

Philosophy of Science Association

Psychology as a Science of Objective Relations

Author(s): Egon Brunswik

Source: *Philosophy of Science*, Vol. 4, No. 2 (Apr., 1937), pp. 227-260

Published by: The University of Chicago Press on behalf of the Philosophy of Science Association

Stable URL: <http://www.jstor.org/stable/184864>

Accessed: 14/06/2010 20:19

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at <http://www.jstor.org/page/info/about/policies/terms.jsp>. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at <http://www.jstor.org/action/showPublisher?publisherCode=ucpress>.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.



Philosophy of Science Association and The University of Chicago Press are collaborating with JSTOR to digitize, preserve and extend access to Philosophy of Science.



Psychology as a Science of Objective Relations¹

BY

EGON BRUNSWIK

I

THERE is sufficient evidence from more recent experiments in psychology that equal retinal stimulus-elements do not lead to equal experiences and reactions except under certain rather specific conditions. An unsophisticated observer will find himself surprised to be able to cover with his own finger a person entering the door of his living room. When the finger is moved to the right or left, thus doing away with the precise retinal coincidence with the person, the observer will soon become unable to recognize intuitively the actual retinal stimulus equality of the two distant things. This usually holds even for the case when he is making every inner effort towards an antagonistic, analytic perceptual attitude of the type which is used by painters or draughtsmen in order to represent the environmental situation in a similar way as it would project itself on a photographic plate or on a retina.

¹ This article was read, with minor changes, before the Cosmos Club of the University of California, at Berkeley, April 1936.

It is a short outline of some of the more general considerations made in the author's "*Wahrnehmung und Gegenstandswelt—Grundlegung einer Psychologie vom Gegenstand her*" (Leipzig, Deuticke, 1934).

A more extended presentation of the connected experimental research will be found in a series of studies edited by the present writer under the general title "*Untersuchungen über Wahrnehmungsgegenstände*." Until now the following titles have appeared:

228 Psychology as Objective Science

Instead of this, the unconstrained observer will find it easy and natural to perceive and to compare bodies satisfactorily with respect to their own measurable physical sizes, regardless of all changes in distance or spatial orientation. For a somewhat developed human being, an approaching visitor will not grow from a tiny fingerlike dwarf up to an immense giant, but will, within certain limits, quite fairly retain a constant apparent size. This "body-size constancy" (despite changes of distance and therefore of retinal stimulus-sizes) is under normal conditions a fairly reliable, deep-rooted, well-established, broadly supported habit of the perceptual system. It also holds almost equally well for objects not as familiar in their bodily characteristics and even under conditions of reduced clearness in spatial organization.

Perceptual constancy is not limited to the type of physical property ("object") called "body-size." In connection with changes in special orientation, even the shape of a body will be radically distorted in its retinal representation; for instance, a circle in oblique orientation will project itself as an ellipse. Despite this it usually will still appear in the "Gestalt" of a circle and the projective distortion will ordinarily not even be noticed. Furthermore, a piece of chalk placed in shadow may send equal

I. E. Brunswik, Die Zugänglichkeit von Gegenständen für die Wahrnehmung und ihre quantitative Bestimmung, *Archiv für die ges. Psychol.*, 1933, **88**, 377-418.

II. B. E. Holaday, Die Grössenkonstanz der Sehdinge bei Variation der inneren und äusseren Wahrnehmungsbedingungen, *ibid.*, 419-486.

III. K. Eissler, Die Gestaltkonstanz der Sehdinge, *ibid.*, 487-550.

IV. S. Klumpfänger, Ueber den Einfluss von intentionaler Einstellung und Uebung auf die Gestaltkonstanz, *ibid.*, 551-598.

