

The Concept of Gestalt in the Light of Modern Logic*

I. Introduction

In 1890 Christian von Ehrenfels published his well-known treatise “Über ‘Gestaltqualitäten’”¹, which has had a revolutionary impact on psychology. In the last decades this movement has spread to areas bordering on psychology, in particular to biology and the humanities. In this way the expression ‘Gestalt’ has become a favourite catchword, but up to now by no means a generally recognized instrument of scientific thought; indeed some researchers altogether deny the fruitfulness of the concept of Gestalt and apparently related concepts like ‘whole’ [*Ganzes*]

* English translation of “Der Gestaltbegriff im Lichte der neuen Logik”, *Erkenntnis* 7, 1937/38, pp. 211–25; here published with the kind permission of Professor Felix Oppenheim.

Translator's Note: The term ‘*Klassifikator*’ has been translated ‘classifier’, rather than as the ugly ‘classifier’ unnecessarily introduced by the authors in their English supplementary remarks. This has necessitated minor adjustment to the English text of these remarks and the accompanying table of examples. The term ‘*Logistik*’ is an old-fashioned name for mathematical logic; its use in German has now disappeared. Both it and the English translation ‘logistic(s)’ are apt to mislead, and since there is now no need to stress the mathematical aspect of modern logic the term has usually been simply translated ‘logic’. In keeping with the remaining papers in this volume, the word ‘Gestalt’ has kept its German plural and initial capital. In the original version of the “Supplementary Remarks” it was written ‘gestalt’, though it retained the German plural form. The term ‘course of values’ translates ‘*Wertverlauf*’, which was introduced by Frege in his *Grundgesetze* to designate the objectual counterpart of a function. The use of the term by Grelling and Oppenheim is looser and more natural than that found in Frege. Where the domain of positions is temporal, as in the cardinal example of a melody, ‘*Verlauf*’ approaches its everyday meaning of the course, progress or development of something. – PMS

'totality' [*Ganzheit*], etc. In addition, Wolfgang Köhler, through his book *Die physischen Gestalten in Ruhe und im stationären Zustand*, has aroused discussion as to how far one is justified in also employing the concept of Gestalt in the exact natural sciences.

This question and the difficulties mentioned form the subject of our enquiry.

As even a first glance at the literature shows, however, the various authors by no means use the word 'Gestalt' with the same meaning. They also frequently use different expressions to mean the same thing, without any elucidation. Finally, and perhaps most remarkably, there is frequently no clearly defined concept at all.

Our main aim must therefore be to suggest definitions which accomplish the following: when the concepts thus determined are appropriately inserted into sentences which appear characteristic of the Gestalt theorists, these sentences turn out neither trivial nor empty of sense.

This aim is only attainable with the means of modern mathematical logic.² However in the interests of general intelligibility we must here forego employing logical symbolism, although it is our intention to do this within the framework of a more detailed presentation of this subject. For the same reason we shall occasionally choose a somewhat less exact, more intuitive form of expression rather than a precise one.

We further do not take it to be our task in this connection to give an opinion on technical questions of the specialized sciences.

We shall first build up out of the usual basic concepts of mathematical logic a series of auxiliary concepts which are necessary for our definitions. Following that we give two different definitions, which in our opinion correspond to the two most important senses in which the word 'Gestalt' is used.

II. Main Part

§1 Complex

1.1 *Classifiers*. The first auxiliary concept which we introduce, following an unpublished suggestion of Carl G. Hempel, is that of a *classifier*. We

call e.g. the concept 'pitch (of a musical tone)' a classifier, because it determines a classification of musical tones (according to their pitch). Another example of a classifier is the concept 'state of matter'. This divides bodies into solid, liquid and gaseous. So what we call a 'classifier' is a concept (e.g. 'state of matter' or 'weight') which belongs to what in mathematical logic are known as descriptive functions, and ascribes to every element to which it can be meaningfully applied a certain *value* (so e.g. to a certain body the value 'solid' or '8 Kg.'). These elements will be called '*arguments*' of the classifier.

