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The Unit of Thought

At least since the days of Locke it had been assumed that mental life went from the simple to the complex, and that complex operations were painstakingly constructed out of elementaristic components. As we saw earlier, Hartley made quite explicit the notion that complexity=summation. This seemed such an obvious formulation that it was difficult to combat, and it was not until the beginning of the twentieth century that the proposition was seriously considered that complex units and operations may be acquired and used in one fell swoop.

Unhappiness with atomism had been around for some time, however, and it seemed patently obvious to some writers that thinking could not be reduced to a conglomeration of images and ideas. William James, for example, had clearly posed the problem in 1890 in relation to perception when he wrote:

We certainly ought not to say what usually is said by psychologists, and treat perception as a sum of distinct psychic entities, the present sensation namely, *plus* a lot of images from the past, all "integrated" together in a way impossible to describe. The perception is one state of mind or nothing *

And in discussing the stream of thought, he cuts the Gordian knot that had made the concept of "relation" such a puzzle for the associationists by saying:

There is no manifold of coexisting ideas; the notion of such a thing is a chimera. Whatever things are thought in relation are thought from

* W. James, *The principles of psychology*, Vol. 2. New York: Holt, 1890, p. 80.

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the outset in a unity, in a single pulse of subjectivity, a single feeling, or state of mind.*

No part of the new psychology of thinking produced a greater departure from tradition or a more revolutionary attitude than the notion that the elementaristic particles of association psychology could not in principle do justice to the problems of complex thought. † To abandon once and for all the conception of larger units of consciousness being glued and pieced together out of atomistic ideas and sensations meant to create a new vocabulary and new theories. Slowly the conviction that the mind contained such new and wondrous things as tasks, sets, and goal representations had gained adherents. Even the associationists admitted these new entities, though often in the role of *dei ex machina*. The new theories used these new units as their building blocks, not as crutches. Environmental inputs set into motion a vast apparatus of complexes, structures, and directing mechanisms, none of which were to be found in consciousness, many of which represented whole trains of ideas or sensations and replaced these particles with complicated hypothetical processes that restructured, organized, and molded the process of thinking.

Probably the major turning point in the history of thinking came with the work of Otto Selz. Although Selz studied with some of the Würzburg psychologists, his *magna opera* were written elsewhere and published in 1913 and 1922. Not only does he deal in these two volumes with the problem of directed thinking, but he is the first psychologist who is both willing and able to deal with the problem of productive thinking under the same rubric as reproductive thought. Neither his original two volumes of work ‡ nor the summary of his theory of productive and reproductive think-

* W. James, *The principles of psychology*, Vol. 1. New York: Holt, 1890, p. 278.

† In American psychology it was John Dewey who carried on James' battle against elementarism during the early part of the century. His search for the functional unit of behavior, including thought, was to color much of the contemporary scene.

‡ O. Selz, *Über die Gesetze des geordneten Denkverlaufs*. Stuttgart: Spemann, 1913; and *Zur Psychologie des produktiven Denkens und des Irrtums*. Bonn: Cohen, 1922.

demand, may be summarized in the following basic thesis: Intellectual processes are not a system of diffuse reproductions-as association psychology thought-but, rather, like a system of body movements, particularly of reflexes, they are a system of specific reactions in which there is as a rule an unambiguous relation between specific conditions of elicitation and both general and special intellectual operations. When association psychology was concerned with doing justice to the intellectual processes, it arrived at the constellation theory of diffuse reproductions...The reproductive tendencies of the associative links of the process diverge diffusely in all directions and they are said to enter into competition with the reproductive or perseverative tendencies of a goal-representation or some superordinate idea. During this struggle for existence among the competing tendencies, with its reciprocal inhibitions and facilitations [*Förderungen*], victory goes to that tendency which, according to the momentary constellation, is the strongest. The importance of the strongly perseverating goal-representations or superordinate conceptions in determining [the] direction [of thought] was explained by the assumption that the reproductive tendencies derived from them reinforce reproductive tendencies operating in a similar direction but inhibit those operating in a different direction.

However, even an analysis of *reproductive* thought processes shows the untenability of this theory of diffuse reproductions. For example, we set a subject a task of searching for the generic concept for some presented stimulus words. He is given the stimulus word "farmer" and the response "occupation" occurs without any mediating experiences. G. E. Müller, until recently the main representative of a constellation theory, proposed in his work on memory the following explanation for the solutions of such tasks. The task "generic concept" acts as a directional representation which reinforces certain reproductive tendencies of the stimulus word. The task puts into heightened readiness a wide gamut of representations-namely, the names of all generic concepts that have been previously acquired, such as "plant," "animal," and so forth. Among the names of generic concepts that have been made ready there is also the generic concept "occupation." Thus, among the several reproductive tendencies [associations] of the stimulus

word "farmer," the task-relevant reproductive tendency "farmer-occupation" receives a reinforcement due, to the favorable constellation produced for the association "occupation," and thus leads to a correct solution. This constellation theory, convincing as it is at first glance, would only be useful if reproductive tendencies other than the task-relevant ones were not favored by the constellation to the same degree. But the opposite is the case. Thus, in our example, among all the generic names that have been put in readiness by the task, there is also the generic designation "tradesman." The concept "tradesman" is furthermore also strongly associated with the stimulus word "farmer." For example, farmer and tradesman are tied together in every tax form. Thus the constellation favors the reproduction of "tradesman" in response to "farmer" in exactly the same degree as the reproduction of "occupation." A consistently applied constellation theory can offer no reason why the incorrect response "tradesman," which represents a coordinate instead of a superordinate concept, does not appear just as frequently as the correct response "occupation."

Such difficulties, into which any *theory of diffuse reproductions* inescapably leads, can be avoided in a rather simple manner by the *theory of specific responses*. This theory shows that the task "generic concept" and the relevant stimulus word "farmer" cannot be treated as factors acting in isolation, but rather that they act like the coherent question "What is the generic concept for farmer?" This question of the experimenter already anticipates schematically the knowledge-unit (or structure)* "Farmer is an occupation" which the subject has previously acquired. The question contains one member (A) of the known facts of the case and the relation (γ) to the other, sought-for member; in this case the relation is of species to genus. The question can, therefore, act as

* Translators' note: Selz uses as a central concept of his theory the term "*Komplex*." We have found it usually inadvisable to translate this term directly as "complex" since Selz's usage and obvious intention would be hidden by a term that does not do justice to the structural, unitary, and patterning implications of his term. We have preferred to use the terms, "unit" and "structure" whenever possible, thus emphasizing that Selz's "*Komplexe*" - though constituted of elements - act as single units with their own specific structure.

an eliciting condition for the intellectual operation of knowledge-production [*Wissenaktualisierung*], whereby the uncompleted knowledge-unit ($A \gamma \square$) which the question represents, is completed by restoring the reproductive unit ($A \gamma B$). Instead of a diffuse play of competing reproductive tendencies, this theory offers a comprehensive process wherein the question acts as a unitary total task along with a uniquely relevant operation of knowledge-production. This operation can be shown to be a special case of structure-completion, since the fragmentary structure of the question is made complete by the operation of knowledge-production.

Just as the theory of specific responses differs from the associationist constellation theory, so does it basically differ from all superimposition theories. According to these theories, special directive factors, for example, determining tendencies or insightful acts of relational comprehension, are added to diffuse processes that are in themselves devoid of sense or direction. In this fashion, the ordered process actually is superimposed upon a state of affairs which, in reality or at least in general appearance, is unordered. In fact if one starts with the erroneous constructions of a system of diffuse reproductions, one needs a superstructure of factors to bring order into irregularity, resulting in the futile attempts of superimposition theories ... to make sense out of a state of affairs that was senseless to begin with. If, however, we start with a system of specific responses, then we have from the beginning an ordered, instead of an unordered, system which needs no additions.