V. S. Klumpfänger, Die Entwicklung der Gestaltkonstanz vom Kind zum Erwachsenen, *ibid.*, 599-628.

VI. T. Izzet, Gewicht und Dichte als Gegenstaende der Wahrnehmung, *Archiv f. d. ges. Psychol.*, 1934, **91**, 305-318.

VII. K. v. Fieandt, Dressurversuche an der Farbenwahrnehmung, *Archiv f. d. ges. Psychol.*, 1936, **97**, 1-30.

In English, a very brief sketch emphasizing the empirical aspects has been given under the title "Psychology in Terms of Objects" (*Proceedings, Anniversary, University of Southern California*, Los Angeles, 1936, 122-126). Furthermore, some points are brought out in a joint article of E. C. Tolman and the present writer, "The organism and the causal texture of the environment," *Psychol. Rev.*, 1935, **42**, 43-77.

or even less intense light-stimulation into the eye than does a piece of coal which lies beside it in direct sunshine. And yet under a normal, clear survey of the situation, the chalk will appear white and the coal black, corresponding to their invariant physical color-properties of high vs. low reflectivity. Quite similar effects to size-, Gestalt- and color-constancy have been found to exist in the field of audition, where the apparent loudness of a sound-source remains approximately constant even if the distance—and therefore also the intensity of the sound-wave which arrives at the ear-drum—is subject to considerable changes, etc.

In each of these cases the perceptual system proved itself able to establish, in a fairly approximate way, a constant, i.e. a one-to-one coupling between physical characteristics of distant bodies, on the one hand, and its own perceptual or motor reactions, on the other.² At the same time it succeeded in making itself independent from the varying relations of these distant bodies to the observer (e.g. distance) or to other objects (e.g. the sources of illumination). This effect is of extreme biological importance to the organism, since otherwise no orderly and self-consistent “world” of remote manipulable “independents”³ could be established; the physical and topographical constants of the environment would be completely lost in the random variations of their

² It is essential to connect, in any case, the use of the term “constancy,” as it became customary in psychology, with a further clear conceptual determination of the type of abstract (measured or computed) type of physical property or “object” (*Gegenstand*) for which the “constant” coupling to a certain type of reaction is successfully established.

Gestalt psychology, in its successful fight against the “constancy-hypothesis” (which has been an unrecognized premise of the old associationism), emphasized that there is no one-to-one correlation between retinal (“proximal”) stimulation-elements and perceptual reactions. The same negative statement of an absence of a “retinal-size constancy” was the topic of our first introductory paragraph. This is far from being in contradiction to the positive statement of a body-size constancy. In fact, abandonment of the “constancy-hypothesis” even cleans away for finding that other physical something—body-size—which does stay in a (fairly good) one-to-one relationship to the reaction and thus easily presenting the environmental terms which gives proper sense and meaning to the establishment of the reaction.

³ The term “independent” was used by E. C. Tolman (“Psychology versus Immediate Experience,” *Philos. of Science*, 1935, 2, 356–380) in order to indicate types of objects whose definition does not include a reference to a relationship of an environmental entity to the organism.

230 Psychology as Objective Science

"proximal" stimulus-representations.⁴ No "things" (as, e.g., comrades, the enemy, food, tools) could be recognized as identical, when looked at under changed circumstances, since all their characteristics may have changed their actual projective values.

From the standpoint of an observing physicist or behaviorist, the stimulus-projections of the bodies on the retina belong to the effect-pattern which is sent from all parts of the total environmental situation to the stimulus-surface of the observing organism. Since this total effect-pattern is the only source for a correct orientation and reaction of that organism, the couplings which could be headed under the concept of "thing-constancy" must be mediated by it. In searching for characteristics of the total stimulus pattern which would be able to represent bodily characteristics in a fairly unambiguous way (e.g. body-sizes regardless of distance) we find certain sets of combinations of projective sizes, on the one hand, with distance cues (such as binocular disparity, perspective distortion of right angles, etc.), on the other. A body of a distinct size may be represented in different ways: either by a certain small retinal projection connected with a stimulus-cue for a certain large distance or by a certain large projection connected with a cue for a certain smaller distance. The same holds for the representation of the physical color of a body by combinations of the varying intensities of its projective retinal stimulus-value with cues for the corresponding actual conditions of illumination. The need for such a twofold (at least) stimulus-basis for the causal mediation of every kind of thing-constancy was pointed out by Bühler in his "duplicity-principle."⁵

