

## Chapter XXII.

### Of Uniformities Of Co-Existence Not Dependent On Causation.

§ 1. The order of the occurrence of phenomena in time, is either successive or simultaneous; the uniformities, therefore, which obtain in their occurrence, are either uniformities of succession or of co-existence. Uniformities of succession are all comprehended under the law of causation and its consequences. Every phenomenon has a cause, which it invariably follows; and from this are derived other invariable sequences among the successive stages of the same effect, as well as between the effects resulting from causes which invariably succeed one another.

In the same manner with these derivative uniformities of succession, a great variety of uniformities of co-existence also take their rise. Co-ordinate effects of the same cause naturally co-exist with one another. High water at any point on the earth's surface, and high water at the point diametrically opposite to it, are effects uniformly simultaneous, resulting from the direction in which the combined attractions of the sun and moon act upon the waters of the ocean. An eclipse of the sun to us, and an eclipse of the earth to a spectator situated in the moon, are in like manner phenomena invariably co-existent; and their co-existence can equally be deduced from the laws of their production.

It is an obvious question, therefore, whether all the uniformities of co-existence among phenomena may not be accounted for in this manner. And it can not be doubted that between phenomena which are themselves effects, the co-existences must necessarily depend on the causes of those phenomena. If they are effects immediately or remotely of the same cause, they can not co-exist except by virtue of some laws or properties of that cause; if they are effects of different causes, they can not co-exist unless it be because their causes co-exist; and the uniformity of co-existence, if such there be, between the effects, proves that those particular causes, within the limits of our observation, have uniformly been co-existent.

§ 2. But these same considerations compel us to recognize that there must be one class of co-existences which can not depend on causation: the co-existences between the ultimate properties of things--those properties which are the causes of all phenomena, but are not themselves caused by any phenomenon, and a cause for which could only be sought by ascending to the origin of all things. Yet among these ultimate properties there are not only co-existences, but uniformities of co-existence. General propositions may be, and are, formed, which assert that whenever certain properties are found, certain others are found along with them. We perceive an object; say, for instance, water. We recognize it to be water, of course by certain of its properties. Having recognized it, we are able to affirm of it innumerable other properties; which we could not do unless it were a general truth, a law or uniformity in nature, that the set of properties by which we identify the substance as water always have those other properties conjoined with them.

In a former place(189) it has been explained, in some detail, what is meant by the Kinds of objects; those classes which differ from one another not by a limited and definite, but by an indefinite and unknown, number of distinctions. To this we have now to add, that every proposition by which any thing is asserted of a Kind, affirms a uniformity of co-existence. Since we know nothing of Kinds but their properties, the Kind, to us, *is* the set of properties by which it is identified, and which must of course be sufficient to distinguish it from every other kind.(190) In affirming any thing, therefore, of a Kind, we are affirming something to be uniformly co-existent with the properties by which the kind is recognized; and that is the sole meaning of the assertion.

Among the uniformities of co-existence which exist in nature, may hence be numbered all the properties of Kinds. The whole of these, however, are not independent of causation, but only a portion of them. Some are ultimate properties, others derivative: of some, no cause can be assigned, but others are manifestly dependent on causes. Thus, pure oxygen gas is a Kind, and one of its most unequivocal properties is its gaseous form; this property, however, has for its cause the presence of a certain quantity of latent heat; and if that heat could

be taken away (as has been done from so many gases in Faraday's experiments), the gaseous form would doubtless disappear, together with numerous other properties which depend on, or are caused by, that property.