The replacement of the superimposition theories by the theory of specific responses also leads to important conclusions for a developmental theory of stages. A theory of stages using a developmental superimposition theory must be rejected. A system of diffuse reproductions in which the strongest association triumphs cannot be seen as a developmentally older stage to which insightful behavior is added at later stages. The identification of intellectual processes as a system of specific responses suggests rather the developmental integration of intellectual actions into an existing, more primitive system of specific responses; a theory of stages would then be concerned only with different developmental stages of a single system of specific responses. In this manner the auto-

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matic acquisition of novel modes of behavior, Bühler's "stage of training [*Dressur*]," demands no system of diffuse reproduction but can be made comprehensible within the framework of a system of specific responses, as we shall show later.

Together with the theory of diffuse reproduction, a conception of intellectual processes as a mere running off of images must also be abandoned. It is not images, not even the awareness or thoughts that have sometimes been designated as imageless "elements," that make up the constituent units of our system of specific responses; rather these units are acts, intellectual operations that are just as needful of and amenable to analysis as the simple reflexes from which complex body movements are built up. These intellectual operations, together with their conditions of elicitation, do not form a closed system, but they are, just as are the body movements, links in the comprehensive system of specific responses that constitute the individual—a system in which all bodily and mental modes of behavior, and particularly those of the needs and affects, participate.

The fact that for such a long time intellectual processes or their assumed structure could be treated as a system of diffuse reproduction can only be understood in light of the fact that the principal difference between the associationist system of diffuse reproduction and a system of specific responses—such as reflex physiology has long envisaged—has been misperceived. Both systems try to link together the basic elements that previous analysis had discovered. The principal difference, however, consists in the uniqueness of coordinations in a system of specific responses. What happens in such a system is not decided by the momentarily strongest tendency arising out of some accidental constellation, but rather by the specific nature of the conditions of elicitation - the external or internal stimuli - on which the type of response depends. In contrast to a system of diffuse reproduction, partial processes in a system of specific responses, a system of reflex movements, for example, have a character that is relevant to the entire structure. The partial processes produce a specific fragment of the total output of the system and are, therefore, objectively appropriate and meaningful. For this reason, it is initially quite improbable that the higher processes of organisms, involving the intellect,

should be dependent upon the accidental play of meaningless reproductive tendencies, while the processes in a purely reflexive organism are characterized by the relevance to the whole organism such as we find in a system of specific responses. Finally, a system of specific responses is characterized by the fact that a meaningful whole can be reconstructed synthetically from the basic elements that have been found in the course of analysis. The "inadequacy" of the synthetic procedure in psychology which recently Gestalt theory has reasserted, the inadequacy of the "pathway from the bottom to the top," is really relevant only to the inadequate attempts of a theory of diffuse reproduction, which tries to build the meaningful whole out of meaningless constituents. On the basis of a theory of specific responses, however, the synthetic construction of intellectual processes is in principle possible.

The utility of a theory of specific responses derives from the previously mentioned result of experimental self-observation, namely, that stimulus-word and task do not act in isolation, as the constellation theory of diffuse reproductions originally assumed. Rather, stimulus and task constitute the awareness of a total task, an awareness which even without express formulation has the directed structure of a coherent question. At the same time, within the indissoluble whole of the task or the question-unit, we must distinguish a *determining* and an *anticipating* factor. The determining or will-determining factor is part of each task or question as such, and it makes the conditions of elicitation of the intellectual operations a dynamic process. The anticipating factor consists, as we have seen, in the schematic anticipation of the complete structure of the solution by the total task acting as a question. The anticipating factor has a specific structure for each task or question and determines thereby the specific type and actual direction of the intellectual operation that has been initiated, as for example, the direction which the intellectual operation of completing a structure imparts to the phenomenological experience of [reproductive] reflection. In reproductive thinking the question acts, as our previous example has shown, as a fragmentary unit of knowledge, from which at least one part is missing. That missing part is categorically characterized in the formulated question by the interrogatories: what, where, when, how much, and so forth. The

rising voice at the end of a question expresses through language rhythm the fragmentary nature, the functional incompleteness and need for completion of the question-complex. The schematic anticipation of the complete knowledge-unit, which is different for each question, makes the question a specific stimulus for the production of the relevant knowledge-unit. In this way, the knowledge-production at issue has the character of a specific response to the task.

Whenever several memory-units are relevant to a schematic anticipation, there may be a competition of several processes of unit completion. However, this competition, with the attendant inhibitions that are usually associatively interpreted, moves within the narrow range of task-relevant reproductions that have been fixed by the schematic anticipation. Only with a change of the specific task-stimulus, i.e., the awareness of a task and its after effects, do task-irrelevant reproductions arise, particularly in the case when the schematic anticipation is only partially effective.

In the course of experimental self-observation, the individual analysis of task-conditioned thought processes always shows an uninterrupted chain of both general and specific partial operations which at times cumulatively ($A + B + C$) and at times in a stepwise fashion (B after failure of A) impel the solution of the task. These operations are continued until a solution is found or up to a momentary or lasting renunciation of the solution. Each one of these partial operations is tied to a specific condition of elicitation, for example: the success of a partial operation elicits the initiation of the next partial operation; the failure of one partial operation elicits the initiation of an alternative operation; the failure of a system of partial operations which cumulatively should lead to solution of the task elicits a new start and the potentiation of an alternative system; following the success of one partial operation, insight into the additional partial operations necessary for success leads to their elicitation in the order determined by that insight. Each attempted solution finally ends as a specific condition of elicitation for control [test] operations which terminate with the consummation or correction of the solution. Within these strictly directed and determined processes there is no room for diffuse reproductions. An occasional divergence from the task as seems to

be the rule in cases of flight of ideas, depends on specific responsivity to certain diverting stimuli and does not represent a negative instance for the theory of specific responses.

The failure of *reproductive thinking*, or reflection, that has been initially brought to bear upon a problem, due to the absence, for example, of reproducible task-relevant knowledge-units, represents the specific conditions of elicitation for the, operations of *productive thinking*. The primary operations of productive thinking are the operations of means-production, leaving aside special cases such as a striving for originality. We are concerned here with the application of previously developed methods of solution to the mastery of a task in an analogous case, whereby a new product is developed. Should the operations of means-production fail then the operations of means-abstraction are initiated. They are designed for the discovery of new methods of solution and are arrived at by analyzing the structure of the immediately given or reproductively restored problem: [*Aufgabesituation*].

The posing of a problem in productive thinking also contains the schematic anticipation of the solution as a directing aspect. From among the previously developed modes of behavior only those are potentiated in means-production which lead to the schematically anticipated final state. In the case of means-abstraction, the schematic realization of the conditions of solution impress structurally lawful methods of solution on the problem. Or else, memory-units which are relevant to the schematically anticipated conditions of solution are called upon so that, for example, previously observed causal connections can now function as means. If the solution has to be abandoned for the time being, later accidental observations which conform to the schematically anticipated conditions of solution, can reawaken the latent problem and bring about the abstraction of the means-relations at a later time. In this fashion chance becomes a regular factor in the process of creation.

The overweening importance of schematic anticipation becomes developmentally comprehensible as soon as we realize that the most primitive drive in mental life-desire-contains within itself an anticipation of the final state, and this anticipation becomes

schematic even when the partial conditions for reaching the goal are still unknown.