An organism which has established a system of reactions which appear to depend in a fairly constant manner on body-character-

⁴ The term "proximal stimulus" was used by K. Koffka ("Principles of Gestalt Psychology," New York, Harcourt Brace, 1935), in order to discriminate the stimulating event arriving at the sense organ from the "distant" body. For the sake of brevity we use the term "stimulus" always in the sense of proximal stimulus or even of primary physiological excitation, whereas the remote manipulable cause of the stimulation will be called "body" or "body property." Both, stimulus as well as body property, are types of physical entities or "objects."

⁵ Cf. K. Bühler, *Die Erscheinungsweisen der Farben*, Jena, Fischer, 1922, and E. Brunswik und L. Kardos, Das Duplizitätsprinzip in der Theorie der Farbenwahrnehmung, *Zeitschr. F. Psychol.*, 1929, 111, 307-320.

istics as such, regardless of their actual retinal projections, has proved therefore two abilities: (1) to make use of indirect stimulus effects of bodies as cues or signs indicating their presence, (2) to integrate distinct stimulus-elements into unified functional wholes which act as a single unitary basis for further reactional effects. Both statements follow from a purely objective, physicalistic analysis of the type of achievement or success involved in the facts of thing-constancy. Since the first statement refers to the notion of meaningful representation by signs and the second to the totalitarian *Gestalt* principle, this way of functioning is best comprehended in the proposition of Tolman, that the intercourse of the organism with its environment takes place in the formation of "sign-Gestalten."⁶

The way in which this effect is attained may be compared with the functioning of a collecting lens. The single central ray arriving at a particular point does not allow any inference as to the distance of the point wherefrom it is starting. A possibility for such an inference will not become granted unless other partial-effects of the situation—that is, for our present case, the marginal rays—will be brought, by the collecting lens, from their original divergent status into convergence and finally to intersection. From a knowledge of the point of intersection and the distance, curvature and material of the lens, a fairly unambiguous statement regarding the location of the radiating point can be obtained.

An analogous general way of functioning is true for the case of perceptual thing-constancy. As has been pointed out, the gross characteristics of the direct retinal projections of the physical bodies in question are, *per se*, unable to represent in a satisfactorily unambiguous manner their sizes, forms, colors (reflectivities) etc. Certain particular further traits of the effect-pattern which reaches the retina, indicating distance, illumination, etc., have to be included in order to accomplish this task. These "cues for the circumstances" (*Umstandskriterien*) play, therefore, the rôle of the marginal rays in the case of the lens. The lens itself is represented in our more generalized case by the eye together with the optical sector of the nervous system. Corre-

⁶ Cf. E. C. Tolman, *Purposive Behavior in Animals and Men*, New York, Century, 1932.

232 Psychology as Objective Science

sponding with the more complex nature of the task, even the integrative action has to be spread out into more complex and extended patterns. The lens of the eye, which is involved in this system of procedures, is but a part of this bringing together of differently spread-out and randomly diverging effects of the situation which is to be mastered in regard to its behaviorally important physical traits.

The couplings established in thing-constancy, therefore, appear to be a particular complex case of a causal relationship. The characteristics of the bodies in the distant environment, on the one hand, and the final (perceptual or motor) reactions, on the other, are connected with each other by a texture of causal chains first diverging and then brought to a new convergence and to intersection at the point of reaction. Such a mechanism of "*multiple mediation*" may grant a one-to-one correspondence between object and reaction for all the variety of circumstances under which the object can be perceived.