1.2 *State-Classifiers*. There are in particular classifiers which assign certain values to the '*positions*' in a '*domain of positions*', such as the points of a space-time-domain. We call such classifiers '*state-classifiers*', or '*S-classifiers*' for short. 'Temperature' and 'pitch' are often applied in this way, though rarely e.g. 'profession (of a person)'.

1.3 *Complex*. With the help of the concept 'S-classifier' we can now describe a sequence of musical tones: the time-continuum within which the tone sequence unfolds is our domain of positions. Every position, i.e. every moment, is assigned a certain value of the S-classifiers 'pitch', 'timbre' and 'intensity'. A rest corresponds to the zero intensity value. We call such a structure a '*complex*'. In general therefore a complex is a relation between a class of S-classifiers and a domain of positions, such that every S-classifier assigns a value to each position in the domain.

1.4 *Courses of Values and Course of Value Classifiers*. The course of the values of a single S-classifier, e.g. tone-intensity, within the domain of positions of a complex we call the '*course of values*' belonging to this S-classifier and complex. This concept can be made clear by the example of a temperature chart. This is the graphic representation of the course of values of temperature during an illness. The 'character' of a temperature chart at times enables the doctor to diagnose the illness; so e.g. the temperature chart of a malaria patient has a very characteristic course. This concept of 'character' is therefore once again a classifier. Its arguments are courses of values of the S-classifier 'body temperature', one of its values being e.g. 'malarial'. In general we wish to call classifiers whose arguments are courses of values of S-classifiers '*course of value classifiers*', or '*C-classifiers*' for short. Accordingly the concept 'interval sequence' is a C-classifier for the course of values of pitch in a sequence of

tones, since it characterizes a melody in the same way as the C-classifier 'character (of a temperature chart)' characterizes an illness.

§2 Articulation

2.1 *Division*. A complex may be considered in respect of its *articulation*.³ In clarifying this concept we begin with the concept of the *division* of a whole, which must here be assumed to be understood. A brick wall for instance can be divided up in many different ways, e.g. into its individual bricks, or else in such a way that the boundaries of the parts go through bricks.

2.2 *Connection*. We will also need the concept of connection [*Zusammenhang*], which again is sufficiently comprehensible: between a brick and the mortar surrounding it there is a less internal connection than there is between any two parts of one and the same brick.

2.3 *Articulation*. If now the wall is divided into bricks (where we leave the mortar out of consideration), we wish to call the resulting division an '*articulation*'. In general we call a division an articulation with respect to a given connection when each part possesses this connection internally in greater measure than different parts to one another. The parts forming an articulation we call '*members*'. Several members can form a hierarchical order.

The concepts 'division' and 'articulation' are applicable to any whole between whose parts a connection subsists. These include certain complexes, e.g. sequences of tones. A certain kind of connection subsists between the parts of a musical structure, as will be immediately clear if one thinks e.g. of the articulation of a melodic sequence of tones into the motifs which make it up; the smallest members which can be obtained in this way are obviously the tones and rests.

§3 Correspondence

3.1 *Simplest Case following Carnap*. We now wish to consider a certain relation between complexes, which we call '*correspondence*'. The

simplest case of such a correspondence⁴ is given when the following three conditions are fulfilled: (1) Between the domains of positions there is an *isomorphism* with respect to their positional relation, i.e. there is a mapping of the one domain onto the other such that relative positions are preserved. (2) The S-classifiers are pairwise identical. (3) The courses of values of corresponding, or, one might say, '*homologous*'⁵ S-classifiers are equal.

This simplest form of correspondence subsists between two sequences of tones which differ merely in respect of their location in space and time.

3.2 *Generalization of 3.1.* Among the various possible generalizations of this relation we consider only such as relate to the courses of values: (1) The requirement of equality of course of values need *not* relate to *all* S-classifiers. (2) We can generalize the requirement of equality to the requirement of agreement in respect of the values of *certain* C-classifiers. As example we choose the case where the same melody is played with the same tempo and dynamics, but on different sorts of instrument and in a different key. The tone sequences thus arising are complexes between which the generalized correspondence just described subsists. For (1) only in respect of the S-classifier 'intensity' is there complete equality in course of values, and (2) as for the courses of values of pitches, they agree only in respect of the C-classifier 'sequence of intervals'.

