CHAPTER XXI

Division and Classification

Section 1. Classification, in its widest sense, is a mental grouping of facts or phenomena according to their resemblances and differences, so as best to serve some purpose. A "mental grouping": for although in museums we often see the things themselves arranged in classes, yet such an arrangement only contains specimens representing a classification. The classification itself may extend to innumerable objects most of which have never been seen at all. Extinct animals, for example, are classified from what we know of their fossils; and some of the fossils may be seen arranged in a museum; but the animals themselves have disappeared for many ages.

Again, things are classed according to their resemblances and differences: that is to say, those that most closely resemble one another are classed together on that ground; and those that differ from one another in important ways, are distributed into other classes. The more the things differ, the wider apart are their classes both in thought and in the arrangements of a museum. If their differences are very great, as with animals, vegetables and minerals, the classing of them falls to different departments of thought or science, and is often represented in different museums, zoological, botanical, mineralogical.

We must not, however, suppose that there is only one way of classifying things. The same objects may be classed in various ways according to the purpose in view. For gardening, we are usually content to classify plants into trees, shrubs, flowers, grasses and weeds; the ordinary crops of English agriculture are distinguished, in settling their rotation, into white and green; the botanist divides the higher plants into gymnosperms and angiosperms, and the latter into monocotyledons and dicotyledons. The principle of resemblance and difference is recognised in all these cases; but what resemblances or differences are important depends upon the purpose to be served.

Purposes are either (α) special or practical, as in gardening or hunting, or (β) general or scientific, as in Botany or Zoology. The scientific purpose is merely knowledge; it may indeed subserve all particular or practical ends, but has no other end than knowledge directly in view. And whilst, even for knowledge, different classifications may be suitable for different lines of inquiry, in Botany and Zoology the Morphological Classification is that which gives the most general and comprehensive knowledge (see Huxley, On the Classification of Animals, ch. 1). Most of what a logician says about classification is applicable to the practical kind; but the scientific (often called 'Natural Classification'), as the most thorough and comprehensive, is what he keeps most constantly before him.

Scientific classification comes late in human history, and at first works over earlier classifications which have been made by the growth of intelligence, of language, and of the practical arts. Even in the distinctions recognised by animals, may be traced the grounds of classification: a cat does not confound a dog with one of its own species, nor water with milk, nor cabbage with fish. But it is in the development of language that the progress of instinctive classification may best be seen. The use of general names implies the recognition of classes of things corresponding to them, which form their denotation, and whose resembling qualities, so far as recognised, form their connotation; and such names are of many degrees of generality. The use of abstract names shows that the objects classed have also been analysed, and that their resembling qualities have been recognised amidst diverse groups of qualities.

Of the classes marked by popular language it is worth while to distinguish two sorts (cf. chap. xix. Section 4): Kinds, and those having but few points of agreement.

But the popular classifications, made by language and the primitive arts, are very imperfect. They omit innumerable things which have not been found useful or noxious, or have been inconspicuous, or have not happened to occur in the region inhabited by those who speak a particular language; and even things recognised and named may have been very superficially examined, and therefore wrongly classed, as when a whale or porpoise is called a fish, or a

slowworm is confounded with snakes. A scientific classification, on the other hand, aims at the utmost comprehensiveness, ransacking the whole world from the depths of the earth to the remotest star for new objects, and scrutinising everything with the aid of crucible and dissecting knife, microscope and spectroscope, to find the qualities and constitution of everything, in order that it may be classed among those things with which it has most in common and distinguished from those other things from which it differs. A scientific classification continually grows more comprehensive, more discriminative, more definitely and systematically coherent. Hence the uses of classification may be easily perceived.

Section 2. The first use of classification is the better understanding of the facts of Nature (or of any sphere of practice); for understanding consists in perceiving and comprehending the likeness and difference of things, in assimilating and distinguishing them; and, in carrying out this process systematically, new correlations of properties are continually disclosed. Thus classification is closely analogous to explanation. Explanation has been shown (chap. xix. Section 5) to consist in the discovery of the laws or causes of changes in Nature; and laws and causes imply similarity, or like changes under like conditions: in the same way classification consists in the discovery of resemblances in the things that undergo change. We may say (subject to subsequent qualifications) that Explanation deals with Nature in its dynamic, Classification in its static aspect. In both cases we have a feeling of relief. When the cause of any event is pointed out, or an object is assigned its place in a system of classes, the gaping wonder, or confusion, or perplexity, occasioned by an unintelligible thing, or by a multitude of such things, is dissipated. Some people are more than others susceptible of this pleasure and fastidious about its purity.