The most important trait of this one-to-one causal relationship seems to be that, at certain mediating cross-sections of the causal texture mentioned, no single event will participate in it. Size-constancy, for instance, means that, e.g., an 8-cm. body will, under a great variety of conditions, always (approximately) be responded to as an 8-cm. body, that is, be recognized as such. There is a certain set of correct "8-cm. responses" given in all cases where an 8-cm. body is present. But nevertheless the direct retinal stimulus, which is an element of the mediating causal texture, will vary within a wide range corresponding to the actual distance of the body.

Along with the variability of the retinal projection and indirectly proportional to it, the corresponding stimulus-cues indicating the distance of the body will also vary.

Besides this variation which compensates for the variation of the direct retinal image another kind of variability of the distance-cues will be noticed, which may be even more interesting from the standpoint of the sign rôle which the proximal stimuli have to play in mediating the environment to the organism. One and the same distance may be represented once by a certain amount

of binocular disparity, another time (or even simultaneously) by a certain amount of perspective distortion of bodies of right-angular form, etc. Organisms have learned to use a large variety of cues in a *vicarious* manner, especially where a certain life-important type of fact is functionally difficult to attain, i.e., where simple, always present, and unambiguous cues are not available. The cues thus belonging to one "*cue-family*" may have nothing in common among themselves, *per se*, i.e., in their intrinsic, geometrical properties. They may be connected by nothing except their indicating value for a more or less probable common cause which is remote from the stimulus-surface of the organism.⁷ The formation of such an "or-collection" (*Oder-Verbindung*) of coordinate cues (or cue-configurations) cooperating and substituting for each other in releasing identical behavioral consequences without being similar among themselves, seems to me to constitute an objective *operational criterion for the fact that these stimuli have received "meaning"* for the organism by being admitted as signs for something else.⁸

To characterize these important features of multiple and variable causal mediation, we may call the constant far-reaching couplings between objects and reactions "interruptable." There are two focal (or modal) regions, or kinds of events—objects and reactions—, and the spatial and temporary gap between them

⁷ According to their objective probability cues may be graded on a scale of "reliability." No cue, of course, is perfectly reliable, i.e. inimitable and therefore univocal in its indicative value. One may think of a stereoscope counterfeiting a cue of such high reliability, as binocular disparity is.

⁸ It has been shown by Holaday (*l.c.*) that binocular disparity is able by itself to sustain a high degree of size-constancy, whereas its elimination (by closing one eye) becomes almost ineffective in cases in which the full normal variety of other possible distance-cues is available. A similar and very perfect "substitutability" of tactual and visual cues for the volume of a body has been found by Izzet (*l.c.*) in experiments on weight-constancy.

The cognitive concept of the "or-collection" building up a "cue-family" has its parallel, on the action-side, in the concept of the "habit-family-hierarchy" of C. L. Hull ("The concept of the habit-family hierarchy and maze learning," *Psychol. Rev.*, 1934, 41, 33-54). The term "hierarchy" is—in both cases—apt to indicate the differences in "goodness" or "reliability" of cues or means respectively. W. S. Hunter ("The psychological study of behavior," *Psychol. Rev.*, 1932, 39, 1-24) made the fact of "vicarious functioning" a central point in the distinction between psychology and physiology.

234 Psychology as Objective Science

appears to be in some sense over-bridged by their constant coupling, since at the mediating layer of retinal stimulation (and of primary physiological excitation) none of the types of single cues do correspond with either of these classes of events. But nevertheless the whole process can be completely understood in terms of a certain type of physical process, as symbolized by the case of the collecting lens.⁹