In the case of accidental means-abstraction which we have just mentioned, the reactivation of the latent problem-complex is possible only under the condition of undetermined (involuntary) reproductive processes. This undetermined process, however, does not justify a theory of diffuse reproductions since it acts only as a condition of elicitation of previously prepared specific responses. Due to the potential energy of the response dispositions, this process requires only a minimal amount of specific energy and remains, therefore, ineffective when no relevant response dispositions, that is, problem-complexes, are present. It is for this reason that accidental discoveries in the history of science and technology only occur after the relevant problems have come to the fore.

Through the operations of means-abstraction, new integrated [*ganzheitsbezogen*] modes of behavior, the new methods of solution, develop causally out of previously developed integrative modes of behavior, namely, the general operations of means abstraction. Whatever we see in this insightful novel acquisition of integrated modes of behavior, we also see in the case of un insightful automatic acquisition of such behavior. A new situation releases at first previously developed responses, for example, inherited instinctual movements or partially insightful trial-and-error movements. Among the movements initiated by these previously perfected responses, those that are successful in the new situation, that lead to a satisfying end state, are automatically selected. The selection is based on the schematic anticipation of the end state that is found in the desire for the goal. Thus on the basis of already existing responses, new specific responses can be developed for special situations. The system of specific responses that constitutes an individual carries in itself, therefore, the conditions for its growth through the assimilation of new integrative modes of behavior. All this assumes that, just as in the examples cited, the previously perfected integrative responses are of such a nature that under specific conditions of elicitation they occasion a lawful creation of new responses. In this fashion, the old vitalistic problem also seems to be nearer to a solution, to an answer to why

the parts of a living system show this integrative character at each stage of development. It is characteristic of the structure of the whole, seen as a system of specific responses of the type described here, that the newly assimilated parts are always integrated. The integration of the parts of an organic system ... becomes understandable at least insofar as we can, in principle, synthetically derive the later developmental stages of a primitive system of integrated specific responses, just as we can derive the later state of a mechanical system, e.g., the solar system, from a hypothetical initial state.

The line of development that stretches from the Würzburgers to Selz and to the Gestalt school is nicely illustrated in a dispute over priorities. In 1925 Koffka published an article on psychology* in a general handbook. In 1926 Bühler †- and Selz ‡ critically evaluated Koffka's article and, in particular, charged that Koffka had "borrowed" his theory of thinking from Selz without giving the latter adequate credit. The attack was both strident and pertinent enough to move Koffka to publish a reply in 1927§ in which he defended himself against the accusation on the grounds that "since Selz's theory is essentially ... different from mine I cannot very well have borrowed my theory from Selz." The essential difference apparently lies in Koffka's insistence on the emergence of new qualities: "Meaning" is the essential quality of the natural process "thinking"; structure develops out of processes and is not produced by external factors. He calls Selz's theory a machine theory which

*K. Koffka, *Psychologie*. In M. Dessoir (Ed.), *Lehrbuch der Philosophie*. Band II. Die Philosophie in ihren Einzelgebieten. Berlin: Ullstein, 1925.

† K. Bühler, Die "Neue Psychologie" Koffkas. *Z. f. Psychol.*, 1926, **99**, 145-159.

‡ O. Selz, Zur Psychologie der Gegenwart. Eine Anmerkung zu Koffkas Darstellung. *Z. f. Psychol.*, 1926, **99**, 160-196.

§ K. Koffka, Bemerkungen zur Denk-Psychologie. *Psychol. Forsch.*, 1927, **9**, 163-183.

leaves little or no room for the inherent emergence of novel productions and processes. Forty years later, it seems that the difference is a minor one and that modern thought has tended to prefer Selz's "machine" position against the implied nativism of the Gestaltists. The growth of the psychology of thinking, however, need not be evaluated in terms of priorities; the important aspect is that a structural psychology of thinking was being developed in contrast to the constellation theory.

Starting with von Ehrenfels in 1890,* the notion of Gestalt qualities had made some inroads into sensory psychology, but it was not until the 1920's that Gestalt psychology became concerned with problems of thinking. We shall return to this aspect of the Gestalt movement later. For the time being it is useful, to stress another aspect of the contribution of Gestalt psychology.

It is quite apparent that by the time Selz wrote his theory of thought, psychologists had abandoned the notion, that all the concepts used to explain the thinking process must be found in consciousness. Tasks, determining tendencies, and anticipatory schemas were all theoretical notions constructed from the data available to the psychologist. But this development had taken place nearly unnoticed, and soon the Gestalt psychologists were to come along with Gestalt qualities and the laws of organization—none of which were even remotely "given" in consciousness.

With this step, the break with a tradition which demanded that thinking be explained in terms of introspective evidence was practically complete. However, one other traditional attitude had to be changed before psychology would come of age. In the following selection, Kurt Koffka argues convincingly for a distinction between descriptive and functional concepts. This introduction to Koffka's analysis of imagery, published in 1912, clearly states the difference between the data of immediate experience and the concepts constructed by the scientist. As Koffka points out, many of his contemporaries had been unable or unwilling to make such a distinction, which was to become diagnostic of the age when behaviorism was being born in America. The Gestalt school's

* C. v. Ehrenfels, Über «Gestaltqualitäten.» *Vierteljahrsschr. f. wissenschaftl. Philos.*, 1890, **14**, 249-292.

commitment to this distinction is underlined by Koffka's prefatory expression of debt to Wolfgang Köhler and Max Wertheimer for many useful discussions.

Kurt Koffka

The Distinction between Descriptive -and Functional Concepts

We are concerned with an analysis of concept formation in psychology, to be undertaken in the first instance with the use of a series of examples.

We shall start with concept formations that are feasible even within a prescientific psychology, and that have been undertaken by reflex psychology.

By imagining a great variety of different experiences, I am able to bring some order into them, in the first place by differentiating between images and feelings. Within these two groups, again by the sheer recreation of experience, I can specify new categories: I distinguish between perceptual and nonperceptual contents, between acts and appearances [contents], and within the latter I can distinguish colors and sounds, again distinct on the other hand from smells and tastes, etc. Within the colors I can, purely experientially, distinguish between the chromatic and achromatic ones, between saturated and unsaturated, between light and dark colors. An infinite number of such examples of concept formation could be listed.

On the other hand, I could make a series of observations of the following type: I hear a melody with great pleasure for the

K. Koffka, Zur Analyse der Vorstellungen und ihrer Gesetze. Leipzig. Quelle and Meyer, 1912. Pp. 2-16 transl. by George and Jean M. Mandler.

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first time; it gives me pleasure even the second and third time that I hear it. The fourth time around, however, I seem to notice that my pleasure is less than what it was previously, by the fifth time my pleasure may have disappeared, and by the sixth time I may even feel some annoyance. As I reflect on this state of affairs, I may arrive at the concepts of adaptation and reversal of feelings.

Further: I remember an experience that has recently taken place. I am aware of each detail, I see the situation in front of me and can hear the people concerned talking. I do not think about it again for a whole year, until for some accidental reason I remember the occurrence; but despite all effort I am unable to recall every detail, even whole important sequences are irrecoverably lost, and what is left has significantly paled and lost the distinctly perceptual character of my initial memory. Should I have available a direct report of that event, or a report prepared at the time of my first recall, I would be able to ascertain that much of what I now think I remember either never happened or did not happen in quite that way. Reflection on this state of affairs leads me to ascribe to time certain influences on memory. Concepts such as one about memory distortion may result.

As a third instance: Again and again I have the experience that, with increasing twilight, I am unable to find objects on my table because their color is indistinguishable from the background. However, I tell myself that as long as any light comes into the room it will be reflected by both the background and the objects placed on it. Thus, even with the weakest illumination, qualitatively and quantitatively different light is reaching my eye. I must conclude that this difference becomes so small that I do not notice it any more, and I have therefore arrived at the concept of a threshold.

Contrast these two types of examples. What is the relation between the resulting concepts and the experiences on which they are based?