A second use of classification is to aid the memory. It strengthens memory, because one of the conditions of our recollecting things is, that they resemble what we last thought of; so that to be accustomed to study and think of things in classes must greatly facilitate recollection. But, besides this, a classification enables us easily to run over all the contrasted and related things that we want

to think of. Explanation and classification both tend to rationalise the memory, and to organise the mind in correspondence with Nature.

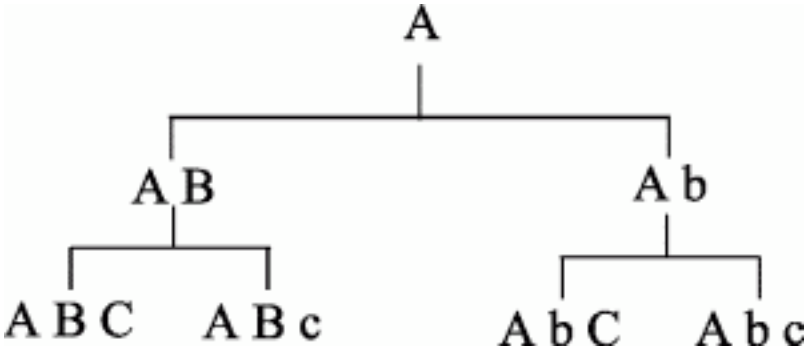
Every one knows how a poor mind is always repeating itself, going by rote through the same train of words, ideas, actions; and that such a mind is neither interesting nor practical. It is not practical, because the circumstances of life are rarely exactly repeated, so that for a present purpose it is rarely enough to remember only one former case; we need several, that by comparing (perhaps automatically) their resemblances and differences with the one before us, we may select a course of action, or a principle, or a parallel, suited to our immediate needs. Greater fertility and flexibility of thought seem naturally to result from the practice of explanation and classification. But it must be honestly added, that the result depends upon the spirit in which such study is carried on; for if we are too fond of finality, too eager to believe that we have already attained a greater precision and comprehension than are in fact attainable, nothing can be more petrific than 'science,' and our last state may be worse than the first. Of this, students of Logic have often furnished examples.

Section 3. Classification may be either Deductive or Inductive; that is to say, in the formation of classes, as in the proof of propositions, we may, on the whole, proceed from the more to the less, or from the less to the more general; not that these two processes are entirely independent.

If we begin with some large class, such as 'Animal,' and subdivide it deductively into Vertebrate and Invertebrate, yet the principle of division (namely, central structure) has first been reached by a comparison of examples and by generalisation; if, on the other hand, beginning with individuals, we group them inductively into classes, and these again into wider ones (as dogs, rats, horses, whales and monkeys into mammalia) we are guided both in special cases by hypotheses as to the best grounds of resemblance, and throughout by the general principle of classification–to associate things that are alike and to separate things that are unlike. This principle holds implicitly a place in classification similar to that of causation in explanation; both are principles of intelligence. Here,

then, as in proof, induction is implied in deduction, and deduction in induction. Still, the two modes of procedure may be usefully distinguished: in deduction, we proceed from the idea of a whole to its parts, from general to special; in induction, from special (or particular) to general, from parts to the idea of a whole.

Section 4. The process of Deductive Classification, or Formal Division, may be represented thus:



Given any class (A) to be divided:

1. Select one important character, attribute, or quality (B), not common to all the individuals comprehended in the class, as the basis of division (fundamentum divisionis).

