LOGICAL ANALYSIS OF "GESTALT" AS "FUNCTIONAL WHOLE"[1]

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1. Aim of the present paper

In a former paper[2] we pointed out that the term "gestalt" is being used in at least two essentially different meanings. We suggested limiting the use of the term "gestalt" to its original meaning, i.e. "shape," "form," or "configuration". Its other meaning is often expressed by "functional (or organized) whole"; we used[3] the expression "determinational system" ("Wirkungssystem") instead. In the former paper we gave a rather detailed analysis of "gestalt". It is the aim of the present paper to do the same for the term functional whole.

2. Provisional explanation of "interdependence" and "independence"

For this purpose let us start with an almost famous example, namely the equilibrated distribution of electricity on the surface of an isolated conductor; this example was chosen by KÖHLER[4] in order to illustrate the characteristics of functional wholes. The main feature which is of interest here may be formulated as follows: the density of charge at any point determines the density at all others. Let us provisionally call this characteristic "Interdependence".

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[1] Paper sent in for the fifth International Congress for the Unity of Science (Cambridge, Mass. 1939). [It was distributed at the meeting but was not read. Volume 8 of The Journal of Unified Science (formerly Erkenntnis) contains only the title, p. 370. Volume 9, in which the article was to appear, was not published due to war conditions.]

[2] K. GRELLING and P. OPPENHEIM, "Der Gestaltbegriff im Lichte der neuen Logik", Erkenntnis, vol.7 [1937/1938], p.211-225 and p.357-359.

[3] l.c.

[4] Wolfgang KÖHLER, "Die physischen Gestalten in Ruhe und im stationären Zustand", Erlangen, 1920, p. 54 ff.

It can easily be proved that whenever modern gestaltists use expressions such as "functional whole", "organized whole", "dynamic unity", they ascribe this property of "interdependence" to their respective designata[5] .

Now, in gestalt literature this conception is often illustrated by opposing it to what might be called an "aggregative whole" ("Summatives Ganzes", "Und-Verbindung") of which KÖHLER's three stones lying in three different continents are an often quoted instance. In a certain sense there is no interaction between these stones. The characteristic of such an aggregate may be called "independence".

Accordingly, one of the main objections made by gestaltists to their opponents may be formulated thus: it is an error to explain, say, the genesis of a perceptional field by an aggregate of mutually independent causal chains.

3. Definition of "dependence", "interdependence" and "independence"

In order to give a definition of "interdependence" and "independence" it is necessary to introduce the more fundamental notion of dependence. Let it be defined as follows:[6] a function f will be said to depend on a class ϕ of functions, when and only when f has the same value for any two arguments for which each element of ϕ has equal values.

Let e.g., f(t) be that (3-valued) function which assigns to a given quantity of water, for every moment t, its state of aggregation (i.e. solid, liquid or gaseous); and let ϕ contain just the two functions temperature and pressure of the same quantity of water, defined for every t. Then according to well known physical laws, the states of aggregation (i.e. the values of f) are the same at two different moments if, at these moments, the water has both the same temperature and pressure. Consequently, f depends on ϕ, in the above defined sense.

This notion enables us to define "interdependence" as follows: a class of functions, ϕ, will be called "interdependent" when and only when every element f of ϕ depends on the "complementary class" consisting of all elements of ϕ except f. Considering the law of BOYLE and MARIOTTE, we find an instance of interdependence in the class of functions: pressure, volume, temperature of an ideal gas.

Let us use the notion of dependence in order to give also a definition of "independence": a class ϕ of functions will be called "independent" when and only when no element of ϕ depends on the complementary class.

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[5] e.g., W. KÖHLER, l.c. p.XVI, XVIII, 57, 58,61. Kurt LEWIN, "Principles of Topological Psychology" p.172. Kurt KOFFKA "Principles of Gestalt Psychology", London (McGraw-Hill) 1936, p.677.

[6] We are indebted to Mr. C. G. HEMPEL for important suggestions regarding this definition.

4. Different modifications of "dependence" and "interdependence"

The concept of interdependence being fundamental for this discussion we want to deal with it in a more detailed manner[7] : from a syntactical point of view, it is evident that for gestalt theory only causal dependence is relevant, since it deals with empirical wholes, whereas e.g., mathematics deals with logical wholes; besides the latter can be treated in exactly the same way on the basis of logical dependence.

But also from a material point of view we must make several distinctions:

Whereas according to our above definition of "interdependence" it is sufficient that each element depend on all others, we must also consider the converse case in which roughly spoken all elements depend on every single one of them. Evidently the latter case entails the former but the converse is not true. Therefore we shall call the latter kind of interdependence, a "strict" one. The following example may illustrate what we mean: according to some business-cycle theorists, a certain correlation exists between the tendencies of speculation, business and money. As far as this correlation holds exactly, there is strict interdependence between these functions.