In regard to all substances which are chemical compounds, and which therefore may be regarded as products of the juxtaposition of substances different in Kind from themselves, there is considerable reason to presume that the specific properties of the compound are consequent, as effects, on some of the properties of the elements, though little progress has yet been made in tracing any invariable relation between the latter and the former. Still more strongly will a similar presumption exist, when the object itself, as in the case of organized beings, is no primeval agent, but an effect, which depends on a cause or causes for its very existence. The Kinds, therefore, which are called in chemistry simple substances, or elementary natural agents, are the only ones, any of whose properties can with certainty be considered ultimate; and of these the ultimate properties are probably much more numerous than we at present recognize, since every successful instance of the resolution of the properties of their compounds into simpler laws, generally leads to the recognition of properties in the elements distinct from any previously known. The resolution of the laws of the heavenly motions established the previously unknown ultimate property of a mutual attraction between all bodies; the resolution, so far as it has yet proceeded, of the laws of crystallization, of chemical composition, electricity, magnetism, etc., points to various polarities, ultimately inherent in the particles of which bodies are composed; the comparative atomic weights of different kinds of bodies were ascertained by resolving into more general laws the uniformities observed in the proportions in which substances combine with one another, and so forth. Thus, although every resolution of a complex uniformity into simpler and more elementary laws has an apparent tendency to diminish the number of the ultimate properties, and really does remove many properties from the list; yet (since the result of this simplifying process is to trace up an ever greater variety of different effects to the same agents) the further we advance in this direction, the greater number of distinct properties we are forced to recognize in one and the same object; the co-existences of which properties must accordingly be ranked among the ultimate generalities of nature.

§ 3. There are, therefore, only two kinds of propositions which assert uniformity of co-existence between properties. Either the properties depend on causes or they do not. If they do, the proposition which affirms them to be co-existent is a derivative law of co-existence between effects, and, until resolved into the laws of causation on which it depends, is an empirical law, and to be tried by the principles of induction to which such laws are amenable. If, on the other hand, the properties do not depend on causes, but are ultimate properties, then, if it be true that they invariably co-exist, they must all be ultimate properties of one and the same Kind; and it is of these only that the co-existences can be classed as a peculiar sort of laws of nature.

When we affirm that all crows are black, or that all negroes have woolly hair, we assert a uniformity of co-existence. We assert that the property of blackness or of having woolly hair invariably co-exists with the properties which, in common language, or in the scientific classification that we adopt, are taken to constitute the class crow, or the class negro. Now, supposing blackness to be an ultimate property of black objects, or woolly hair an ultimate property of the animals which possess it; supposing that these properties are not results of causation, are not connected with antecedent phenomena by any law; then if all crows are black, and all negroes have woolly hair, these must be ultimate properties of the kind *crow*, or *negro*, or of some kind which includes them. If, on the contrary, blackness or woolly hair be an effect depending on causes, these general propositions are manifestly empirical laws; and all that has already been said respecting that class of generalizations may be applied without modification to these.

Now, we have seen that in the case of all compounds--of all things, in short, except the elementary substances and primary powers of nature--the presumption is, that the properties do really depend upon causes; and it is impossible in any case whatever to be certain that they do not. We therefore should not be safe in claiming for any generalization respecting the co-existence of properties, a degree of certainty to which, if the properties should happen to be the result of causes, it would have no claim. A generalization respecting co-existence, or, in other words, respecting the properties of kinds, may be an ultimate truth, but it may also be merely a

derivative one; and since, if so, it is one of those derivative laws which are neither laws of causation nor have been resolved into the laws of causation on which they depend, it can possess no higher degree of evidence than belongs to an empirical law.

§ 4. This conclusion will be confirmed by the consideration of one great deficiency, which precludes the application to the ultimate uniformities of co-existence, of a system of rigorous scientific induction, such as the uniformities in the succession of phenomena have been found to admit of. The basis of such a system is wanting; there is no general axiom standing in the same relation to the uniformities of co-existence as the law of causation does to those of succession. The Methods of Induction applicable to the ascertainment of causes and effects are grounded on the principle that every thing which has a beginning must have some cause or other; that among the circumstances which actually existed at the time of its commencement, there is certainly some one combination, on which the effect in question is unconditionally consequent, and on the repetition of which it would certainly again recur. But in an inquiry whether some kind (as crow) universally possesses a certain property (as blackness), there is no room for any assumption analogous to this. We have no previous certainty that the property must have something which constantly co-exists with it; must have an invariable co-existent, in the same manner as an event must have an invariable antecedent. When we feel pain, we must be in some circumstances under which, if exactly repeated, we should always feel pain. But when we are conscious of blackness, it does not follow that there is something else present of which blackness is a constant accompaniment. There is, therefore, no room for elimination; no method of Agreement or Difference, or of Concomitant Variations (which is but a modification either of the Method of Agreement or of the Method of Difference). We can not conclude that the blackness we see in crows must be an invariable property of crows merely because there is nothing else present of which it can be an invariable property. We therefore inquire into the truth of a proposition like "All crows are black," under the same disadvantage as if, in our inquiries into causation, we were compelled to let in, as one of the possibilities, that the effect may in that particular instance have arisen without any cause at all.