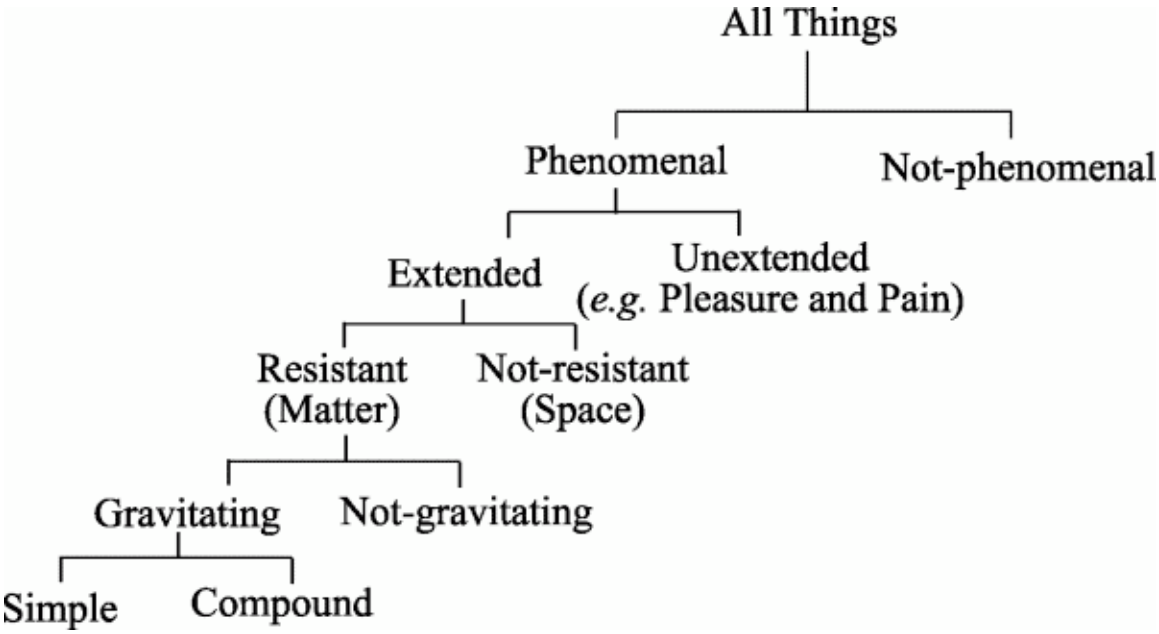
2. Proceed by Dichotomy; that is, cut the given class into two, one having the selected attribute (say, B), the other not having it (b). This, like all formal processes, assumes the principles of Contradiction and Excluded Middle, that 'No A is both B and not-B,' and that 'Every A is either B or not-B' (chap. vi. Section 3); and if these principles are not true, or not applicable, the method fails.

When a class is thus subdivided, it may be called, in relation to its subclasses, a Genus; and in relation to it, the subclasses may be called Species: thus–genus A, species AB and Ab, etc.

3. Proceed gradually in the order of the importance of characters; that is, having divided the given class, subdivide on the same principle the two classes thence arising; and so again and again, step by step, until all the characters are exhausted: Divisio ne fiat

per saltum.

Suppose we were to attempt an exhaustive classification of things by this method, we must begin with 'All Things,' and divide them (say) into phenomenal and not-phenomenal, and then subdivide phenomena, and so on, thus:



Having subdivided 'Simple' by all possible characters, we must then go back and similarly subdivide Not-phenomenal, Unextended, Not-resistant, Not-gravitating, and Compound. Now, if we knew all possible characters, and the order of their importance, we might prepare a priori a classification of all possible things; at least, of all things that come under the principles of Contradiction and Excluded Middle. Many of our compartments might contain nothing actual; there may, for example, be nothing that is not phenomenal to some mind, or nothing that is extended and not-resistant (no vacuum), and so forth. This would imply a breach of the rule, that the dividing quality be not common to the whole class; but, in fact, doubts have been, and are, seriously entertained whether these compartments are filled or not. If they are not, we have concepts representing nothing, which have been generated by the mere force of grammatical negation, or by the habit of thinking according to the principle of Excluded Middle; and, on the strength of these empty concepts, we have been misled

into dividing by an attribute, which (being universal) cannot be a fundamentum divisionis. But though in such a classification places might be empty, there would be a place for everything; for whatever did not come into some positive class (such as Gravitating) must fall under one of the negative classes (the 'Nots') that run down the right-hand side of the Table and of its subdivisions.