3.3 *Articulation Isomorphism.* The correspondence can in addition relate to the articulation. In the two sequences of tones just considered for example, this is the case for the motifs or tones. On the other hand the articulation of the tone sequences into bars could be different. In the former case we have *articulation isomorphism*.

3.4 *Transposition.* The passage from one key to another mentioned previously is of course known in musical theory as transposing. Following the usage usual in Gestalt-theory since Ehrenfels we wish to generalize this concept. We shall call '*transposition*' with respect to a given correspondence the operation which takes one complex into another which stands in the given correspondence to it. Of course even for tone sequences our concept of transposition is wider than the usual one in musical theory; there one would not think of an alteration of dynamics, tempo or timbre, whereas our concept of transposition also includes these alterations.

§4 Gestalt

4.1 *Gestalt as Invariant of Transpositions.* We are now sufficiently prepared to suggest a definition for the concept of *Gestalt* which was introduced by Ehrenfels. We can here make use of the concept of transposition just determined. Over this operation something remains invariant. In the case of a tone sequence it is the melody, and in fact for our extended concept of transposition this is the only invariant. Now it is well known that melody is the classical example by which Ehrenfels elucidated the concept of *Gestalt*. So we feel justified in defining it as follows: the *Gestalt* (of a complex with respect to a correspondence) is the *invariant of transpositions* (of the complex with respect to the correspondence). It follows from this definition that the *Gestalt* of a tone sequence is actually its melody. The following definition fits better with the logistic way of speaking: *Gestalten are the equivalence classes of correspondences.* (In a discussion note on Schlick's lecture "On the Concept of Totality" at the Prague International Congress for Philosophy in 1934, Ajdukiewicz suggested defining 'Gestalt' as an n -termed relation. We take this definition to be too broad, since then every relation would be a *Gestalt*, and the latter expression would be completely dispensable.) According to this a melody is a certain class of tone sequences which stand in a correspondence to one another, namely that of melodic equality. Some readers may have noticed that we use the term 'tone sequence' ('sequence of tones') in cases where it would seem more appropriate to use the word 'melody'. The reason for this will now be clear.

4.2 *Gestalt as Classifier.* We now wish to oppose the concept of *Gestalt* to that of the individual *Gestalt* of a given complex, which we could call a '*Gestalt-individual*', just as one distinguishes between melody in general and a particular melody, such as that of the Blue Danube Waltz. By this we do not mean a tone sequence sounding at a particular place at a particular time, which has the melody of the Blue Danube Waltz. We must rather distinguish three things: (1) the classifier 'melody', (2) its arguments, individual tone sequences, (3) its values, the melodies of these tone sequences, such as the Blue Danube, just as we previously said that 'state (of matter)' as classifier assigned, say, the value 'solid' to a certain body. So in general '*Gestalt*' can be represented as a classifier whose arguments are complexes and whose values are *Gestalt*-

individuals. Now the names of sensory qualities, such as colour, smell, taste etc. can be seen as classifiers, so we can understand that Ehrenfels, Cornelius and others called what we call a Gestalt a 'Gestalt quality'. Perhaps the assumption behind this was that just as the colour of a body is immediately perceived with the senses, so we immediately perceive the musical Gestalt, i.e. the melody, of a tone sequence.

4.3 *Further Examples of Gestalten*. It can be seen therefore that our terminology fits in well with that introduced by Ehrenfels. But we can also show that it fits satisfactorily with the usage of science, to the extent that this does not suffer from the unclarities mentioned at the beginning: what in ordinary language is known as the 'shape [*Gestalt*] of a body', we call the 'geometric form', to distinguish it from our general concept of Gestalt. Geometric form is of course the invariant under similarity-transformations, and our concept of Gestalt can be applied rigorously to this *mathematical* example.