In the first group the concept clearly contains only characteristics which can always be found in the experience from which it is formed. The concept of "achromatic color" includes a series

of color experiences, just as the concept "color" includes all color experiences, and the concept "image" all images. All these concepts directly contain the experiences.

Just the opposite applies to the second group: I do not experience the adaptation or reversal of feeling, nor a distortion of memory, nor a threshold, the way I experience a color. Rather, I use these concepts to put experiences into relation with other objects, either with other experiences - as in the first two examples - or with stimuli as in the last example. Thus, these concepts contain characteristics that are not contained in the experiences from which they are derived.

All concepts that directly touch upon experience we shall call *descriptive concepts*, and all concepts of the second type we shall call *functional concepts*.

Since both types are derived from experiences, and from the same experiences, the difference between them can, only have come about because the path that leads from experience to concept is different in the two cases. This difference must now be specified.

In order to do this, we shall again investigate concept formations, attending this time not to the goal of these concepts but, rather, to the path which the formation takes. However, in place of our previous examples, which were more or less related to prescientific thinking, we shall more suitably use some that are based on a skillfully worked out methodology. The road thereby becomes longer and offers more clues to be investigated, but it also becomes richer so that despite all variations the constant characteristics stand out more clearly.

We shall start with the descriptive concepts:

The path here is easily surveyed.... In the last analysis [even] an improved methodology can do no more for descriptive concepts than to produce the opportunity for experiences: The immediate experience, and the description of the immediately experienced, constitute the unavoidable condition for such concept formation...

We maintain, therefore:

All descriptive concepts derive from simple perception and the description of experiences.

The path that leads to functional concepts is much more varied. Here we can be guided by examples:

The introduction of a definite task in the well known association experiment leads to a complete change in results. The reproduced words show ... a certain relation to the task.

Given the task to name a superordinate concept for the stimulus word, the response to "thunder" might become "natural phenomenon" rather than the usual "lightning." The subjects' description of their experiences during the fore-and main-periods shows that in the early tests erroneous words and thoughts about the task frequently come into consciousness. Such interposed conscious contents slowly drop out and the subject responds to the stimulus word with the appropriate response word with full consciousness of the correctness of his response.

It is usually deduced from this state of affairs that the task has certain effects upon the reproductive process and the concept of determining tendencies is introduced in order to describe this effect.

Not stopping there, we can at the same time produce reproductive tendencies that vary in strength and then we can introduce a measure of the strength (i.e., the associative equivalent) of the determining tendency by finding out what strength of an associative reproduction tendency can be just overcome by the determining tendency.

Another example: We produce associations of equal or different strength between one syllable and two others. We then compare responses given to such double bond syllables with those given to single bond syllables, paying particular attention to response time and the subjects' report of their experiences. The results lead to the concept of generative and effective inhibition.

Or. One has subjects compare standard weights with various comparison weights and then determines from the distribution of judgments the differential threshold for the particular standard weights, using purely mathematical assumptions and deductions.

The physicist measures the amount of light I_1 , that is projected onto a surface, and the amount of light R_1 , that is reflected from that surface. He then measures a second pair I_2 and R_2 and he finds that the ratios I_1/R_1 and I_2/R_2 , and as a matter of fact all

ratios I/R , are equal, and thus arrives at the concept of reflectance. During all this, reflectance itself has never been observed. In the same sense, the differential threshold has never been observed in a psychophysical experiment. What have been observed are only experiences that end with a judgment. And the same is true for the concepts of generative and effective inhibition, and determining tendency.

What have been observed are only the sound of the stimulus syllable and the processes that follow it up to the pronunciation of the response syllable, processes that might well include experiences of tormenting emptiness. In the first example, again only experiences are observed, beginning with the foreperiod and ending with the response, and here too experiences may appear that could be described as goal-directed feelings of being driven.

Experiences such as the tormenting emptiness during the occurrence of an inhibition or the goal-directed feeling of being driven by a determination [determining tendency] might tempt us to argue with our derivation: both the inhibition and the determination are being experienced; there actually seem to be just such inhibition or determination experiences. But it is quite clear that this is inadmissible equivocation. An inhibition that I experience and an inhibition that I derive from the result of an experiment are just as different as color and light-wave, as sound and vibration of the air.

I do not mean the experience of inhibition when I talk about generative and effective inhibition, but rather the fact that a syllable that is associatively connected with another will show greater difficulty in forming an association with a third one than it showed in forming the original association. In other words, to reproduce a syllable in response to another syllable will be more difficult when the latter has been associated with two than when it has been associated with only one other syllable. An analogous argument applies to the determining tendencies.

The concepts which were illustrated in the analysis of the last examples quite clearly fall into the group of functional concepts derived above; they describe relations among experiences, not the experiences themselves.

Note the characteristics of the path that has led us to these concepts.

We were previously able to show a parallel between these concepts and physical concepts. Does this parallel also apply to the method whereby they are obtained?

The positivist will have no doubt about this, but proof can easily be provided even for a defender of realism.

What are the materials of concept formation in our physical example? Certain values of I and R . But these values are only an expression for certain observations, and in the last analysis these are again experiences, such as experiences of the equality of the intensities of two photometric surfaces. Not even the most stringent realism can deny that at the beginning - and even at the end - of each induction there is experience.... Even for the physicist the immediate material is experience, only what he makes of it is not an experience any more.¹

Exactly the same process takes place in the formation of [psychological] functional concepts. Somewhere there are also experiences and they, too - whenever possible - are quantitatively apprehended: distributions of psychophysical judgments, number and distribution of responses as well as length of response times related to the number of repetitions, number of correct reactions and the reaction time of a conditioned reproduction. These objective data are the immediate starting points for our functional concepts.

Maybe the great progress that modern psychology has made in comparison with the old psychology, especially in the area of the functional concept, can be derived from the great improvement in its objective stance [*Objektivierung*]. Only here does counting and measuring make any sense; the simple experience remains as ever unmeasurable.

In contrast to our proposition about the formation of descriptive concepts, we now state:

¹ Our derivation would not be disturbed in the least if instead of experience we say "thing," as most physicists would prefer. But even then it is clear that from "things" "non - things" are derived.

All functional concepts have as their basis experiences that have somehow been made objective. This kind of concept formation is of the same type as the formation of physical concepts.

Varying degrees of objectivity may be recognized not only in the precision and in the fine details of concepts, but also in their source.

While pure experience has been objectified in the reflex examples, in the methodological examples there is an objectively given [state of affairs] which more or less guides us. to the goal of objectivity. Reaction and response times are purely objective; spoken reaction words, responses, and judgments have at least some objective aspect. If I depend solely upon expressive movement, as in some older applications of the expressive method and particularly in animal psychology, the material is already objective before I make use of it.

The objection will be raised that the preceding exposition is trivial. Why such a long disquisition in order to state the obvious? But this objection can be refuted, and the best way is to show what a disastrous role inadequate attention to our distinction has played in research.

We are only left with the task of showing in examples taken from the literature how descriptive and functional concepts have been confused in concept formation and, therefore, also in explanation. A good example can be found in the concept of attention.

In general this concept has the role of a functional concept: both absolute and differential thresholds depend on certain conditions, one of which may be called attention; the same can be said about the quality of learning and of memory and in respect to many other processes. Ebbinghaus and Külpe both based their concept of attention more or less clearly upon such a functional derivation.

On the other hand, there is a certain state of consciousness which can be called a state of attention so that a descriptive concept of attention is also possible.

Titchener most clearly represented such a derivation of the concept.

Thus it would be possible to give the name "attention" both to a functional and to a descriptive concept and it would be purely a question of nomenclature to decide which concept should actually be called by that name.