This is the ideal of classification. Unfortunately we have to learn what characters or attributes are possible, by experience and comparison; we are far from knowing them all: and we do not know the order of their importance; nor are we even clear what 'important' means in this context, whether 'widely prevalent,' or 'ancient,' or 'causally influential,' or 'indicative of others.' Hence, in classifying actual things, we must follow the inductive method of beginning with particulars, and sorting them according to their likeness and difference as discovered by investigation. The exceptional cases, in which deduction is really useful, occur where certain limits to the number and combination of qualities happen to be known, as they may be in human institutions, or where there are mathematical conditions. Thus, we might be able to classify orders of Architecture, or the classical metres and stanzas of English poetry; though, in fact, these things are too free, subtle and complex for deductive treatment: for do not the Arts grow like trees? The only sure cases are mathematical; as we may show that there are possible only three kinds of plane triangles, four conic sections, five regular solids.

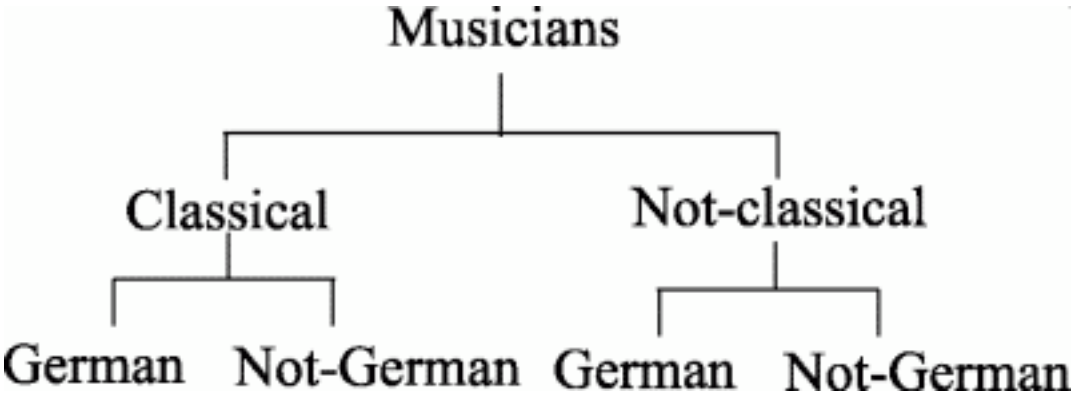
Section 5. The rules for testing a Division are as follows:

1. Each Sub-class, or Species, should comprise less than the Class, or Genus, to be divided. This provides that the division shall be a real one, and not based upon an attribute common to the whole class; that, therefore, the first rule for making a division shall have been adhered to. But, as in Section 4, we are here met by a logical difficulty. Suppose that the class to be divided is A, and that we attempt to divide upon the attribute B, into AB and Ab; is this a true division, if we do not know any A that is not B? As far as our knowledge extends, we have not divided A at all. On the other hand, our knowledge of concrete things is never exhaustive; so

that, although we know of no A that is not B, it may yet exist, and we have seen that it is a logical caution not to assume what we do not know. In a deductive classification, at least, it seems better to regard every attribute as a possible ground of division. Hence, in the above division of 'All Things,'–'Not-phenomenal,' 'Extended-Not-resistant,' 'Resistant-Not-gravitating,' appear as negative classes (that is, classes based on the negation of an attribute), although their real existence may be doubtful. But, if this be justifiable, we must either rewrite the first test of a division thus: 'Each sub-class should possibly comprise less than the class to be divided'; or else we must confine the test to (a) thoroughly empirical divisions, as in dividing Colour into Red and Not-red, where we know that both sub-classes are real; and (b) divisions under demonstrable conditions–as in dividing the three kinds of triangles by the quality equilateral, we know that it is only applicable to acute-angled triangles, and do not attempt to divide the right-angled or obtuse-angled by it.

2. The Sub-classes taken together should be equal to the Class to be divided: the sum of the Species constitutes the Genus. This provides that the division shall be exhaustive; which dichotomy always secures, according to the principle of Excluded Middle; because whatever is not in the positive class, must be in the negative: Red and Not-red include all colours.