We should also like to give an example from *logic*, and to this end we quote Carnap⁶:

We call two expressions equal when the corresponding signs in each are equal. If two signs or two expressions are (syntactically) equal, we also say that they have the same (syntactic) *shape* [*Gestalt*]; they can still have different figural shape ... almost all investigations of the book ... have to do with the *shapes* of expressions [*Ausdrucksgestalten*].

In *physics* our concept of Gestalt could probably be applied to any field, in structural chemistry to a molecule.

We naturally find a particularly large number of examples in *psychology*: we must confine ourselves at this juncture to the following example from a much-quoted work by Max Wertheimer⁷: if in a series of black dots on a white background the absolute distances between the dots are changed while their relative distances are maintained (transposition!), then the phenomenal articulation (Gestalt!) remains invariant.

For lack of time we are unable to bring examples from other sciences.

4.4 *Properties of Gestalten*. Now that our concept of Gestalt is presumably clarified through definition and examples, we now wish to consider some *properties of Gestalten* which play a role in the literature.

When Ehrenfels judges Gestalten from the points of view of purity and

height, he is dealing with *Gestalt-classifiers*, which are supposed to enable a given Gestalt to be ascribed a certain degree of purity or height as a property. Here belongs also the concept of the goodness of a Gestalt, which plays an important role in the pregnancy law, about which we shall later come to speak. A Gestalt-classifier for melodies as arguments is e.g. 'time-signature'; its values include for instance '3/4 time'. Here also belongs the beauty of a Gestalt. Such qualities of Gestalten must not of course be confused with the Gestalt-qualities of Ehrenfels. The Ehrenfelsian expression 'Gestalt-quality' is, as we have seen, synonymous with our expression 'Gestalt', and so has a different logical type from the expression 'quality of a Gestalt-individual'; names of Gestalt-qualities are predicates of complexes, whereas names of qualities of Gestalt-individuals are predicates of Gestalten.

4.5 The Two Ehrenfels Criteria. Ehrenfels considers it a criterion for something's being a Gestalt that it remains unaltered by transposition. We need only recall the first definition we gave of 'Gestalt' to see that our concept of Gestalt always fulfils this criterion. This seems to contradict the opinion of Wolfgang Köhler⁸ that there are Gestalten which do not fulfil this criterion. But it is clear that Köhler cannot have been thinking of the meaning of the word 'Gestalt' at issue here, because it would not otherwise have escaped him that trivially every Gestalt so understood is transposable. The apparent contradiction is on our view better resolved by noting that Köhler, as we shall show later, understands by 'Gestalt' something other than Ehrenfels and we do.

The second of the two so-called Ehrenfels criteria has become a popular catchword in the form: 'The Gestalt is more than the sum of its parts'. To test its applicability to our concept of Gestalt, we wish to translate this sentence into our terminology. To this end we must consider the concept of sum here employed more closely.

The word 'sum' is used by Tarski, following Leśniewski, in a way which more or less corresponds to what Ehrenfels understands by a sum.⁹ It seems to us more practicable to designate this concept with the word 'totality' [*Gesamtheit*]. A totality is completely determined by its parts and is of the same type as these. In this it differs from a complex, among other things. So e.g. the totality in this sense of the tones of a certain tone sequence is to be strictly distinguished from the tone sequence itself, since every other tone sequence made up of the same tones has the same totality of tones. As a result meaningful statements can be made about

tone sequences which cannot be made about totalities of tones. It is e.g. not possible to say of a totality that its tones stand in a certain sequential order. Generalizing this, we believe that the sentence under discussion is most adequately translated as follows: the Gestalt of a complex is a property which cannot meaningfully be ascribed to the totality of its parts corresponding to any division. This Ehrenfels criterion is therefore basically just a consequence of the syntactic prohibition of the mixing of types. We shall however soon get to know a less formalistic interpretation of this criterion.

§5 Determinational System

5.1 *System*. We have indicated in various places that the expression 'Gestalt' is employed in another sense. To make this more precise, we again need some auxiliary definitions.

