CHAPTER IV

ON STRUCTURE

No satisfactory justification has ever been given for connecting in any way the consequences of mathematical reasoning with the physical world. (22)

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Any student of science, or of the history of science, can hardly miss two very important tendencies which pervade the work of those who have accomplished most in this field. The first tendency is to base science more and more on experiments; the other is toward greater and more critical verbal rigour. The one tendency is to devise more and better instruments, and train the experimenters; the other is to invent better verbal forms, better forms of representation and of theories, so as to present a more coherent account of the experimental facts.

The second tendency has an importance equal to that of the first; a number of isolated facts does not produce a science any more than a heap of bricks produces a house. The isolated facts must be put in order and brought into mutual structural relations in the form of some theory. Then, only, do we have a science, something to start from, to analyse, ponder on, criticize, and improve. Before this something can be criticized and *improved,* it must first be produced, so the investigator who discovers some fact, or who formulates some scientific theory, does not often waste his time. Even his errors may be useful, because they may stimulate other scientists to investigate and improve.

Scientists found long ago that the common language in daily use is of little value in science. This language gives us a form of representation of very old structure in which we find it impossible to give a full, coherent account of ourselves or of the world around us. Each science has to build a special terminology adapted to its own special purposes. This problem of a suitable language is of serious importance. Too little do we realize what a hindrance a language of antiquated structure is. Such a language does not help, but actually prevents, correct analysis through the semantic habits and structural implications embodied in it. The last may be of great antiquity and bound up, by necessity, with primitive-made structural implications, or, as we say, metaphysics, involving primitive *s.r.*

The above explains why the popularization of science is such a difficult and, perhaps, even a semantically dangerous problem. We attempt to translate a creative and correct language which has a structure

similar to the structure of the experimental facts into a language of different structure, entirely foreign to the world around us and ourselves. Although the popularization of science will probably remain an impossible task, it remains desirable that the *results* of science should be made accessible to the layman, if means could be found which do not, by necessity, involve misleading accounts. It seems that such methods are at hand and these involve *structural* and semantic considerations.

The term 'structure' is frequently used in modern scientific literature, but, to the best of my knowledge, only Bertrand Russell and Wittgenstein have devoted serious attention to this problem, and much remains to be done. These two authors have analysed or spoken about the structure of propositions, but similar notions can be generalized to languages considered as-a-whole. To be able to consider the structure of one language of a definite structure, we must produce another language of a *different* structure in which the structure of the first can be analysed. This procedure seems to be new when actually performed, although it has been foreseen by Russell.[1] If we produce a $\bar{A}$-system based on 'relations', 'order', 'structure'., we shall be able to discuss profitably the A-system, which does not allow asymmetrical relations, and so cannot be analysed by A means.

The dictionary meaning of 'structure' is given somewhat as follows: Structure: Manner in which a building or organism or other complete whole is constructed, supporting framework or whole of the essential parts of something (the structure of a house, machine, animal, organ, poem, sentence; sentence of loose structure, its structure is ingenious; ornament should emphasize and not disguise the lines of structure),. The implications of the term 'structure' are clear, even from its daily sense. To have 'structure' we must have a complex of ordered and interrelated parts.

'Structure' is analysed in *Principia Mathematica* and is also simply explained in Russell's more popular works.[2] The *Tractatus* of Wittgenstein is built on structural considerations, although not much is explained about structure, for the author apparently assumes the reader's acquaintance with the works of Russell.[3]

One of the fundamental functions of 'mental' processes is to distinguish. We distinguish objects by certain characteristics, which are usually expressed by adjectives. If, by a higher order abstraction, we consider individual objects, not in some perfectly *fictitious* 'isolation', but as they appear empirically, as members of some aggregate or collection of objects, we find characteristics which belong to the collection

and not to an 'isolated' object. Such characteristics as arise from the fact that the object belongs to a collection are called 'relations'.