3. The Sub-classes must be opposed or mutually exclusive: Species must not overlap. This again is secured by dichotomy, according to the principle of Contradiction, provided the division be made upon one attribute at a time. But, if we attempt to divide simultaneously upon two attributes, as 'Musicians' upon 'nationality' and 'method,' we get what is called a Cross-division, thus 'German Musicians.' 'Not-German,' 'Classical,' 'Not-Classical;' for these classes may overlap, the same men sometimes appearing in two groups–Bach in 'German' and 'Classical,' Pergolesi in 'Not-German' and 'Classical.' If, however, we divide Musicians upon these attributes successively, cross division will be avoided, thus:



Here no Musician will be found in two classes, unless he has written works in two styles, or unless there are works whose style is undecided. This "unless–or unless" may suggest caution in using dichotomy as a short cut to the classification of realities.

4. No Sub-class must include anything that is not comprised in the class to be divided: the Genus comprises all the Species. We must not divide Dogs into fox-terriers and dog-fish.

Section 6. The process of Inductive Classification may be represented thus:

Given any multitude of individuals to be classified:

(1) Place together in groups (or in thought) those things that have in common the most, the most widely diffused and the most important qualities.

(2) Connect those groups which have, as groups, the greater resemblance, and separate those that have the greater difference.

(3) Demarcate, as forming higher or more general classes, those groups of groups that have important characters in common; and, if possible, on the same principle, form these higher classes into classes higher still: that is to say, graduate the classification upwards.

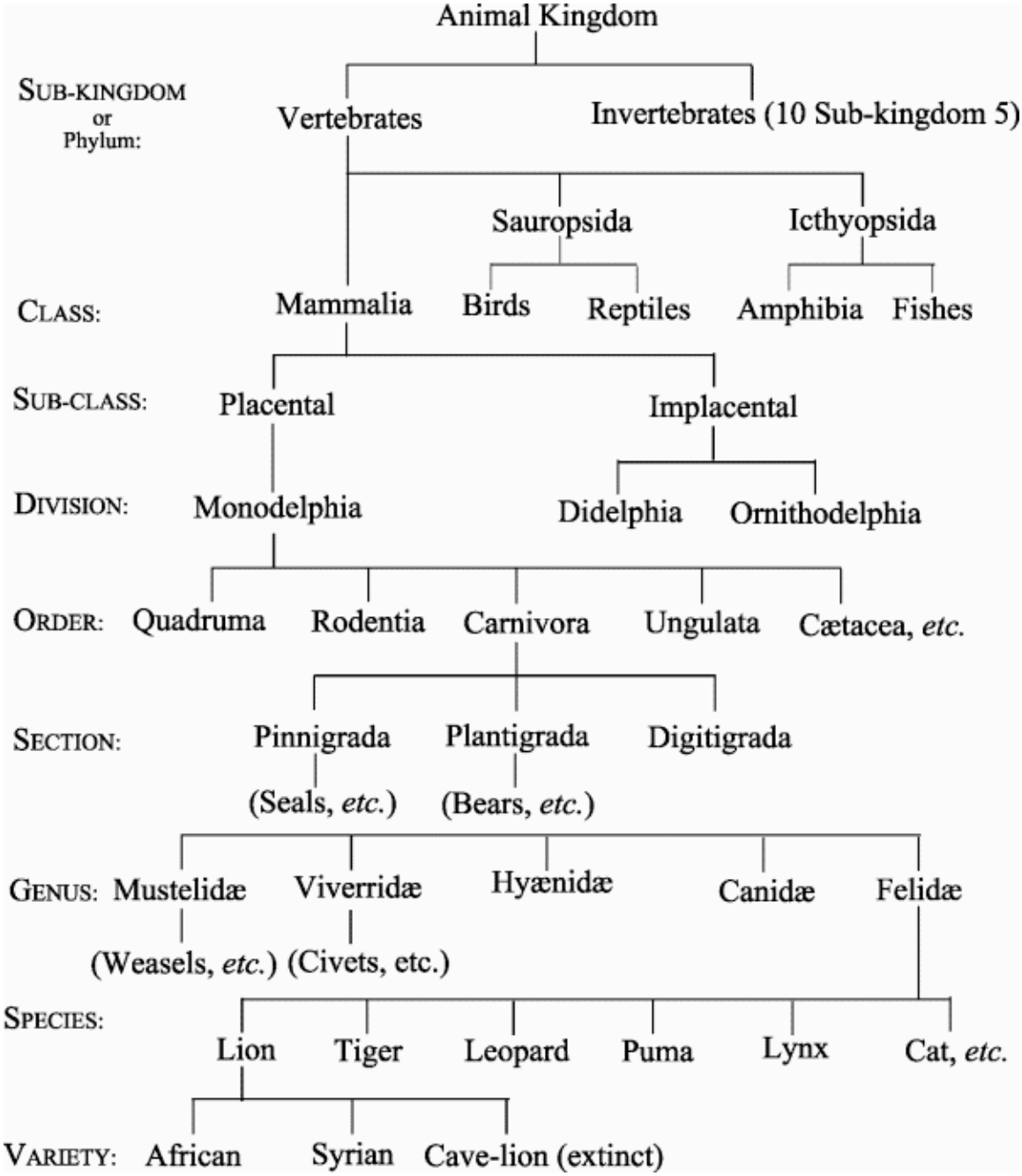
Whilst in Division the terms 'Genus' and 'Species' are entirely relative to one another and have no fixed positions in a gradation of classes, it has been usual, in Inductive Classification, to confine