To overlook this grand distinction was, as it seems to me, the capital error in Bacon's view of inductive philosophy. The principle of elimination, that great logical instrument which he had the immense merit of first bringing into general use, he deemed applicable in the same sense, and in as unqualified a manner, to the investigation of the co-existences, as to that of the successions of phenomena. He seems to have thought that as every event has a cause, or invariable antecedent, so every property of an object has an invariable co-existent, which he called its form; and the examples he chiefly selected for the application and illustration of his method, were inquiries into such forms; attempts to determine in what else all those objects resembled, which agreed in some one general property, as hardness or softness, dryness or moistness, heat or coldness. Such inquiries could lead to no result. The objects seldom have any such circumstances in common. They usually agree in the one point inquired into, and in nothing else. A great proportion of the properties which, so far as we can conjecture, are the likeliest to be really ultimate, would seem to be inherently properties of many different kinds of things not allied in any other respect. And as for the properties which, being effects of causes, we are able to give some account of, they have generally nothing to do with the ultimate resemblances or diversities in the objects themselves, but depend on some outward circumstances, under the influence of which any objects whatever are capable of manifesting those properties; as is emphatically the case with those favorite subjects of Bacon's scientific inquiries, hotness and coldness, as well as with hardness and softness, solidity and fluidity, and many other conspicuous qualities.

In the absence, then, of any universal law of co-existence similar to the universal law of causation which regulates sequence, we are thrown back upon the unscientific induction of the ancients, *per enumerationem simplicem, ubi non reperitur instantia contradictoria*. The reason we have for believing that all crows are black, is simply that we have seen and heard of many black crows, and never one of any other color. It remains to be considered how far this evidence can reach, and how we are to measure its strength in any given case.

§ 5. It sometimes happens that a mere change in the mode of verbally enunciating a question, though nothing

is really added to the meaning expressed, is of itself a considerable step toward its solution. This, I think, happens in the present instance. The degree of certainty of any generalization which rests on no other evidence than the agreement, so far as it goes, of all past observation, is but another phrase for the degree of improbability that an exception, if any existed, could have hitherto remained unobserved. The reason for believing that all crows are black, is measured by the improbability that crows of any other color should have existed to the present time without our being aware of it. Let us state the question in this last mode, and consider what is implied in the supposition that there may be crows which are not black, and under what conditions we can be justified in regarding this as incredible.

If there really exist crows which are not black, one of two things must be the fact. Either the circumstance of blackness, in all crows hitherto observed, must be, as it were, an accident, not connected with any distinction of Kind; or if it be a property of Kind, the crows which are not black must be a new Kind, a Kind hitherto overlooked, though coming under the same general description by which crows have hitherto been characterized. The first supposition would be proved true if we were to discover casually a white crow among black ones, or if it were found that black crows sometimes turn white. The second would be shown to be the fact if in Australia or Central Africa a species or a race of white or gray crows were found to exist.