We wish to call a 'System with respect to a certain relation R ' a whole which satisfies the following conditions: there is a division of the whole such that every part in this division stands in the relation R to every other, and every object which stands in the relation R to at least one part is itself a part of the whole. What is meant can perhaps be made clear by a private telephone network without an exchange, where every subscriber is directly connected with every other and no subscriber is connected with anyone outside.

5.2 *Determination*. As a further auxiliary concept we wish to introduce that of a *determination relation*, as this is logically defined by Carnap in § 37b of his *Abriß der Logistik*. It is sufficient here to recall that concept of determination which plays such a considerable part in present-day science.

5.3 *System of Reciprocal Determination*. If we substitute the determination relation just mentioned in the previously defined concept of system for the relation R , there left open, we obtain a specialized concept of system. We wish to call this a 'system of reciprocal determination', or '*determinational system*' ['*Wirkungssystem*'] for short. For specialists we would point out that Carnap's concept of determination is a three-termed relation between determining domain of positions, the determined

position and the class of S-classifiers in respect of which determination occurs. As against this, we are here using a somewhat different kind of relation, but have reason nevertheless to assume that this gives rise to no logical difficulties.

As an example of such a determinational system we choose one which Köhler treats at length in the book previously mentioned, namely a charged and isolated conductor. The whole is here the field with the charges in it, the parts are the field elements, and the relation is that of the field strengths, by which the field elements reciprocally determine one another.

Further determinational systems are atomic nuclei, atoms, molecules, cells, organisms, economies. The formal sciences, such as mathematics and logic, offer no examples of determinational systems, because the concept of effect or determination is not applicable to the objects of these sciences. On the other hand examples of systems of another kind can easily be quoted from these sciences, but these are not our subject here. We shall come to discuss psychology in particular.

5.4 Some Characteristics of Determinational Systems.

5.4.1 Opposition between Aggregate and Determinational System. To elucidate further the concept of a determinational system we contrast it with its polar opposite, that of an *aggregate*. That is what we call a whole with respect to a certain division of the same, when there are no two parts of this division between which there is determination. Edwin Rausch¹⁰ has engaged in investigations which bear a close connection to this. It is perhaps useful to point out that the two concepts 'determinational system' and 'aggregate' do not stand to one another as contradictory opposites. They form the poles of a polar opposition, as the following considerations show: (1) the reciprocal determination between parts can have different degrees of intensity; (2) the degree of reciprocal determination within the system can have different values. We have a 'pure' aggregate when the reciprocal determination between all parts is absolutely or practically zero. We believe that we have here given a precise definition for what Köhler and others mean by expressions like 'and-connection', 'summative whole' and the like. This view of ours agrees with that which Schlick expresses in his lecture, mentioned above,¹¹ in which, incidentally, he recognizes the legitimacy of the concept of Gestalt in psychology. An aggregate is formed (to choose

another example from Köhler) by three stones, which lie on the Earth so far apart from one another that their reciprocal determination in the sense just indicated can for all intents and purposes be taken as zero.

5.4.2 *Boundary Conditions*. The processes in a determinational system are in general only fully determined when the *boundary conditions* are specified, as e.g. for the distribution of charge on a conductor, its form and the absence of other charged bodies in the neighbourhood. Of course all these examples involve considerable idealizations, and we can here only sketchily delineate them.

5.4.3 *Extremal Properties*. If determinational systems are in static or stationary equilibrium, certain characteristic magnitudes tend to assume *extremal* values. So e.g. (again following Köhler) the surface of an oil drop suspended in a liquid with which it does not mix, and which is uniformly dense, assumes a minimum, namely a special form. Such extremal properties will show themselves to be extremely important in application to psychology.