the term ‘Species’ to classes regarded as lowest in the scale, to give the term ‘Genera’ to classes on the step above, and at each higher step to find some new term such as ‘Tribe,’ ‘Order,’ ‘Sub-kingdom,’ ‘Kingdom’; as may be seen by turning to any book on Botany or Zoology. If, having fixed our Species, we find them subdivisible, it is usual to call the Sub-species ‘Varieties.’

Suppose an attempt to classify by this method the objects in a sitting-room. We see at a glance carpets, mats, curtains, grates, fire-irons, coal-scuttles, chairs, sofas, tables, books, pictures, musical instruments, etc. These may be called ‘Species.’ Carpets and mats go together; so do chairs and sofas; so do grates, fire-irons, and coal-scuttles and so on. These greater groups, or higher classes, are ‘Genera.’ Putting together carpets, mats and curtains as ‘warmth-fabrics’; chairs, sofas and tables as ‘supports’; books, pictures and musical instruments as ‘means of culture’; these groups we may call Orders. Sum up the whole as, from the housewife’s point of view, ‘furniture.’ If we then subdivide some of the species, as books into poetry, novels, travels, etc., these Sub-species may be considered ‘Varieties.’

A Classification thus made, may be tested by the same rules as those given for testing a Division; but if it does not stand the test, we must not infer that the classification is a bad one. If the best possible, it is good, though formally imperfect: whatever faults are found must then be charged upon the ‘matter,’ which is traditionally perverse and intractable. If, for example, there is a hammock in the room, it must be classed not with the curtains as a warmth-fabric, but with the sofas as a support; and books and pictures may be classed as, in a peculiar sense, means of culture, though all the objects in the room may have been modified and assorted with a view to gratifying and developing good taste.

Section 7. The difficulty of classifying natural objects is very great. It is not enough to consider their external appearance: exhaustive knowledge of their internal structure is necessary, and of the functions of every part of their structure. This is a matter of immense research, and has occupied many of the greatest minds for very many years. The following is a tabular outline of the classification of the animal kingdom.



As there is not space enough to tabulate such a classification in full, I have developed at each step the most interesting groups: Vertebrates, Mammalia, Monodelphia Carnivora, Digitigrada, FelidÃ_, Lion. Most of the other groups in each grade are also subdivisible, though some of them contain far fewer sub-classes than others.

To see the true character of this classification, we must consider

that it is based chiefly upon knowledge of existing animals. Some extinct animals, known by their fossils, find places in it; for others new places have been made. But it represents, on the whole, a cross-section, or cross-sections of Nature as developing in time; and, in order to give a just view of the relations of animals, it must be seen in the light of other considerations. The older systems of classification, and the rules for making them, seem to have assumed that an actual system of classes, or of what Mill calls 'Kinds,' exists in nature, and that the relations of Kinds in this system are determined by quantity of resemblance in co-inherent qualities, as the ground of their affinity.

Section 8. Darwin's doctrine of the origin of species affects the conception of natural classification in several ways, (1) If all living things are blood-relations, modified in the course of ages according to their various conditions of life, 'affinity' must mean 'nearness of common descent'; and it seems irrational to propose a classification upon any other basis. We have to consider the Animal (or the Vegetable) Kingdom as a family tree, exhibiting a long line of ancestors, and (descended from them) all sorts of cousins, first, second, third, etc., perhaps once, twice, or oftener 'removed.' Animals in the relation of first cousins must be classed as nearer than second cousins, and so on.