§ 6. The former of these suppositions necessarily implies that the color is an effect of causation. If blackness, in the crows in which it has been observed, be not a property of Kind, but can be present or absent without any difference generally in the properties of the object, then it is not an ultimate fact in the individuals themselves, but is certainly dependent on a cause. There are, no doubt, many properties which vary from individual to individual of the same Kind, even the same *infima species*, or lowest Kind. Some flowers may be either white or red, without differing in any other respect. But these properties are not ultimate; they depend on causes. So far as the properties of a thing belong to its own nature, and do not arise from some cause extrinsic to it, they are always the same in the same Kind. Take, for instance, all simple substances and elementary powers; the only things of which we are certain that some at least of their properties are really ultimate. Color is generally esteemed the most variable of all properties: yet we do not find that sulphur is sometimes yellow and sometimes white, or that it varies in color at all, except so far as color is the effect of some extrinsic cause, as of the sort of light thrown upon it, the mechanical arrangement of the particles (as after fusion), etc. We do not find that iron is sometimes fluid and sometimes solid at the same temperature; gold sometimes malleable and sometimes brittle; that hydrogen will sometimes combine with oxygen and sometimes not; or the like. If from simple substances we pass to any of their definite compounds, as water, lime, or sulphuric acid, there is the same constancy in their properties. When properties vary from individual to individual, it is either in the case of miscellaneous aggregations, such as atmospheric air or rock, composed of heterogeneous substances, and not constituting or belonging to any real Kind,(191) or it is in the case of organic beings. In them, indeed, there is variability in a high degree. Animals of the same species and race, human beings of the same age, sex, and country, will be most different, for example, in face and figure. But organized beings (from the extreme complication of the laws by which they are regulated) being more eminently modifiable, that is, liable to be influenced by a greater number and variety of causes, than any other phenomena whatever; having also themselves had a beginning, and therefore a cause; there is reason to believe that none of their properties are ultimate, but all of them derivative, and produced by causation. And the presumption is confirmed, by the fact that the properties which vary from one individual to another, also generally vary more or less at different times in the same individual; which variation, like any other event, supposes a cause, and implies, consequently, that the properties are not independent of causation.

If, therefore, blackness be merely accidental in crows, and capable of varying while the Kind remains the same, its presence or absence is doubtless no ultimate fact, but the effect of some unknown cause: and in that case the universality of the experience that all crows are black is sufficient proof of a common cause, and establishes the generalization as an empirical law. Since there are innumerable instances in the affirmative, and hitherto none at all in the negative, the causes on which the property depends must exist everywhere in the limits of the observations which have been made; and the proposition may be received as universal within those limits, and with the allowable degree of extension to adjacent cases.

§ 7. If, in the second place, the property, in the instances in which it has been observed, is not an effect of causation, it is a property of Kind; and in that case the generalization can only be set aside by the discovery of a new Kind of crow. That, however, a peculiar Kind not hitherto discovered should exist in nature, is a supposition so often realized that it can not be considered at all improbable. We have nothing to authorize us in attempting to limit the Kinds of things which exist in nature. The only unlikelihood would be that a new Kind should be discovered in localities which there was previously reason to believe had been thoroughly explored; and even this improbability depends on the degree of conspicuousness of the difference between the newly-discovered Kind and all others, since new kinds of minerals, plants, and even animals, previously overlooked or confounded with known species, are still continually detected in the most frequented situations. On this second ground, therefore, as well as on the first, the observed uniformity of co-existence can only hold good as an empirical law, within the limits not only of actual observation, but of an observation as accurate as the nature of the case required. And hence it is that (as remarked in an early chapter of the present book) we so often give up generalizations of this class at the first summons. If any credible witness stated that he had seen a white crow, under circumstances which made it not incredible that it should have escaped notice previously, we should give full credence to the statement.

It appears, then, that the uniformities which obtain in the co-existence of phenomena--those which we have reason to consider as ultimate, no less than those which arise from the laws of causes yet undetected--are entitled to reception only as empirical laws; are not to be presumed true except within the limits of time, place, and circumstance, in which the observations were made, or except in cases strictly adjacent.

§ 8. We have seen in the last chapter that there is a point of generality at which empirical laws become as certain as laws of nature, or, rather, at which there is no longer any distinction between empirical laws and laws of nature. As empirical laws approach this point, in other words, as they rise in their degree of generality, they become more certain; their universality may be more strongly relied on. For, in the first place, if they are results of causation (which, even in the class of uniformities treated of in the present chapter, we never can be certain that they are not) the more general they are, the greater is proved to be the space over which the necessary collocations prevail, and within which no causes exist capable of counteracting the unknown causes on which the empirical law depends. To say that any thing is an invariable property of some very limited class of objects, is to say that it invariably accompanies some very numerous and complex group of distinguishing properties; which, if causation be at all concerned in the matter, argues a combination of many causes, and therefore a great liability to counteraction; while the comparatively narrow range of the observations renders it impossible to predict to what extent unknown counteracting causes may be distributed throughout nature. But when a generalization has been found to hold good of a very large proportion of all things whatever, it is already proved that nearly all the causes which exist in nature have no power over it; that very few changes in the combination of causes can affect it; since the greater number of possible combinations must have already existed in some one or other of the instances in which it has been found true. If, therefore, any empirical law is a result of causation, the more general it is, the more it may be depended on. And even if it be no result of causation, but an ultimate co-existence, the more general it is, the greater amount of experience it is derived from, and the greater therefore is the probability that if exceptions had existed, some would already have presented themselves.