5.5 '*Determinational System*' and '*Gestalt*'. The meaning of the word '*Gestalt*' has undergone a change in the course of time, in that it has steadily shifted away from Ehrenfels' '*Gestalt qualities*' to a concept which Köhler¹² calls '*organized whole*' and Koffka¹³ calls '*functional whole*'. Köhler refers expressly to this shift on p. 148 of the work we cited. We now assert that the two concepts just mentioned coincide with our concept of a determinational system. The expressions chosen by Köhler and Koffka at least do not contradict this interpretation. To give an exact proof we should have to insert our concept of determinational system as meaning for those words in the appropriate sentences of these authors in the way mentioned in the introduction. Meanwhile we must here confine ourselves to giving assurance that this test has been successful wherever we have carried it out. For '*Gestalt*' as the invariant of transposition Köhler and Koffka, in the works repeatedly mentioned, choose other expressions such as '*form*' or '*shape*'. It is only too understandable that in the course of this development the danger of confusing the two concepts has been considerable. So C. Spearman¹⁴ has also referred expressly to the '*confusion between "shapes" and "wholes"*.' Against Köhler and Koffka, we suggest using the term '*Gestalt*' as in ordinary language and in the other sciences only in the original Ehrenfelsian sense. If it is wished to

use the expression 'Gestalt' in designating determinational systems, then one could speak of 'forming systems' [*gestaltende Systeme*]. The concept of a determinational system was by no means first introduced by Köhler into the theory of science. The idea of using it as an instrument of thought goes back at least to Kant, who of course included the category of reciprocal determination [*Wechselwirkung*] in his table of categories. His pupil J. F. Fries, in his *Mathematische Naturphilosophie* (1822), subsequently developed similar ideas which conspicuously recall those of Köhler.

5.6 *Extremal Properties and the Pregnancy Law.* Just as in the natural sciences equilibrium states of determinational systems satisfy extremal laws, so modern Gestalt Psychology introduces a number of laws which are brought together in Wertheimer's *pregnancy law*, which Koffka expressly calls the 'maximum-minimum-principle'. This law states that Gestalten become as 'good' as the boundary conditions allow. The expression 'good' comprehends such characteristics as regularity, symmetry and simplicity. This leads to a ranking of Gestalten according to their goodness. The concept 'Gestalt' is here used in the sense suggested by us: the complex is a determinational system. Of all the possible Gestalten of such a system, those which the system assumes in equilibrium are, as we saw, distinguished by extremal properties. If, as modern Gestalt theorists assert, our perceptual field (or, more exactly, its physiological substrate) is such a determinational system, then its equilibrium Gestalten must satisfy the pregnancy law. This is supposed to explain e.g. why a stimulus configuration which only approximates to a circle appears as a complete circle in the perceptual field. This shows that there is a very subtle (though, we believe, logically clear) connection between the concept of a determinational system as a forming [*gestaltende*] system and that of the formed [*gestaltete*] complex. Here perhaps lies the reason for the above-mentioned ambiguity in the terminology of Gestalt theory.

5.7 *Boundary Conditions in Gestalt Psychology.* Just as we could apply the concept of equilibrium to the perceptual field, so we can apply that of *boundary conditions*. These are divided into 'external' and 'internal'. The former consist of the configuration of immediate stimuli, e.g. the retinal image; the latter comprise the attitude, memory-traces and typological factors applying at the time.

5.8 *Ehrenfels Criteria and Determinational Systems*. We now wish to make a suggestion as to how the first Ehrenfels criterion as applied to determinational systems can be translated into our terminology. In the sentence 'The Gestalt is more than the sum of its parts' we now translate 'Gestalt' by 'determinational system' and, corresponding to this shift in meaning of the Gestalt concept, 'sum' by 'aggregate'. So now our suggested translation runs thus: in comparing a determinational system with its corresponding aggregate it can be seen that the former is richer to the extent of the determination relation. We cannot here go into a more detailed justification of this suggested translation, which is in any case quite illuminating as it is.

As far as the second Ehrenfels criterion, that of transposability, goes, it is now understandable why this has steadily receded into the background; Köhler already expressed the opinion in 1919¹⁵ that there were 'Gestalten' which did not satisfy it. The reason is that the concept of transposition can only meaningfully be applied to a determinational system to the extent that this can be viewed as a formed [*gestaltete*] complex, a viewpoint which is not essential to the explanatory function of the concept 'determinational system'.