There is, of course, one common abstract feature in the total stimulus configuration which is actually mediating body-size to the organism: a certain mathematical function (product) of the visual angle, as indicated by the retinal size, on the one hand, and the distance, as indicated by the particular nature of the distance-cues available, on the other. If we should not be able to find such a common trait, which would be—within the limits of the reliability of the cue-elements in question—in a one-to-one relationship to the attained type of object, “body-size,” the whole achievement would remain miraculous. There is no discontinuity in this sense. But, taken as concrete events, there is a large variety of functionally discriminable mediating cue-configurations, as compared with the undifferentiable equality within the field of the releasing remote object-property, on the one hand, and within the behavioral output, on the other. In this sense, the strain of univocality between object and reaction is indeed interrupted.¹⁰

⁹ The only question remaining open for a physical explanation is as to how natural or artificial tools (or organismic “institutions”) like collecting lenses, or the even more complex organismic systems functioning in a similar integrative way, might have developed at all. This general genetic question of living organization belongs to the field of theoretical biology and the psychologist does not need to be concerned with it, since his problems are centered more around actual achievement and functioning.

¹⁰ Multiple mediation—i.e. checking as much as possible all variations in the situational circumstances—is one way of rendering “far-reaching” couplings undisturbed by interfering conditions of causation. Another practice would be that of keeping all conditions of observation actually as constant and insulated as possible and let no uncontrolled “lateral” causal chains interfere. This latter would be the procedure usually followed by physical as well as by the traditional psychophysical experimentation, and also by man-made machinery, as e.g. electrical transmission of a message. Here the univocality remains obvious along the whole chain of mediation. This second procedure is in general the more reliable one, but also the more round-about way as far as the single case is concerned.

Psychology deals with the abilities of organisms to establish intercourse in a successful way with the surrounding world, in reception (cognition) as well as in action. It seems, now, that a most essential description of (receptive) abilities could be given by differentiating as clearly as possible the types of physical properties ("objects") to which the organism is able to react in a fairly undisturbable, univocal manner, or which, in short, he is able to "*attain*." Let us return again to our example of size-perception. There the alternative would be whether, as a decisive type of object influences a reaction, we should have to consider the retinal stimulus in its own size-properties or the body far away which lies "behind" it as its partial cause and is represented by the stimulus to the organism. The problem would be, in short, whether an organism "sees" the retina or the remote environmental bodies.

We find an objective basis for deciding questions of that kind in constancy-research. Since the findings in higher animals did not afford a constant coupling between retinal projective size and reaction, but a rather satisfactory one between body-size and reaction, we may call body-size (and not retinal size) the attained object of reception. In the same way, under normal conditions, not the stimulus-intensity of arriving light-rays, but the reflectivity of body-surfaces would have to be called the attained object of color-reception, and likewise note the intensity of the received, but of the emitted sound the object of a normal auditory reaction, etc. This way of experimenting upon and describing an individual's abilities by *projecting the reactions upon their focal conditions*, or upon the environmental end-terms of the (cognitive) couplings, we may call "*psychology in terms of objects*" (*Psychologie vom Gegenstand her*).¹¹

¹¹ Our emphasis upon the "object attained" may be considered as a kind of *long-sectional figure-ground treatment* of psychological research following the stimulating causal chains backwards in search for their actual "meaning" (see above), i.e. for those types of object within the environmental system upon which the reaction became focalized. The relationship of the "object attained" to "mediation" is a complement to the more cross-sectional relationship between figure and ground as emphasized in Gestalt psychology. Ground as well as mediation are both characterized as being present as stimuli but remaining lost amidst the "things" which they are "framing." Cf. also F. Heider, "Ding und Medium," *Symposium*, 1927, 1.

236 Psychology as Objective Science

As can be shown, this method would not be limited in its application to the psychology of reception, but could be extended equally well to the psychology of overt action. In the former case the causal chains entering the organism are followed systematically backward until they reach types of causes which prove themselves to be, at least in "normal" cases, the most essential focal causes for the outcoming reaction; whereas in the latter case the causal chains set into action by some movements of the organism would have to be followed in a great number of different cases and under systematically varying conditions in forward direction in order to find out the common ends into which they converge (unless they are disturbed by "extraordinary" conditions). In studying action problems, psychology in terms of objects would specify a discipline which would operate in terms of success.