Another instance for strict interdependence was furnished by the well-known law of correlation in biology, when Georges CUVIER who first gave its strict formulation claimed to be able to reconstruct an entire animal skeleton if one single bone of it were given to him.

We shall mention only briefly a third type of interdependence founded on another modification of dependence: this relation holds between f and ϕ, when and only when f has different values for each pair of arguments for which exactly one element of ϕ has different values.

Finally we note a generalization of "dependence" which results from the following considerations: as illustrated by our business-cycle example, empirical dependencies generally show different degrees. This can be taken account of provided we modify the definition of "dependence" by introducing the notion of probability. More generally, "dependent" can be replaced by "more or less dependent" and thus "interdependence" and "independence" appear as the two poles of a serial order[8] .

5. System and dependence system

We repeatedly dealt with the following property of a class ϕ with respect to a relation R: this relation holds between each element of ϕ and the complementary class. In this case we call ϕ a system with respect to R. A system which is not a part of a

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[7] For still more detail cf. K. GRELLING, "A logical theory of Dependence" The Journal of Unified Science, vol. 8. [Remark appended to the first footnote of the present paper applies here also.]

[8] Cf. C.G. HEMPEL and P. OPPENHEIM, "Der Typusbegriff im Lichte der neuen Logik" Leiden, 1936, p.78 ff.

larger one with respect to the same relation may be called "closed". The classes considered above are systems with respect to dependence.

Now it looks plausible to translate the complete expressions "functional whole" and the like in terms of "system of functions with respect to dependence", or, shortly, "dependence system".

According to the different modifications of dependence, we distinguish several kinds of systems which can be considered as the corresponding modifications of the notion, "dependence system". It is a matter of special investigation in each case which type of system is being represented by the "functional whole" in question.

6. Determination system

As mentioned in our introduction, we previously used the expression "determinational system" ("Wirkungssystem") for "functional whole". The notion of system as employed then, though somewhat different from the one defined just now, can be reduced to it. Anyhow the whole expression belongs to another language which is in closer relation to the so called thing-language used in every-day life. Yet things will be represented here by their so called world lines, a notion which the theory of relativity has made rather popular. Let us now give in this "world-line language" the definition of "determination system". For this purpose let us start from the relation of determination defined by CARNAP[9]. Then we define "determination system" as follows: a class $\overline{W}$ of world-lines will be called a determination system with respect to a class λ of state functions, when and only when every class[10] determining a point on one of the world lines belonging to $\overline{W}$ is a selective class[11] of $\overline{W}$ with respect to λ. If a class $\overline{W}$ is such a determination system, then it must be also a system in the sense defined above, though the relation R involved is a more complicated one which will be explained elsewhere.

7. Functional language and world-line language

As will be remembered, this definition of "functional whole" expressed in world-line language ("w- λ") was preceded by another expressed in functional language ("f- λ"). Let us compare the two solutions of our problems.

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[9] R. CARNAP, "Abriß der Logistik" Wien (J. Springer) 1929, p. 86.

[10] The definition of "determining class" must be supplemented by a certain minimum condition.

[11] What is meant by "selective class" (cf. CARNAP, 1.c. p. 59) may be illustrated by the following example: a select committee to which each class of a school delegates just one representative is a selective class of the class of the school classes. - It is worthwhile to notice that a determination system as defined here is always closed.

The w- λ being more closely related to every-day language will often be more practical than the f- λ. On the other hand, the use of the w- λ is sometimes impractical or even impossible; we can hardly imagine how one could actually describe in w- λ, e.g., a phenomenal field or the above mentioned business-cycle correlations. Especially the following arguments plead in favor of the f- λ: the w- λ presupposes the concept of genidentity which in some sciences e.g. psychology and sociology, can only be applied with difficulties. At any rate we feel entitled to state without further arguments that the f- λ is much more general and modern[12].

In spite of differences, the two concepts of determination system and of dependence system can, in a less formal language, both be designated by "functional whole", because both "determination" and "dependence" can in a certain sense be considered as functional relations. As far as the much discussed term "whole" is concerned, we must limit ourselves here to the remark that already FRIES[13] speaks of a "Ganzes der Wechselwirkung" and KANT[14] uses similar expressions in this connection.

8. Applications of our definitions

Now, the state of a functional whole can be either stable (balanced, equilibrated) or unstable. The former case (including states of rest and so called stationary states) is characterized by the state functions being constant in time. Such states of equilibrium play an important part in the writings of gestaltists because, according to them, functional wholes when left to themselves tend to become balanced and to remain so.