III. Results

In following our stated aim, we take ourselves to have shown the following:

The word 'Gestalt' occurs with at least two meanings, both of which we have defined.

Our expression may well have rendered it probable that these two concepts are useful instruments of thought, though of course the final judgement on this is the prerogative of the specialized sciences.

In our view this applies to *both* concepts as regards all real sciences, so also for the exact natural sciences; only for *our* concept of Gestalt does it apply in the formal sciences like logic and mathematics.

In pursuing our task of applied logic, we believe we have also contributed something to the development of pure logic: by introducing the concept of correspondence e.g. we accordingly extend that of isomorphism and correspondingly the concept of structure to that of Gestalt.

Finally, our work serves the unification of scientific language and hence the logical ideal of the unity of science.

IV. Discussion

K. DÜRR Comment:

Rather than introducing the term 'classifier' it would be more appropriate to employ the usual term 'functor'.

ARNE NAESS Comment:

As far as I can see, the definition of Gestalt offered by Oppenheim fulfils the requirements for making something more precise.

The term 'Gestalt' does not have a unitary meaning [*Leistung*] in psychology. The meaning Oppenheim has chosen to make his object of study is perhaps the one most closely connected with scientific work. I hope Oppenheim will continue along the path he has taken. There are terms in psychology today which are less vague than 'Gestalt', and whose meaning includes the kernel of the scientific (not ideological) concept of Gestalt. These newer 'Gestalt terms' are closely connected with experimental research. For example: 'organized reaction', 'gestalted adjustment', 'functional behaviour-units', 'sign-gestalt', 'cue family', 'perceptual constancy', '*intentionale Objektbeziehung*', 'habit-family-hierarchy' etc. It can well be said that no one is completely clear about the relations holding among all these terms: the various authors do not take enough account of one another. A logical analysis would in this case be of great service to psychology.

Notes

¹ *Vierteljahrsschrift für wissenschaftliche Philosophie* 14, 1890, 242–92, Eng. trans. in this volume, pp.82–117.

² The present lecture forms part of more extensive considerations on the subject of 'order concepts'. Cf. the remarks on order concepts in Carl G. Hempel and Paul Oppenheim, *Der Typusbegriff im Lichte der neuen Logik*, Leiden: Sijthoff, 1936.

- ³ We are grateful here for stimulating discussion with Heinrich Poll.
- ⁴ Cf. Rudolf Carnap, *Abriß der Logistik*, Vienna: Springer, 1929, § 37a.
- ⁵ We believe that the concept of correspondence can also serve to classify the concept of *homology*, which plays such a large part in biology.
- ⁶ *Logische Syntax der Sprache*, Vienna: Springer, 1934, p. 14.
- ⁷ Max Wertheimer, "Untersuchungen zur Lehre von der Gestalt II", *Psychologische Forschung* 4, 1923, 301–350.
- ⁸ Wolfgang Köhler, *Die physischen Gestalten in Ruhe und im stationären Zustand*, Erlangen: Philosophische Akademie, 1920, p. 37.
- ⁹ Cf. "Appendix E", written by Tarski, in J. H. Woodger, *The Axiomatic Method in Biology*, Cambridge: Cambridge University Press, 1937. It would take us too far to exactly reproduce Tarski's ideas here.
- ¹⁰ Edwin Rausch, "Über Summativität und Nicht-Summativität", *Psychologische Forschung* 21, 1937, pp. 209–89.
- ¹¹ *Actes du Huitième Congrès international de Philosophie à Prague*, Prague: Calve, 1936, pp. 85 ff.
- ¹² Wolfgang Köhler, *Gestalt Psychology*, 1929.
- ¹³ K. Koffka, article "Gestalt" in *Encyclopedia of the Social Sciences*, 1931, and by the same author, *Principles of Gestalt Psychology*, 1935.
- ¹⁴ C. Spearman, "Two defects in the theory of gestalt", *International Congress of Psychology*, Groningen, 1926.
- ¹⁵ Cf. *Die physischen Gestalten*, p. 37.