In problems of reception (i.e. perception and thinking) as well as of action, psychology in terms of objects would turn out to be a physical and biological natural science, being concerned in particular with all kinds of fairly well-established (i.e. fairly univocal), far-reaching, interruptable causal couplings between the classes of reactions on the one hand, and the corresponding classes of releasing, or effected, "attained" types of (environmental) constants or events on the other. *This—rather than the intrinsic properties of behavior as such—seems to me the primary topic of psychology, which thus appears to be defined by a formal criterion, as a certain particular type of objective correlation.*

The essentials of all response or behavior would in this way be projected upon the total manifoldness of the physical environment, segregating from it the particular "world" of the individual (or of one of its sub-functions, as, e.g., perception) as a part of the intellectually constructed world of a highly sophisticated human physicist. This would be "his world," the "*Umwelt*" (to borrow this term from Uexküll) for which he was able to establish fairly reliable cues and means, and which he thus mastered in cognition or in action (or in both at the same time).

This reacted-to world could be detected and described in a purely objective fashion. In fact, constancy research can be and

has been undertaken equally well with animals as with human beings and has shown up highly developed achievements of thing-constancy in some of them. The general method may, in the representative case, be guided by the following frame: (1) a search for all equalities in the field of reactions, (2) a registration of all traits of the corresponding environmental situations, and (3) a finding out of those traits among them which are equal when reactions are equal. This is, in short, the method of reactional equalities, or of equivalent situations.¹² The particular emphasis from the standpoint of psychology in terms of objects lies on step (2), requiring a *satisfactorily abstract and differentiated conceptual system of possible objects* (see below).

Furthermore, constancy research is not limited to the organisms's environment. As the work of physiologists like Cannon shows, even the "wisdom of the body" may be expressed in terms of its established constants, as e.g. in terms of the physiological regularities of temperature, blood-composition, etc., which all appear to be kept in a high degree invariant independently of a great number of randomly varying circumstances.

Thus the topic of psychology in terms of objects would be all kinds of "constant" couplings—kept fairly undisturbed from interfering "lateral" causal chains—between separate layers of the environment and of the organism, or within the organism itself, or even within the environment; all of them would, in fact, require the integrative functioning of an organism or of one of its tools (as e.g., machines or collecting lenses).

Let us compare, in short, psychology in terms of objects with some of the outstanding traditional forms of psychological investigation: the early behavioristic research and the traditional type of psychophysics.

Leaving out of consideration some generalities not sufficiently emphasized to become effective in research or in detailed conceptual systematization, in both of these fields a rather undifferentiated stimulus-reaction scheme was used, which did not even sufficiently keep in mind the distinction between proximal stimuli

¹² Cf. also H. Klüver, "*Behavior Mechanisms in Monkeys*," Chicago 1933. Some of the work of Lashley follows the same principle.

238 Psychology as Objective Science

and distant things or between reaction and its distant results. Since, e.g., in size-comparison experiments both bodies—the standard and the variable—were put carefully at the same distance from the observer and in the same surrounding, no decision could be made regarding our alternative mentioned above, namely whether retinal size (visual angle) or body-size is the actual object of perception. The outcome of this type of psychophysical experiment was, therefore, not much more than data about thresholds, i.e. the mere sensual acuity under certain very favorable but specified and artificial conditions, and not of the avoidance (or non-avoidance) of gross errors impending under the disturbing and misleading conditions essential to the random variability of practical daily-life situations. The *kind* of object actually mastered can not be disclosed unless the disordered variations of the proximal stimulus representations of the environmental entities have received a proper place in experimental research. On the contrary full emphasis is given to the neglected questions of the disturbances involved in these variations, in constancy research, where objects set up at different distances, indifferent orientations, surroundings, etc., are to be compared intuitively.