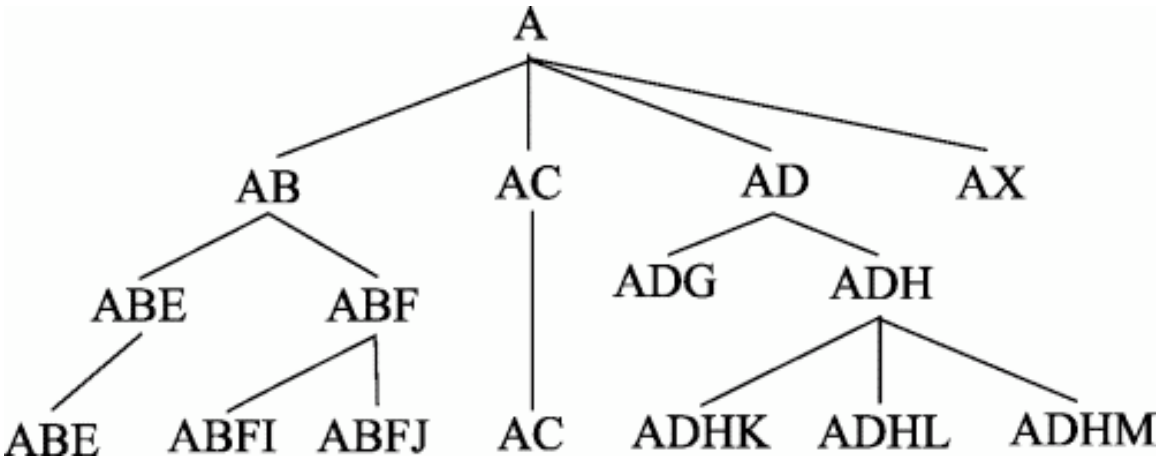
But, if we accept this principle, and are able to trace relationship, it may not lead to the same results as would be reached by simply relying upon the present 'quantity of resemblance,' unless we understand this in a very particular way. For the most obvious features of an animal may have been recently acquired; which often happens with those characters that adapt an animal to its habits of life, as the wings of a bat, or the fish-like shape of a dolphin; or as in cases of 'mimicry.' Some butterflies, snakes, etc., have grown to resemble closely, in a superficial way, other butterflies and snakes, from which a stricter investigation widely separates them; and this superficial resemblance is probably a recent acquisition, for the sake of protection; the imitated butterflies being nauseous, and the imitated snakes poisonous. On the other hand, ancient and important traits of structure may, in some species, have dwindled into inconspicuous survivals or be still found only in the embryo; so that only great knowledge and

sagacity can identify them; yet upon ancient traits, though hidden, classification depends. The seal seems nearer allied to the porpoise than to the tiger, the shrew nearer to the mouse than to the hedgehog; and the Tasmanian wolf looks more like a true wolf, the Tasmanian devil more like a badger, than like a kangaroo: yet the seal is nearer akin to the tiger, the shrew to the hedgehog, and the Tasmanian flesh-eaters are marsupial, like the kangaroo. To overcome this difficulty we must understand the resemblance upon which classification is based to include resemblance of Causation, that is, the fact itself of descent from common ancestors. For organic beings, all other rules of classification are subordinate to one: trace the genealogy of every form.

By this rule we get a definite meaning for the phrase 'important or fundamental attribute' as determining organic classes; namely, most ancient, or 'best serving to indicate community of origin.' Grades of classification will be determined by such fundamental characters, and may correspond approximately to the more general types (now extinct) from which existing animals have descended.