Our analysis enables us to correct a mistake due, we believe, to the confusion between "gestalt" and "functional whole": some functional wholes can also be described as "complexes"[15]. This holds e.g., for the distribution of electricity over an isolated conductor. When considering this distribution as a complex, one can define a certain class of transpositions such that any distribution having with respect to these transpositions the same gestalt as a balanced distribution, is itself a balanced one. Such transpositions are described by KÖHLER[16]. However, these transpositions can also be applied to unbalanced distributions, so that one is equally justified

[12] This statement need not be changed when the so-called co-ordinate-language is taken into consideration as well.

[13] Cf. J.F. FRIES "Die mathematische Naturphilosophie" Heidelberg 1822, p. 597.

[14] Cf. [I.] KANT, "Kritik der reinen Vernunft" Ausgabe der preussischen Akademie der Wissenschaften [1781] Vol. III, p. 97.

[15] Cf. GRELLING and OPPENHEIM, 1.c., p.212 ff., also for the following remarks.

[16] KÖHLER, l.c., p.62 ff., also "Gestalt Psychology" London 1930, p.168.

in ascribing to them a gestalt with respect to these transpositions. Consequently it would be false to assume that only balanced functional wholes have a gestalt.

In terms of the preceding analysis the opposition between aggregative and functional whole turns out not to be contradictory. For a class of functions can happen to be neither independent nor interdependent: indeed some of its elements may depend on their respective complementary classes and others may not. Consequently, to say that something is not an aggregate, it is not sufficient to characterize it as a functional whole: this main concept of gestalt theory has rather to be based, as we have done, on the notion of interdependence.

Summary *(by A.S. LUCHINS and E.H. LUCHINS)*

An earlier paper by GRELLING & OPPENHEIM distinguished between two essentially different meanings of the term "Gestalt". That paper focused on the term's original meaning of "shape", "form", or "configuration". The present paper deals with its other meaning of a "functional (or organized) whole" or "dynamic unity". Notions of "dependence", "independence", and "interdependence" are defined. Concepts are discussed in both "world-line language" (used in EINSTEIN´s relativity theory) and "functional language". Noting that a functional whole can be either stable (balanced, equilibrated, including stationary states) or unstable (imbalanced, unequilibrated), GRELLING & OPPENHEIM contend that it is false to assume that only balanced functional wholes have a Gestalt. They caution that the concepts of functional whole and aggressive (aggregative) (and-summative) wholes are neither contradictory nor exhaustive. To say that something is an aggregate does not characterize it as a functional whole. They conclude that functional whole, a main concept of Gestalt theory, has to be based, as they have done, on the notion of interdependence.

Zusammenfassung *(von A.S. LUCHINS und E:H: LUCHINS)*

In einer ihrer früheren Arbeiten hatten GRELLING und OPPENHEIM zwei wesentliche Bedeutungsunterschiede des "Gestalt"-Begriffs herausgearbeitet. Jene Arbeit konzentrierte sich dabei auf die ursprüngliche Bedeutung des Begriffes, nämlich als „Form" oder „Konfiguration". Der vorliegende Artikel thematisiert stärker eine andere Bedeutung: „Gestalt" als ein funktionales oder organisiertes Ganzes bzw. als eine dynamische Einheit. Dazu werden zunächst die Begriffe „Unabhängigkeit", „Abhängigkeit" und „Interdependenz" definiert und diese Konzepte dann sowohl in der „world-line language" (ein Fachterm, der auf die sog. „Weltlinien" der Relativitätstheorie EINSTEINs verweist) als auch in der „functional language" diskutiert. Vor dem Hintergrund, daß ein funktionales Ganzes entweder stabil (ausbalanciert, im Gleichgewicht befindlich) sein kann (einschließlich stationärer Zustände) oder instabil (unbalanciert, im Ungleichgewicht) sein kann, stellen GRELLING und OPPENHEIM die These auf, daß die Annahme falsch sei, daß nur balancierte funktionale Ganzheiten eine Gestalt hätten. Vielmehr weisen sie darauf hin, daß die Konzeptionen des funktionale Ganzen und des aggregierten (und-summativen) Ganzen weder widersprüchlich noch umfassend sind. Etwas als Aggregat zu bezeichnen, charakterisiere es nicht als funktionales Ganzes. Schließlich erheben sie die Forderung, daß ein funktionales Ganzes, als ein zentrales Konzept der Gestalttheorie, vor allem auf dem Aspekt der Interdependenz gegründet sein müsse.