.

Were such a case demonstrated by well-established facts, it would necessarily be admitted; and we would add, that investigations directed to this point are the most important that modern science can undertake. But until proved by arguments better than those drawn from domesticated animals, we may plead the general principle against the *possibilities* on the other side. If there is a law to be discovered, it is a wide and comprehensive law, for such are all nature's principles. Nature will teach it, not in one corner of her system only, but more or less in every part. We have therefore a right to ask for well-defined facts, taken from the study of successive generations of the interbreeding of species known to be distinct.

Least of all should we expect that a law, which is so rigid among plants and the lower animals, should have its main exceptions in the highest class of the animal kingdom, and its most extravagant violations in the genus *Homo*; for if there are more than one species of Man, they have become in the main indefinite by intermixture. The very crown of the kingdom has been despoiled; for a kingdom in nature is perfect only as it retains all its original parts in their full symmetry, undefaced and unblurred. Man, by receiving a plastic body, in accordance with a law that species most capable of domestication should necessarily be most pliant, was fitted to take the whole earth as his dominion, and live under every zone. And surely it would have been a very clumsy method of accomplishing the same result, to have made him of many species, all admitting of indefinite or nearly indefinite hybridization, in direct opposition to a grand principle elsewhere recognized in the organic kingdoms. It would have been using a process that produces impotence or nothing among animals for the perpetuation and progress of the human race.

There are other ways of accounting for the limited productiveness of the mulatto, without appealing to a distinction of species. There are causes, independent of mixture, which are making the Indian to melt away before the white man, the Sandwich Islander and all savage people to sink into the ground before the power and energy of higher intelligence. They disappear like plants beneath those of stronger root and growth, being depressed morally, intellectually and physically, contaminated by new vices, tainted variously by foreign disease, and dwindled in all their hopes and aims and means of progress, through an overshadowing race.

We have therefore reason to believe from man's fertile intermixture, that he is one in species; and that all organic species are divine appointments which cannot be obliterated, unless by annihilating the individuals representing the species.

It may be said, that different species in the inorganic

world combine so as to form new units, and why may they not in the organic? It is true they combine, but not by indefinite blendings. There is a definite law of multiples, and this is the central idea in the system of inorganic nature. In organic nature, such a law of multiples, if existing, would be general, as in the inorganic; it would be an essential part of the system and should be easily verified, while, in fact, observation lends it no support, not even enough to have suggested the hypothesis.

In one kingdom, the *inorganic*, there is multiplication of kinds of units by combination, according to the law of multiples, and no reproduction; while in the *organic*, there is reproduction of like from like and no multiplication of kinds by combination. And thus the two departments of living and dead nature widely diverge.

Neither does the possibility of mere mixture among inorganic substances afford any analogy to sustain the idea of possible hybrid mixture indefinitely perpetuated, among living beings. The mechanical aggregation of units that make up ordinary mixture, is one thing; and the combination that would alter a germ, one of the units in organic species, even to its fundamental nature, is quite another. This last is not aggregation. It is as different from mere mixture as is chemical combination and stands somewhat in the same relation, so that the analogy has no bearing on the question.

### 3. *Variations of Species.*

. But there are variations in species, and this is our next topic. The principles already considered teach, as we believe, that each species has its specific value as a unit, which is essentially permanent or indestructible by any natural source of change; and we have, therefore, to admit in the outset, if these principles are true, that variations have their limits, and cannot extend to the obliteration of the fundamental characteristics of a species.

To understand these variations, we may again appeal to general truths.

Variation is a characteristic of all things finite; and is

involved in the very conditions of existence. No substance or body can be wholly independent of every or any other body in the universe. The most comprehensive and influential law in nature, most fundamental in all change, composition or decomposition, growth or decay, is the law of mutual sympathy, or tendency to equilibrium in force through universal action and reaction.

The planets have their orbits modified by other bodies in space through their changing relations to those bodies. A substance, as oxygen or iron, varies in temperature and state of expansion from the presence of a body of different temperature; in chemical tendencies from the presence of a luminous body like the sun; in magnetic or electrical attraction from surrounding magnetic or electrical influences. There is thus unceasing flow and unceasing change through the universe. All the natural forces are closely related as if a common family or group, and are in constant mutual interplay.

The degree or kind of variation has its specific law for each element; and in this law the specific nature of the element is in a degree expressed. There is to each body or species, the normal or fundamental force in which its very nature consists; and, in addition, the relations of this force to other bodies, or kinds, amounts or conditions of force, upon which its variations depend. One great end of inorganic science is to study out the law of variables for each element or species. For this law is as much a part of an idea of the species, as the fundamental potentiality; indeed the one is a measure of the other.