In a way analogous to psychophysics, the early behaviorism and physiological psychology seemed to become overconcerned with the mere mediation-problems of sensory, nervous and muscular action as such, and therefore lost contact with the decisive more remote focal causes and effects of these actions which have to be searched for in regions of the environment spatially or temporally distant from the organism in its present status.¹³ Psychology appeared to be almost limited to events in the organism itself or on its surface, whereas the anchor-points of life lying outside the skin did not enjoy an equal amount of analytical care.

¹³ Even G. F. Skinner ("The Concept of Reflex in the Description of Behavior," *J. Gen. Psychol.*, 1931, 5, 427-458), though maintaining that "psychologists had better give up the nervous system and confine their attention to the end-terms, does apologize for doing so in pointing toward the greater immediacy of observation of these end-terms and the reduced temptation for insecure speculation. We do not find it a matter of embarrassment, but rather one of positive emphasis, to go even further in psychology and restrain—as far as at least one term of the correlations in question is concerned—completely from the organismic events as such in favor of the initial (or terminal) environmental limits or focal systems as connected with one of the organism's activities.

Psychology in terms of objects, on the other hand, tries to apply some method which could be called *object-critical* (*gegenstandskritisch*): the type of object really attained in reception or action is ascertained by the application of objective operations and described in its precise conceptual distinction, involving a widespread conceptual differentiation of the older comprehensive notion of the "stimulus." The "*what-problems*" of objects attained are put in the first row and the "*how-problems*" of mediation admitted only in so far in psychology as they throw light upon what-problems.

II

The psychological problems treated in section I were apt to be formulated in an objective, behavioristic fashion. An organism was supposed to be studied in its causal relationships to the environment by a neutral observer in the same way as any physical problem would have been treated. If the proposition is true that we were concerned with a scheme for the most fundamental problems in psychology, we must be able to answer the question as to what bearing these considerations may have to that field which for a long time has been considered the central or even the only one in psychology: consciousness.

The problem of perception in the traditional type of psychology—psychology of consciousness—is usually stated in terms of antitheses like the following: consciousness vs. reality; appearance vs. existence; subjectivity vs. objectivity; realm of immediately experienced introspected phenomenal qualities vs. realm of constructively inferred physical quantities; etc. In those terms the facts of thing-constancy at once appear in a fashion more familiar to common sense: a complete perceptual constancy would simply mean that a real 8-cm. body under all varying circumstances always succeeds in appearing in the apparent size of 8 cm., or a white chalk under all illumination conditions as white, etc., or, in short, that bodies would appear always in the same way as they really are, and that always what seems to be equal, is equal and vice versa. These formulations seem at first to touch many problems and differentiations usually treated in philosophy and not

240 Psychology as Objective Science

in an empirical science. But since our considerations in the previous chapter have shown us that an objective formulation of the constancy problem does not involve any metaphysical complications, we may be still hopeful that even the introspective version of our problem might be formulated in a way which is, and which will even look, philosophically neutral.

As a basis for physical statements not all kinds of observations are equally admitted. As Schlick¹⁴ has especially emphasized, a certain type of observation plays an outstanding rôle as a basis of physical judgments: the observation of complete spatio-temporal coincidences. All kinds of "*measurements*" rely upon this highly specialized type of observation.¹⁵ The main outstanding feature of this type of observation is an ideal self-consistency (non-variability) of the data, which makes it possible to build up out of them a "world" which is free of contradictions. However, no philosophical distinction between an ordinary and such a selected type of perception could be made. Physics and any "topographical" description of the world are, primarily, a constructive outgrowth of a set of measurements. For the introspecting psychologist there is no need to discuss any further questions as to an "independent reality" corresponding to this constructed physical world. He may for his own empirical purposes stop at this point. The problem of perception, therefore, would appear as a comparison of the results of the more ordinary, care-free and everyday-life observation—called perception in a narrower sense of the word—on the one hand, with the outcome of a critically selected special set of observations followed by processes of explicit discursive intellectual and conceptual construction—i.e. the "physical" world of measurement and computation—on the other hand. Thing-constancy, then, could be formulated as a good correspondence between intuitive judgment and measurement of the characteristics of the environmental bodies, regardless of the varying circumstances under which the intuitive judgments occur.