This would be the case if research were conducted not by human beings but by pure intellects. But since researchers are human beings, it becomes very easy to regard two concepts as *one* because they have the same name, even though at the start the concept is specifically defined in only one particular sense. That is what has actually happened and we can even say quite confidently that no psychologist can state with certainty that he has never been guilty of such a confusion. We want to demonstrate it in two places which are of great importance for psychological research - namely, in the great work of Wundt and in the most modern of all text books, that of Titchener.

Wundt says: "Apart from the coming and going of feelings and images, we can perceive in ourselves, in more or less clear variations, an activity which we call attention." According to this definition, attention would be a pure descriptive concept which could be shown in experience at any time.

On the other hand, there are statements about the effect of attention. "Only impressions which lie above the intensity threshold can pass the apperceptive threshold; but in order for this to occur the subjective function of attention must be added."

But this sentence is a functional sentence: Attention is the cause of an impression crossing the apperceptive threshold. Attention here is a functional concept since the causation cannot be experienced but only derived.

Wundt did not fail to see that he is dealing here with two different things, but still he did not appreciate that he has formed two quite different concepts:

From what we have said, attention and apperception are expressions for one and the same psychological state of affairs. We prefer to select the first of these expressions in order to designate the subjective side of that state, i.e., the accompanying feelings and sensations; we use the second one mainly in order to indicate the objective results, the changes in the quality of the conscious contents.

There is no question that Wundt puts greater emphasis on the unity of, rather than on the difference between the two concepts; the use of "prefer" and "mainly" leave no doubt about this matter. But what kind of unitary state of affairs is it which has a subjective and an objective side to it? . . . What we are dealing with here are two different concepts, one descriptive and the other functional. Obviously the confusion of these two has a series of important consequences, for example, the conception of apperception as a process of the will. The important point here is the adoption of a causal effect into a descriptive concept.

Turning to Titchener, he wants to use attention purely as a descriptive concept: "In the last resort, and in its simplest terms, attention is identical with sensory clearness."

But this author has no other way open to him; he knows only descriptive concepts in psychology: "Whatever attention is, it must be described in terms of mental processes, sensations and images and affections, and explained by reference to its physiological conditions."

That this author is completely unaware of the distinction we have made may be gathered from the fact that he leaves the decision among the various definitions of attention, functional and descriptive in our terminology, entirely to introspection. He does not even see the possibility of forming concepts with characteristics that are not to be found in experience, about which simple introspection cannot make any decision. Titchener's definition, therefore, leads unavoidably to an equivocal use of the word "attention" in which the functional concept eventually comes to the fore. In his discussion whether or not an increase in the clarity of a content parallels an increase in its intensity, we can find, for example, the following sentence: "You can hear, with attention, a faint sound that you cannot hear if you do not attend."

If we now substitute - which we obviously can - for the word "attention" the word "clearness" which, for Titchener, is identical, then the sentence reads: "If a weak sound is clear, you can hear it under certain circumstances; however, you cannot hear it when it is not clear."

It follows from this that under certain circumstances clearness

can exist without the content which is supposed to be clear. What then is clear in this case? And, particularly, does Titchener's sentence say, after the substitution, the same that it says for most psychologists without the substitution? Not even Titchener would want to maintain that....

The physiological concept of attention has no more in common with Titchener's psychological one than its name. But this concept quite clearly does what we expect the concept of "attention" to do; it explains, for example, the lowering of the threshold. But then it ceases being a descriptive concept and becomes a functional one.

We might have [one] physiological explanation that describes physiological processes which are synchronous with clearness, or [another] which describes processes that precede clearness. In fact we then have two quite different concepts, one descriptive concept, "attention" equals "clearness," and one functional concept, "attention" equals "facilitation and inhibition." But since Titchener did not differentiate these two concepts, he gets into a series of difficulties such as in his theory of voluntary attention which leads him to the consequence that the greater the effort the lower the degree of attention. It is not our present task to criticize Titchener's theory of attention; it only served to demonstrate that the distinction which we have introduced is not quite so trivial, and that its neglect may have dangerous consequences.

Instead of Titchener's theory of attention, we might have used his theory of association, where the same confusion of concepts may be found.

We want to add one other example from Titchener's book because his teachings here directly contradict the views which we want to defend later on - we refer to the concept of meaning. Meaning is said to be characteristic of all perception, in contrast to the sensations. What is meaning?

Meaning, psychologically, is always context; one mental process is the meaning of another mental process if it is that other's context. And context, in this sense, is simply the mental process which accrues to the given process through the situation in which the organism finds itself.

Originally the situation is physical (and thus not a mental process) and the meaning is kinesthetic: the organism reacts with movement to the situation and the characteristic sensations of this movement give meaning to the process that is in the focus of consciousness; these sensations are psychologically its meaning. One could well notice a contradiction here, but we would rather ask in principle: Is the concept of meaning still a descriptive concept which undoubtedly it would have to be?

As an answer, we will use another quotation in order to be quite sure about the author's opinion:

In characterizing perception, it is said that the context of perceptions has a fringe, a background, a context, and that this context is the psychological equivalent of logical meaning. But what does it mean to say that the context or background is the meaning of the content that stands in the center of attention? Is this meaning experienced? According to Titchener, only sensations, images, and feelings can be experienced. The sheer togetherness of context, vague perceptions, and central contents is not an experience of their togetherness. I can only experience A and B at the same time, not the connection between the two. Titchener denies just this. In his example about the primitive state, cited above, it says that the sensations of movement are the meaning of the most deeply conscious part of the situation. What is there more than mere succession or simultaneity?

Here, too, there has been a confusion between functional and descriptive concepts: on the one hand is the fact that words and other perceptual contents have a different meaning according to their relationship, and from this we deduce that the relationship has some influence upon meaning. But then "relationship" is being used as a functional concept. On the other hand, one can describe meaning in such a way that it is described as the fringe of perceptual contents; here we have a pure descriptive concept. Finally, even the relationship can be given as such in the fringe, and from these three states of affairs, two descriptive and one functional, arises the Titchenerian theory.

Generally, the consequence of Titchener's ignoring our differentiation is that his concept of the analysis of mental contents remains completely unclear and his concepts are, therefore, mostly

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neither pure descriptive nor pure functional concepts, but contain both elements in an unfortunate and concealing mixture.

Koffka's preoccupation with the nature and use of theoretical concepts was not only reflected in the work of the Gestalt school. In 1917, Claparède, for example, who was to stress the importance of "hypotheses" in problem solving, used a method of thinking aloud as an experimental technique. He was careful, however, to distinguish between these protocols and introspection, and he warned against treating them as such.*

In the same year, in *The Mentality of Apes*, Köhler made the subject-scientist distinction, although perhaps his subjects gave him an unfair advantage in arriving at this conclusion. Speaking of insightful solutions to problems given to his apes, he says:

... [It] often follows upon a period of perplexity or quiet (often a period of survey), but in real and convincing cases, the solution never appears in a disorder of blind impulses. It is one continuous smooth action, which can be resolved into parts *only by abstract thinking* by the onlooker; in *reality* they do *not* appear independently.†

In some ways, Köhler's book is more relevant to the studies of animal learning which had begun to appear in the early twentieth century than it is to the topic of this book. Much of his argument against blind trial – and - error behavior is focused on Thorndike's version of association theory, and even in 1917 it was already outmoded as an argument against associative models of human thinking. He did, however, formulate the concept of "in -

* E. Claparède, La psychologie de l'intelligence. *Scientia*, 1917, 22, 353-368.