So again, a species in the *organic* kingdoms is subject to variations, and upon the same principle. Its very development depends on the appropriation of material around it, and on attending physical forces or conditions, all of which are variable through the whole of its history. Every chemical or molecular law in the universe is concerned in the growth, — the laws of heat, light, electricity, cohesion, etc.; and the progress of the developing germ, whatever its primal potentiality, is unavoidably subject to variations,

from the diversified influences to which it may be exposed. The new germ, moreover, takes peculiarities from the parent or from the circumstances to which its ancestry had been exposed during one or more preceding generations.

There is then a fixed normal condition or value, and around it librations take place. There is a central or intrinsic law which prevents a species from being drawn off to its destruction by any external agency, while subject to greater or less variations under extrinsic forces.

Liability to variation is hence part of the law of a species; and we cannot be said to comprehend in any case the complete idea of the 'type until the relations to external forces are also known. The law of variables is as much an expression of the fundamental equalities of the species in organic as in inorganic nature; and it should be the great aim of science to investigate it for every species. It is a source of knowledge which will yet give us a deep insight into the fundamental laws of life. Variations are not to be arranged under the head of *accidents*; for there is nothing accidental in nature; what we so call, are expressions really of profound law, and often betray truth and law which we should otherwise never suspect.

This process of variation, is the external revealing the internal, through their sympathetic relations; it is the law of universal nature reacting on the law of a special nature, and compelling the latter to exhibit its qualities; it is a centre of force manifesting its potentiality, not in its own inner working, but in its outgoings among the equilibrating forces around, and thus offering us, through the known and physical, some measure of the vital within the germ. It is therefore one of the richest sources of truth open to our search.

The limits of variation, it may be difficult to define among species that have close relations. But being sure that there are limits, — that science, in looking for law and order written out in legible characters, is not in fruitless search, we need not despair of discovering them. The

zoologist, gathering shells or mollusks from the coast of eastern America and that of Japan, after careful study, makes out his lists of identical species, with the full assurance that species are definite and stable existences; and he is even surprised with the identity of characters between the individuals of a species gathered from so remote localities. And as he sees zoological geography rising into one of the grandest of the sciences, his faith in species becomes identified with his faith in nature and all physical truth.

If then we may trust this argument from general truths to special, — general *truths* we say, for general principles as far as established are truths — we should conceive of a species from the potential point of view, and regard it as —

a. A concentrated unit of force, an ineffaceable component of the system of nature; but

b. Subject to greater or less librations, according to the universal law of mutual reaction or sympathy among forces.

And, in addition, in the *organic* kingdom,

c. Exhibiting its potentiality, not simply or wholly in any existing condition or action, but through a cycle of growth from the primal germ to maturity, when the new germ comes forth as a repetition of the first to go another round in the cycle and perpetuate the original unit; and, therefore, as follows from a necessary perpetuity of the cycle —

d. Exhibiting identity of species among individuals, by perpetuated fertile intermixture in all normal conditions, and non-identity by the impossibility of such intermixture, the rare cases of continuation for one or two generations, attesting to the stability of the law, by proving the effort of nature to rid herself of the abnormality, and her success in the effort.

e. The many like individuals that are conspecific do not properly constitute the species, but each is an expression of the species in its potentiality under some one phase of its variables; and to understand a species, we must know its law through all its cycle of growth, and its complete series of librations.

We should therefore conceive of the system of nature as involving, in its idea, a system of units, finite constituents at the basis of all things, each fixed in law; these units in inorganic nature as adding to their kinds by combinations in definite propositions; and those in organic nature adding to their numbers of representative individuals, but *not* kinds, by self-reproduction; and all adding to their varieties by mutual reaction or sympathy. Thus from the law within and the law without, under the Being above as the Author and sustainer of all law, the world has its diversity, the cosmos its fulness of beauty.

It may be remarked again, that we must consider this mode of reaching truth, by reasoning from the general to the special, as requiring also its complement, direct observation, to give unwavering confidence to the mind; and we should therefore encourage research with a willingness to receive whatever results come from nature. We should give a high place in our estimate to all investigation tending to elucidate the variation or permanence of species, their mutability or immutability; and at the same time, in order that appearances may not deceive us, we should glance towards other departments of nature, remembering that all truth is harmonious, and comprehensive law the end of science.

A word further upon our conceptions of species as realities. In acquiring the first idea of species, we pass, by induction, as in other cases of generalization, from the special details displayed among individuals to a general notion of a unity of type; and this general notion, when written out in words, we may take as an approximate formula of the species. One system of philosophy thence argues that this result of induction is nothing but a notion of the mind, and that species are but an imaginary product of logic; or at least, that since, as they say (we do not now discuss this point), genera are groupings without definite limits which may be laid off variously by different minds, so species are undefined, and individuals are the only realities — the supposed limits to species being regarded as proof of

partial study, or a consequence of a partial development of the kingdoms of nature. Another system infers, on the contrary, that species are realities, and the general or type-idea has, in some sense, a *real* existence. A third admits that species are essentially realities in nature, but claims that the general idea exists only as a result of logical induction.