For these reasons, it requires much more evidence to establish an exception to one of the more general empirical laws than to the more special ones. We should not have any difficulty in believing that there might be a new Kind of crow; or a new kind of bird resembling a crow in the properties hitherto considered distinctive of that Kind. But it would require stronger proof to convince us of the existence of a Kind of crow having properties at variance with any generally recognized universal property of birds; and a still higher degree if the properties conflict with any recognized universal property of animals. And this is conformable to the mode of judgment recommended by the common sense and general practice of mankind, who are more incredulous as to any novelties in nature, according to the degree of generality of the experience which these novelties seem to contradict.

§ 9. It is conceivable that the alleged properties might conflict with some recognized universal property of all matter. In that case their improbability would be at the highest, but would not even then amount to incredibility. There are only two known properties common to all matter; in other words, there is but one known uniformity of co-existence of properties co-extensive with all physical nature, namely, that whatever opposes resistance to movement gravitates, or, as Professor Bain expresses it, Inertia and Gravity are co-existent through all matter, and proportionate in their amount. These properties, as he truly says, are not mutually implicated; from neither of them could we, on grounds of causation, presume the other. But, for this very reason, we are never certain that a Kind may not be discovered possessing one of the properties without the other. The hypothetical ether, if it exists, may be such a Kind. Our senses can not recognize in it either resistance or gravity; but if the reality of a resisting medium should eventually be proved (by alteration, for example, in the times of revolution of periodic comets, combined with the evidences afforded by the phenomena of light and heat), it would be rash to conclude from this alone, without other proofs, that it must gravitate.

For even the greater generalizations, which embrace comprehensive Kinds containing under them a great number and variety of *infimæ species*, are only empirical laws, resting on induction by simple enumeration merely, and not on any process of elimination--a process wholly inapplicable to this sort of case. Such generalizations, therefore, ought to be grounded on an examination of all the *infimæ species* comprehended in them, and not of a portion only. We can not conclude (where causation is not concerned), because a proposition is true of a number of things resembling one another only in being animals, that it is therefore true of all animals. If, indeed, any thing be true of species which differ more from one another than either differs from a third, especially if that third species occupies in most of its known properties a position between the two former, there is some probability that the same thing will also be true of that intermediate species; for it is often, though by no means universally, found, that there is a sort of parallelism in the properties of different Kinds, and that their degree of unlikeness in one respect bears some proportion to their unlikeness in others. We see this parallelism in the properties of the different metals; in those of sulphur, phosphorus, and carbon; of chlorine, iodine, and bromine; in the natural orders of plants and animals, etc. But there are innumerable anomalies and exceptions to this sort of conformity; if indeed the conformity itself be any thing but an anomaly and an exception in nature.

Universal propositions, therefore, respecting the properties of superior Kinds, unless grounded on proved or presumed connection by causation, ought not to be hazarded except after separately examining every known sub-kind included in the larger Kind. And even then such generalizations must be held in readiness to be given up on the occurrence of some new anomaly, which, when the uniformity is not derived from causation, can never, even in the case of the most general of these empirical laws, be considered very improbable. Thus, all the universal propositions which it has been attempted to lay down respecting simple substances, or concerning any of the classes which have been formed among simple substances (and the attempt has been often made), have, with the progress of experience, either faded into inanity, or been proved to be erroneous; and each Kind of simple substance remains, with its own collection of properties apart from the rest, saving a certain parallelism with a few other Kinds, the most similar to itself. In organized beings, indeed, there are abundance of propositions ascertained to be universally true of superior genera, to many of which the discovery hereafter of any exceptions must be regarded as extremely improbable. But these, as already observed, are, we have every reason to believe, properties dependent on causation.(192)

Uniformities of co-existence, then, not only when they are consequences of laws of succession, but also when they are ultimate truths, must be ranked, for the purpose of logic, among empirical laws; and are amenable in every respect to the same rules with those unresolved uniformities which are known to be dependent on causation.(193)