† W. Köhler, *The mentality of apes*, 2nd ed., transl by Ella Winter. New York: Harcourt Brace, 1927, p. 191. The original work was published as: Intelligenzprüfungen an Anthropoiden. *Abhandl. d. Kgl. preuss. Akad. d. Wiss., Phys.-Math. Kl. Nr. 1*, 1917. Quoted by permission of The Humanities Press, publisher of the 1951 edition.

sight," and in so doing laid out a battleground to be well littered during the next decade with the reputations of both human and animal psychologists.

In retrospect, much of the controversy seems to have been unnecessary, and was due in large part to an inadequate understanding of what was meant by the term "insight." Although Köhler himself later changed its definition, it is clear from the following passage what was meant at the time:

We can, in our own experience, distinguish sharply between the kind of behavior which from the very beginning arises out of a consideration of the structure of a situation, and one that does not. Only in the former case do we speak of insight, and only that behavior of animals definitely appears to us intelligent which takes account from the beginning of the lay of the land, and proceeds to deal with it in a single, continuous, and definite course. Hence follows this criterion of insight: *The appearance of a complete solution with reference to the whole lay-out of the field....* How one is to explain that the field as a whole, the relations of the parts of the situation to one another, etc., determine the solution, belongs to the theory. Here we have only to exclude the idea that the behavior of the animals is to be explained by the assumption according to which the solution will be accomplished without regard to the structure of the situation, as a sequence of chance parts, that is to say, without intelligence.*

"The theory" was in the process of being worked out by Köhler, by Wertheimer, and by Koffka. Most of the work, both theoretical and experimental, was carried on in the field of perception, and on related problems of recall and memory. Throughout this time the theoretical tools were undergoing a profound change. A vocabulary of wholes and structures was in the making, but these were not merely new elements to be associated as sensations once had been, to be held together by directional forces such as the determining tendency. Directional concepts were to be allowed no special status. For example, in his treatise on problem solving, Duncker explicitly rejects this aspect of the work of N. R. F., Maier. Maier † had suggested that thinking consists of

* Köhler, *op. cit.*, pp. 190-191. T

† N.R.F. Maier, Reasoning in humans, I. On direction. *J. comp. Psychol.*, 1930, **10**, 115-143.

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combining previous experiences in new patterns under the influence of an organizing principle of direction. Duncker refuses even this remnant from the associationist approach:

There exists as little fundamental difference between "direction" and "the elements to be combined" as between "direction" and "problem." For these elements combine with one another with only apparent simultaneity. In reality, they usually follow upon one another in a sequence in which each element possesses problem-character (thus "direction" - character) with respect to the following, and solution - character with respect to the preceding elements.*

The new units were to be basic, and the laws of association to be considered subordinate. The elements of any mental process are not discrete units combined into complex structures; the structures are given in the first place and the laws of association of any part with any other are determined by the laws of the total structure - not vice versa. As a result, association by contiguity is recast in the light of meaningful contiguities within structures, and problems of recall and other memory functions are based on association by similarity, which in turn is a function of the structural requirements of a percept. It is clear, therefore, that not the associative processes but the structures themselves needed study, and to this end Gestalt psychology turned primarily to the field of perception, secondarily to the study of changes in percepts over time, and only finally to other processes.

One of the early essays concerned with a Gestalt analysis of thought is Wertheimer's disquisition in 1920 on syllogistic reasoning. ‡, The goal of this undertaking was most ambitious; Wertheimer wanted to know no less than "How does thinking really work"? In the following abbreviated version of this essay, the ambition sometimes outdistances explanatory achievement. However, whatever one might think of such terms as "recentering" and the "inner necessity of the whole," at a descriptive level Wertheimer's account challenges any theory of thinking. Gestalt theory may

* K. Duncker, On problem solving. *Psychol. Monogr.*, 1945, **58**, No. 5, p. 17. See selection on p. 262 ff.

‡ M. Wertheimer, *Über Schlussprozesse im produktiven Denken*. Berlin - Leipzig: de Gruyter, 1920.

not have significantly advanced our understanding of the structure of the cognitive apparatus, but its representatives did have the courage to tackle the most difficult problems. The following passage illustrates one such attempt.

Max Wertheimer

The Syllogism and Productive Thinking

When one attempts, in actual thinking, to use the *modus barbara*¹ of traditional logic, a curious discrepancy may arise. Like so many of the examples in textbooks of logic the *barbara* often appears empty, inadequate, and sterile. No wonder the *modus barbara* has been styled a *petitio*, or - a merely classificatory device²

And yet this is not invariably the case. Much clever thinking occurs in terms of this modus; very often one has the feeling that ones thinking *has* advanced. *What is really involved in such processes? How does it happen that the same logical operation can yield such diverse results on different occasions?*

Our aim here is to inquire into the nature of thought processes

M. Wertheimer, The syllogism and productive thinking. In W. D. Ellis, *A source book of Gestalt psychology*. New York. Humanities Press, 1950. Abridged and translated by W. D. Ellis from: Über Schlussprozesse im produktiven Denken. In *Drei Abhandlungen zur Gestaltheorie*. Erlangen: Verlag d. Philos. Akad., 1925. Original publication: 1920 (cf. above). Reprinted by permission of The Humanities Press.

All men are mortal M-P (Major premise)

Socrates is a man S-M (Minor premise)

Socrates is mortal S-P (Conclusion)

² Some logicians - notably John Stuart Mill - have maintained that the major premise is really an induction in disguise.

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as they occur in actual affairs (not, as is customary, with regard merely to logical validity).

I

The syllogism should - on this everyone is agreed - lead in its conclusion to a "new" proposition. The extreme case of this requirement is expressed in the rule that the conclusion must not appear as a premise. This requirement is obviously justified, for if the conclusion merely repeats in a new way (i.e., as a kind of recapitulation) what was already known in the premises, the result is "meaningless." But what are the conditions imposed by the requirement?

In its essentials the situation before the process is this: I possess, somewhere in my knowledge, the judgments that are to be used as premises; I do not yet possess the judgment which will appear as conclusion. Later I do possess this.

Now how does this apply to Socrates? If the syllogism is to fulfil its essential conditions I must not know in advance whether Socrates is mortal or not. I write: S?P and then I proceed as follows. Somewhere in my knowledge I encounter the proposition that all men are mortal; elsewhere, that Socrates is a man.... Both of these *without* knowing whether or not Socrates is mortal. But is this possible? Are there really such cases?

The requirement of which we have been speaking sets forth that neither MP nor SM may, taken alone, provide any knowledge regarding SP. Neither may I know of Socrates that he is a man *because* he is mortal, nor that the mortality of "all" men would naturally include that of Socrates. The former condition is easily fulfilled. Of the latter, however, one is at once suspicious, for it is not true that I know about the mortality of *all* men; of many, yes, but not of all. Actually the major premise here is not universal but is an induction in disguise.

Now let us take an example which *does* satisfy both requirements. Socrates goes to pay his taxes. He inquires at the central office which sub - office he should visit. The attendant asks to which Tax Zone Socrates belongs. Socrates does not know; how should he? "Well," answers the other, "you must know the street where you live! ... Good, you live in X Street (SM); and X Street is in Zone 426 (MP)-therefore ..."

The fact that Socrates lives in X Street does not trespass upon the fact of this street being in Zone 426, and hence the conclusion regarding Socrates is not gratuitous. The major premise asserts a civil regulation, not a piece of "knowledge"; it is an ordinance of the city government that for all cases having the property *a*, the property *b* must follow. Nothing is said about Socrates himself one way or the other; for purposes of the ordinance nothing need be known regarding any properties peculiar to Socrates. Indeed this is universally true and therefore holds also in cases where the major premise is a verbal definition or where it states something at least temporarily conceived of as subject only to human specification - e.g., an hypothesis tentatively set forth as presumably a law of nature. This was also accepted by Mill.