(2) By the hypothesis of development the fixity of species is discredited. The lowest grade of a classification is made up not of well-defined types unchanging from age to age, but of temporary species, often connected by uncertain and indistinct varieties: some of which may, in turn, if the conditions of their existence alter, undergo such changes as to produce new species. Hence the notion that Kinds exist in organic nature must be greatly modified. During a given period of a few thousand years, Kinds may be recognised, because, under such conditions as now prevail in the world, that period of time is insufficient to bring about great changes. But, if it be true that lions, tigers, and leopards have had a common ancestor, from whose type they have gradually diverged, it is plain that their present distinctness results only from the death of intermediate specimens and the destruction of intermediate varieties. Were it possible to restore, by the evidence of fossils, all the ranks of the great processions that have descended from the common ancestor, there would nowhere occur a greater difference than between offspring and parents; and the appearance of Kinds existing in nature, which is so striking in a museum or zoological garden, would entirely vanish.

A classification, then, as formerly observed, represents a cross-section of nature as developing in time: could we begin at the beginning and follow this development down the course of time, we should find no classes, but an ever-moving, changing, spreading, branching continuum. It may be represented thus: Suppose an animal (or plant) A, extending over a certain geographical area, subject to different influences and conditions of climate, food, hill and plain, wood and prairie, enemies and rivals, and undergoing modifications here and there in adaptation to the varying conditions of life: then varieties appear. These varieties, diverging more and more, become distinct species (AB, AC, AD, AX). Some of these species, the more widely diffused, again produce varieties; which, in turn become species (ABE, ABF, ADG, ADH). From these, again, ABE, ABFI, ABFJ, AC, ADHK, ADHL, ADHM, the extant species, descend.



If in this age a classifier appears, he finds seven living species, which can be grouped into four genera (ABE, ABF, AC, ADH), and these again into three Families (AB, AC, AD), all forming one Order. But the animals which were their ancestors are all extinct. If the fossils of any of them–say AB, ADG and AX–can be found, he has three more species, one more genus (ADG), and one more family (AX). For AC, which has persisted unchanged, and AX, which has become extinct, are both of them Families, each represented by only one species. It seems necessary to treat such ancient types as species on a level with extant forms; but the naturalist draws our attention to their archaic characteristics, and tries to explain their places in the order of evolution and their

relationships.

But now suppose that he could find a fossil specimen of every generation (hundreds of thousands of generations), from ABFI, etc., up to A; then, as each generation would only differ from the preceding as offspring from parents, he would be unable at any point to distinguish a species; at most, he would observe a slightly marked variety. ABFI and ABFJ would grow more and more alike, until they became indistinguishable in ABF; ABF and ABE would merge into AB; AB, AC, AD and AX would merge into A. Hence, the appearance of species is due to our taking cross-sections of time, or comparing forms that belong to periods remote from one another (like AX, ADG, and ADHK, or AD, ADH and ADHK), and this appearance of species depends upon the destruction of ancestral intermediate forms.

(3) The hypothesis of development modifies the logical character of classification: it no longer consists in a direct induction of co-inherent characters, but is largely a deduction of these from the characters of earlier forms, together with the conditions of variation; in other words, the definition of a species must, with the progress of science, cease to be a mere empirical law of co-inherence and become a derivative law of Causation. But this was already implied in the position that causation is the fundamental principle of the explanation of concrete things; and accordingly, the derivative character of species or kinds extends beyond organic nature.

Section 9. The classification of inorganic bodies also depends on causation. There is the physical classification into Solids, Liquids, and Gases. But these states of matter are dependent on temperature; at different temperatures, the same body may exist in all three states. They cannot therefore be defined as solid, liquid, or gaseous absolutely, but only within certain degrees of temperature, and therefore as dependent upon causation. Similarly, the geological classification of rocks, according to relative antiquity (primary, secondary, tertiary, with their subdivisions), and mode of formation (igneous and aqueous), rests upon causation; and so does the chemical classification of compound bodies according to the elements that enter into them in definite proportions. Hence, only

the classification of the elements themselves (amongst concrete things), at present, depends largely upon empirical Coinherence. If the elements remain irresolvable into anything simpler, the definitions of the co-inherent characters that distinguish them must be reckoned amongst the ultimate Uniformities of Nature. But if a definite theory of their origin both generally and severally, whether out of ether-vortices, or groups of electric corpuscles, or whatnot, shall ever gain acceptance, similarity of genesis or causation will naturally be the leading consideration in classifying the chemical elements. To find common principles of causation, therefore, constitutes the verification of every Natural Classification. The ultimate explanation of nature is always causation; the Law of Causation is the backbone of the system of Experience.