The discussion in the preceding pages sustains most nearly the last view, that species are realities in the system of nature while manifest to us only in individuals; that is, they are so far real, that the idea for each is definite, even of mathematical strictness (although not thus precise in our limited view), it proceeding from the mathematical and finite basis of nature. They are the units fixed in the plan of creation; and individuals are the material expressions of those ideal units.

At the same time we learn, that, while species are realities in a most important and fundamental sense, no comprehensive type-idea of a species can be represented in any material or immaterial existence. For while a species has its constants, it has also its variables, each variable becoming a constant so far only as its law and limits of variation are fixed; and in the organic kingdoms, moreover, each individual has its historic phases, from the germ through the cycle of growth. The general idea sought out by induction, therefore, is not made up of *invariables*. Limited to these, it represents no object, class of objects, or law, in nature. The variables are a necessary complement to the *invariables*; and the complete species-idea is present to the mind, only when the image in view is seen to be ever changing along the lines of variables and development. Whatever individualized conception is entertained, it is evidently a conception of the species in one of its phases, — that is, under some one specific condition as to size, form, color, constitution, etc., as regards each part in the structure, from among the many variations in all these respects that are possible: mind can picture to itself individuals only and not species, and one phase at a time in the life of an organic individual, not the whole cycle.

We may attempt to reach what is called the typical form of a species, in order to make this the subject of a conception. But even within the closest range of what may be taken as typical characters, there are still variables; and moreover, we repeat it, no one form, typical though we consider it, can be a full expression of the species, as long as variables are as much an essential part of its idea as constants. The advantage of fixing upon some one variety as the typical form of a species is this, — that the mind may have an initial term for the laws embraced under the idea of the species, or an assumed centre of radiation for its variant series, so as more easily to comprehend those laws.

Again, abrupt transitions and not indefinite shadings have been shown to be the law of nature. In proceeding from special characters to a general species-idea, nature gives us help through her stepping stones and barriers. In former times, man looked at iron and other metals from the outside only, and, searching out their differences of sensible characters, gradually eliminated the general notion of each, by the ordinary logical method of generalization. But science now brings the elements to the line and plummet, and reaches a fixed *number* for iron and other elements as to chemical combination, etc. By this means, the studying out of the idea of a species seems almost to have escaped from the domain of logic into that of direct trial by weights and measures. It is no longer the undefined progress of simple reason, with a mere notion at the end, but an appeal to definite measurable values, with stable numbers at bottom, fixed in the very foundations of the universe. So, in the organic kingdoms, where there is, to our limited minds, still greater indefiniteness in most characters, the barrier against hybridity appears to stand as a physical test of species. We are thus enabled in searching into the nature of a species, to strike from the outside detail to the foundation law.

The type-idea, as it presents itself to the mind, is no more a subject of defined conception than any mathematical expression. Could we put in mathematical terms the precise

law, in all its comprehensiveness, which is at the basis of the species iron, as we can for one of its qualities, that of chemical attraction, this mathematical expression would stand as a representative of the species; and we might use it in calculations, precisely as we can use any mathematical term. So also, if we could write out in numbers the potential nature of an organic species, or of its germ, including the laws of its variables, this expression would be like any other term in the hands of a mathematician; the mind would receive the formula as an expression for the species, and might compare it with the formulas of other species. But, after all, we have here a mere mathematical abstraction, a symbol for an amount or law of force, which can be turned into conceptions, only by imagining (supposing this possible) the force in the course of its evolution of concrete realities, according to the law of development and laws of variations embraced within it.

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## ARTICLE IX.

### NOTICES OF NEW PUBLICATIONS.

#### Mrs. KNIGHT'S LIFE OF MONTGOMERY.<sup>1</sup>

THE early life of the poet Montgomery was a checkered one. At the age of six years, he was placed at the Moravian School, at Fulneck, near Leeds, where, after an interval of six years, he received a visit of three months, from his parents, just before they left their country, as missionaries to the West Indies. His parents he never saw after this visit; as they both died in the field of their missionary labors, about seven years after. Young Montgomery had been intended for the Ministry, but he showed so little interest in study that the Moravian Brethren soon gave up the hope of educating him for this purpose, and placed him in a retail

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<sup>1</sup> Life of James Montgomery. By Mrs. Helen C. Knight, author of "Lady Huntington and her Friends," "Memoirs of Hannah More," etc. Boston: Gould and Lincoln, 1857. 12mo. pp. 416.