Everything seems to depend upon having the major premise universal without thereby presupposing any knowledge of SP. This brings up the ancient question of how knowledge can be universal without a prior determination of all particulars. Although this question is undoubtedly very important it may nevertheless be left outside our present considerations. I specify: P is known in all its particulars; the major premise is universal. Does it follow then that every syllogism is a *petitio*, a mere recapitulation of things already known? Are the foregoing requirements then impossible of satisfaction?

Let us consider how the requirement applies to the minor premise. Before the syllogism comes into being I must already possess SM but *not* SP. So far as SM is concerned the properties contained in P must be irrelevant. Thus neither S nor M in my minor premise may contain the property P. I can know a thousand things about Socrates, but I must not know that he belongs in Tax Zone 426. The formula, then, is that although any number of other characteristics may be contained in S, those appearing in the major premise must not appear in S. It is a genuine question to ask: *How* does Socrates enter the syllogism? Do I mean here the Socrates who possesses all the possibly true characteristics (known and unknown) of the "object" designated by that name; or do I mean the Socrates whose *known and directly determinable characteristics* are actually given?

The same holds for M. In the most simple case S is introduced as involving but one certain characteristic; S is defined, then, through *characteristic*³ 1. Then to Sc1 there is added c2 [i.e., M], and this is the significance of the minor premise. Neither c1 nor c2 may contain anything of c3 [i.e., P] which appears as predicate of the major premise.

The major premise asserts (according to our formulation of its role, p. 252) that *all* instances of c2 are instances of c3 [i.e., all M is P]. But to assert anything of *all* c2's naturally involves asserting this of S [since all S is M]. Does this lead to a *petitio*? Not necessarily. Let us not overlook what has just been said regarding Sc1 and regarding the difference between the properties of S before and after the process carried out by the syllogism itself.

That there is such a difference seems obvious, and yet it is upon this basis that the charge of *petitio* is founded. This is particularly true in cases where S is defined by denotation, for then S is placed within a class in such a way that the *entire* S with all its characteristics, known and unknown, is thereby assigned its logical (denotative) locus. But if S already "contains" everything that could possibly pertain to it, then no "new" knowledge about it is possible. It is into this *impasse* that the traditional logic is predestined to fall. Such a logic is suitable only for one who already knows everything and needs only a system of classification; for a genuine advance in knowledge it is useless.

When, however, the foregoing is taken into consideration, an advance in knowledge is possible. What does it mean to say that S has already been examined with regard to P? The object S, yes, but is this already Sc1? Must I already know, must it be already stipulated that the given object (it is, namely, one of those containing c2) contains c1? Is it identical with the S which contains c1? As an object containing c2, S has necessarily already been examined. There is, however, *no* necessity that in this examination I should have established or known S as Sc1.

Here is the occasion upon which a genuine (and sometimes

³ [Hereafter the word "characteristic" as used in this connection will be designated by the letter c.]

astonishing) advance in knowledge is possible - viz. when Sc1 reveals itself *as* a member of the group c3, which is already thoroughly known.

Two determinations are involved: I, that all cases having the property of c2 also have the property c3; II, that Sc1 is a member of the group characterized by c2. If I specify that determination I takes place in such a way that no recourse is made or can be made to c1; and, likewise, that in determination II there shall be no reference to c3, then I have a pure case in the desired sense.

Changing our example of the tax payment slightly we may illustrate this situation as follows. Suppose that each taxpayer is given a number and that all numbers between 1 - 1,000 have been entered in the ledger as paid. That such entries have been made has nothing to do with the fact that Socrates, who happens to be No. 43, is thereby involved. Conversely, the fact of *Socrates's* being No. 43, is not involved in the entry procedure.

In science, too, this form of procedure plays its role. Completely pure cases are not easy to find, however, since pure determinations are seldom available. An example, however, may be suggested. I investigate a liquid of unknown composition. I am interested in the relation between low specific gravity and low boiling point. I heat the liquid and note which gases are discharged. The first is yellowish, the second bluish, the third greyish. I observe that in the end the yellow gas floats on top.

The first gas to be discharged is yellowish

The yellowish gas comes to the top

The first gas to be discharged comes to the top.

(I.e., the material of relatively lowest boiling point is also relatively lowest in specific gravity.)

II

But we must consider examples of a different sort if the significant aspects of our problem are to be discovered. A busy lawyer is in the habit of destroying the papers of cases so – and - so many years past. Consequently the records of Case A were recently burned. One day he is looking for a certain receipt connected with a current Case B. He looks in vain. He stops to think: what *was*

it the receipt referred to? Suddenly he recalls that the *contents* of the receipt had to do with Case A - and the A papers have been destroyed! Now, expressed as above, we find: in the determination of the major premise the papers referred solely to Case A; not S and not Sc1, but Sc2. But Sc1 is a receipt referring to Case B. Their simultaneity does not of itself give rise to the conclusions, for in addition there must be a "click," so to speak, which snaps them together into the kind of inner relationship which *is* the conclusion.

Or to take another example. Peter and Paul have for a long time been members of the executive committee of their club. The committee meetings are dull and uninteresting and they have given up attending - except for the principal meeting once a year, when the annual Statement of Accounts is presented. One day Peter returns from a journey and finds a letter telling him of a decision unanimously reached in a recent committee meeting. He is incensed and starts to phone Paul when he reads further and finds: "The decision was reached at the annual Accounts meeting which was held earlier than usual this year. The Statement of Accounts was accepted on motion of Mr. Paul Brown."

It is from examples of this sort that one sees how S can suffer a radical upset. For a moment the premises are side by side, then suddenly there is a "click." A decision distasteful to Peter was reached; an Accounts meeting has been held. Suddenly they snap together. (What! Paul was there! - Paul too - is that *possible!* --aha-ha-so-) The whole concept S (Paul) suddenly undergoes a complete reorganization.

Such processes frequently occur in a study of history. Fundamental changes in one's judgment of an historical figure are often due to the discovery of some new facts about that person. The whole character is suddenly re-centred.

The objection might be raised that our examples of Socrates and his taxes or of Peter and his club raise only nominalistic issues, i.e., that the same object merely appears twice under different names. While not false, this objection is actually quite unimportant. One need merely consider the example of the lawyer in order to appreciate this fact. Here it is not true that the same object appears under two names; instead they are *logically different objects*: a memorandum among the papers of Case A is logically quite

different from a receipt used in Case B. And viewing the matter in this light we see that the same applies to Peter and Paul. An abyss sunders the Paul of before and after the syllogistic process. The concept I have of a thing is frequently not only enriched but changed, improved, altered, deepened by the process itself.

Let us consider some further examples. We shall choose more modest illustrations whose determinations do not require so strenuous a purification in order to render clear the thought process involved.

In this square with a parallelogram strip across it (Figure 1) the lines a and b are given. Find the sum of the contents of the two areas. One can proceed thus: The area of the square is a^2 , in addition that of the strip is ... ? But suppose instead that one hits upon the idea:

The solution has thus been attained, so to speak, at a single stroke.

Or, to take another example. Suppose, in the isosceles triangle of Figure 2 the equal sides are given and the angle between them is 90° . Find the area. One could work out from this what a and b are, divide them by 2 and solve the problem. On, the other hand,

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however, one might *see* that this isosceles triangle is tipped over its base is really s ; its altitude is also s . It is therefore nothing but half a square. Area =

Or again: Is 1,000,000,000,000,000,008 divisible by nine?

The answer: -

$$(1,000,000 \dots + 8) = (1,000,000 - 1) + (8 + 1) \\ \dots\dots\dots = 999,999 \quad +9.$$

Similarly: Is $a^2 + ac + ba + bc$ divisible by $(a + b)$?