In such collections, we have the possibility of *ordering* the objects, and so, for instance, we may discover a relation that one object is 'before' or 'after' the other, or that A is the father of B. There are many ways in which we can order a collection, and many relations which we can find. It is important to notice that 'order' and 'relations' are, for the most part, empirically present and that, therefore, this language is fit to represent the facts as we know them. The structure of the actual world is such that it is *impossible* entirely to isolate an object. An *A* subject-predicate language, with its tendency to treat objects as in isolation and to have no place for relations (impossible in complete 'isolation'), obviously has a structure not similar to the structure of the world, in which we deal *only* with collections, of which the members are related.

Obviously, under such empirical conditions, only a language originating in the analysis of collections, and, therefore, a language of 'relations', 'order'., would have a *similar structure* to the world around us. From the use of a subject-predicate form of language alone, many of our fallacious anti-social and 'individualistic' metaphysics and *s.r* follow, which we will not analyse here, except to mention that their structural implications follow the structure of the language they use.

If we carry the analysis a step further, we can find relations between relations, as, for instance, the *similarity of relations.* We follow the definition of Russell. Two relations are said to be similar if there is a *one-one* correspondence between the terms of their fields, which is such that, whenever two terms have the relation P, their correlates have the relation Q, and vice versa. For example, two series are similar when their terms can be correlated without change of order, an accurate map is similar to the territory it represents, a book spelt phonetically is similar to the sounds when read,.[4]

When two relations are similar, we say that they have a *similar structure,* which is defined as the class of all relations similar to the given relation.

We see that the terms 'collection', 'aggregate', 'class', 'order', 'relations', 'structure' are interconnected, each implying the others. If we decide to face empirical 'reality' boldly, we must accept the Einstein-Minkowski four-dimensional language, for 'space' and 'time' *cannot be separated empirically,* and so we must have a language of *similar structure* and consider the facts of the world as series of *interrelated ordered events,* to which, as above explained, we must ascribe 'structure'. Ein-

stein's theory, in contrast to Newton's theory, gives us such a *language, similar in structure* to the empirical facts as revealed by science 1933 *and common experience.*

The above definitions are not entirely satisfactory for our purpose. To begin with, let us give an illustration, and indicate in what direction some reformulation could be made.

Let us take some actual territory in which cities appear in the following order: Paris, Dresden, Warsaw, when taken from the West to the East. If we were to build a *map* of this territory and place Paris *between* Dresden and Warsaw thus:

Actual territory *——————*——————*
Paris Dresden Warsaw
Map *——————*——————*
Dresden Paris Warsaw

we should say that the map was wrong, or that it was an incorrect map, or that the map has a *different structure* from the territory. If, speaking roughly, we should try, in our travels, to orient ourselves by such a map, we should find it misleading. It would lead us astray, and we might waste a great deal of unnecessary effort. In some cases, even, a map of wrong structure would bring actual suffering and disaster, as, for instance, in a war, or in the case of an urgent call for a physician.

Two important characteristics of maps should be noticed. A map *is not* the territory it represents, but, if correct, it has a *similar structure* to the territory, which accounts for its usefulness. If the map could be ideally correct, it would include, in a reduced scale, the map of the map; the map of the map, of the map; and so on, endlessly, a fact first noticed by Royce.

If we reflect upon our languages, we find that at best they must be considered *only as maps.* A word *is not* the object it represents; and languages exhibit also this peculiar self-reflexiveness, that we can analyse languages by linguistic means. This self-reflexiveness of languages introduces serious complexities, which can only be solved by the theory of multiordinality, given in Part VII. The disregard of these complexities is tragically disastrous in daily life and science.

It has been mentioned already that the known definitions of structure are not entirely satisfactory. The terms 'relation', 'order', 'structure' are interconnected by implication. At present, we usually consider order as a kind of relation. With the new four-dimensional notions taken from mathematics and physics, it may be possible to treat relations and structure as a form of *multi-dimensional order.* Perhaps, theoretically, such a change is not so important, but, from a practical, applied,