Another example: What is $a^2 + b^2 + ab$?

A final example. It is reported of Karl Gauss that one day the teacher asked his class who could first give the total of $1 + 2 + 3 + 4 + 5 + 6 + 7 + 8$. Almost at once Karl's hand was raised. When the teacher asked how he had done it, Karl answered, "If I had had to add 1 and 2 and 3, it would have taken a long time; but 1 and 8 are 9, 2 and 7 are 9, 3 and 6 are 9, 4 and 5 are 9 - four 9's, the answer is 36."

In general we see that in S?P the object (S), whatever it be, is given as Sc1 - but there is no direct route from Sc1 to P. Upon further inspection, however, S proves amenable to a "recentering" away from c1 - and in Sc2 I find the route to P opened. Now this procedure is enormously important in science, particularly in mathematics. It frequently occurs that the needed c3, exhibiting the required relationship to P, is only *possible* when Sc1 has been *re-formed*, *re-grasped*, *re-centred* in a specific way. And it is not less frequently the case that to effect this process *a deeper penetration into the nature and structure of S is required*.

Although illustrations of the steps which thinking involves are particularly obvious in geometry, we are dealing here with

phenomena of a more general character. The hierarchy of properties in a concept may be subjected to the same treatment as has been suggested in the foregoing examples, for here too are involved certain structures and structural principles. And the same holds also for combinations of concepts. We are dealing no less in these cases than formerly with re-centring and the other operations already mentioned.

The history of science, has provided many examples: comprehension of the nature of stellar movements ("falling" toward one another); the theory of the screw (i.e., seeing the screw as a wedge); the history of the conception of inertia. Until recently such accomplishments were thought of as essentially the results of "imagination," or "chance," or "the intuition of genius." But it is not these alone. *Formal* determinations, expressible in definite laws, are also involved. Crucial to many such cases is the fact that *certain* moments or characteristics of S are emphasized and brought into the foreground. In other cases the crucial step consists in a certain combination of factors. In still other cases the essential process may be one of *centring*, where the important point is: *from the point of view of which part shall the remaining parts be seen?* Thus centring leads to a penetration into the essential content and hence to an apprehension of the concrete inner structure and inner necessity of the whole with which one is dealing. Manifestly there are other cognitive operations besides subtraction, abstraction, and classification.

In this connection it can be seen that neither the determination Sc2, nor the step Sc1:Sc2 is *arbitrary*. It is formally not a matter of indifference which of several possible reorganizations shall be employed, for the determination is carried out relative to the question "?P." We are dealing with S and P not as disparate juxtapositions; instead, they enter the operation as parts integrated according to definite formal determinations. Given S?P and no direct route leading to P, then the question arises: What is there in Sc1 (or, better, in the general range of things known about S) which is related to ?P ? On *what* aspects of S must I concentrate?

⁴ Example: $a + b + c + d \dots$ may also be seen as $[a + b] + [c + d] \dots$ or, again, as $a + [b + c] + d \dots$

Or: How *must I apprehend S sub specie the task here before me?* How must I alter my former concept of S if I would see it in terms of ?P ? Expressed more formally: not everything in S, not every view nor every reorganization of S is equal with regard to ?P. There are, in other words, determinations of S which *themselves* point to the required solution.

The question of how Socrates combed his hair would be *meaningless* when we are interested in his mortality. Socrates *too* must be considered *sub specie* the question (of mortality) raised by P. And thus we come to the most important question of our entire study: When is the process meaningful, when meaningless? For the *modus barbara* we may say that over against S?P we have $S \rightarrow M \rightarrow P$ in which M serves as a bridge. There are two extreme forms:

In the *first*, M has no other formal relationship than that of its *bare co-existence*, on the one side with S, and on the other with P. These are two relationships which merely involve general validity of the formal syllogistic procedure.

In the *second*, M is a bridge in the sense that its bridge-character *is meaningful demanded* by the question S?P itself. Here M (i.e., Sc2) stands *sub specie S?P* and it possesses certain formal relations within the whole process or situation.

In the first extreme form M is on principle *arbitrary*, and the most meaningless examples of M are (formally) as good as any other: All persons whose names end in *tes* are mortal, Socrates's name ends in *tes* ... and so on. In the second form M is much more than a mere indicator of co-existence, and whereas the first form, asserting an empty fact of co-existence, leads to mere classification, the second accomplishes a genuine advance in knowledge.

Wertheimer's interest in "thought processes in actual affairs," just as Köhler's previous emphasis on insight, illustrates, one of the distinguishing characteristics of the Gestalt school: a concern

with the determinants and functions of intelligent behavior. Only recently has there been a revival of general interest in the mental processes involved in intelligent behavior, a field kept fitfully alive after the promising beginning made by such men as Binet and Claparède in the first part of the century. Piaget has probably been the most insistent among contemporary figures in promoting this view of intelligence. Ironically, Binet's very success with his intelligence test tended to obscure for many years his more fundamental concern with the problem of intelligence.

The most detailed and thoroughgoing attempts to extend Gestalt theory to the field of thinking were published by Karl Duncker in 1926* and 1935.†

Duncker started his analysis of productive thought processes within a framework very similar to Selz's. The latter had recognized the difficulties association theory faced in dealing with relations such as "part of," "cause of," and "equal to," and he had included these relations among the experimental structures to be learned, to be incorporated into larger complexes, and to be applied to new problems. Duncker used the basic units of Gestalt theory to handle these relations. He did not consider them as learned, but rather, for the most part, as dynamically and perceptually given by the nature of the problem and the structure of the mind. Although he granted that types or classes of solutions can be acquired and then applied by "resonance"-a term taken from Claparède and denoting association by similarity- to new situations, he thought that this approach left certain basic questions unanswered. If the solution is correct, how is it achieved, why is a particular schema brought to bear on the problem; and if incorrect, why has that particular mistake been made? Mistakes or successes *may* be traced to the blind applications of previously learned principles, but if we are to understand how, aside from chance, correct solutions are reached, we must discover what is demanded by the situation as given. In short, we must examine

* K. Duncker, A qualitative study of productive thinking. *Ped. Sem.*, 1926, 33,642-708.

† K. Duncker, *Zur Psychologie des produktiven Denkens*. Berlin: Springer, 1935.

the structural requirements of the problem if we are to understand the subject's behavior within that situation. Thus, Duncker's entire work becomes an explication of "insight," although he places no particular emphasis on that term.

Duncker applies the organization and dynamics of structures to problems of thought, but he is equally interested in the problem of the logical relation of a problem to its solution. He asks how human thought can obtain information about the nature of a conclusion from the nature of the premises. This is a very different question from that asked, for example, by Hume. Duncker's question is not an epistemological but primarily a psychological one.

We have touched only briefly in these pages on the relation of logic to thought, in part because it represents a different tradition from the one we are following, but also because until theories of thinking began to approach the sophistication of theories of logic there was little hope of disentangling the two. Interestingly enough, it was only when logic, thought, and logical thought were clearly demarcated in modern times that the real argument over the relationship of each to the other began. Only after the rift had become a chasm did it seem requisite to begin fitting them together again; this time, however, it was the psychologist who explored the nature of logical relations as they influence thought, not the philosopher using the psychology of thought (such as it was) to construct his logic. These problems have stayed with us until the present, influencing points of view ranging from Piaget's to those of psychologists interested in computer simulation.

In this sense, Duncker, as well as Wertheimer, was influenced more by Kant than by Hume. There is the implied assumption that the mind is constructed in such a way that certain logical relations are imposed upon the world, rather than being built up out of our experience of the world. While Duncker himself expresses the opinion that he differs from Kant on this point, the influences can be clearly seen in the following selection.