¹⁴ Cf. M. Schlick, *Allgemeine Erkenntnislehre*, Berlin, Springer, 1925.

¹⁵ As it has been pointed out above, coincidence may be used sometimes as a help to attain explicitly in perception a certain kind of object which otherwise would not be represented by a conscious dictum, e.g. the retinal stimulus-sizes.

In a formal sense the observer of a complete coincidence underlying the operation of measurement is an observer of a relational datum, in particular of an equality. No "qualitative" statement is involved. It is this trait which yields to physics its "objectivity," that is the highest possible degree of self-consistency and unambiguous social communicability. This standard was adopted for psychology in section I, referring to the "method of reactional equalities." "Consciousness-psychology" may equally well fulfill this ideal. *Excluding all direct metaphorical reference to conscious "contents" we may restrict to the subject's report to equalities among his intuitive contents,¹⁶ and yet get hold of the most subtle phenomenal differentiations, or qualities, by "projecting" them upon the corresponding "objects attained" and thus representing them in environmental terms. This can be done by means of an analysis of the releasing situations involved—thus leading, in the end, to a fully appropriate analytical treatment of totalitarian problems.*

As an outstanding trait of these reactional equalities there remains their reduced self-consistency and high variability in terms of their objects attained. This may be ultimately due to the fact that, like under variable atmospheric conditions, there is a steady interference with all sorts of coinciding outer and inner inequalities. For example, surfaces perceptually recognized to possess a certain well-known "color" (reflectivity) will be different from each other in space and time, will stay under different illumination, in different surroundings, have different areas, etc., and thus never remain quite untouched in their appearance.¹⁷

¹⁶ The author, *l.c.*, tried to show that even the mere *naming* of the apparent equality in question in conceptual terms—i.e. by indicating whether it is an equality of apparent size, or color, or weight, or density, etc.—is, in principle, omitted from "psychology in terms of objects."

Not only the actual attainment but even the types of intentional effort or "attitude" toward attaining certain "intended" objects may be disclosed by objective methods (in fact, by analyzing the statistical distribution of judgments with regard to the number of modes).

¹⁷ I agree with H. L. Hollingworth ("Experimental studies in judgment," *Arch. Psychol.*, 1913, 29), who proposes, in accordance with Wells, to use variability as an objective, quantitative index of "subjectivity" of judgment. (I would not, however, as Hollingworth does, rely upon a ratio of personal vs. group consistency, but keep the definition free from its "social" element and emphasize the more general point of non-attainment, or variable attainment, of a type of object.)

242 Psychology as Objective Science

But, likewise as is true for the mind, this would not involve an obstacle to an exact treatment. Spatio-temporal point-coincidences as a selected basis for physics is a simultaneous equality of two elements in *all* possible respects. That is the trait which makes it especially outstanding.

Both versions of our problem, the behavioristic as well as the introspective, appear to be in an equal way *philosophically neutral*, or non-metaphysical, since no change in the universe of discourse or general categorical system involved is necessary. The introspective version need not transcend the "realm of consciousness," since the problem may be kept restricted to intuitive, set off against sophisticated conscious data. The behavioristic version, on the other hand, will play, in principle, within the frame of these sophisticated, constructive data alone, confronting measured reactions of an organism with measured properties of its surroundings. These two versions may be considered ultimately synonymous, or tautological, thus giving but two different aspects of one and the same empirical problem.

An interesting and promising statement concerning the subject-matter of psychology was made by Brentano.¹⁸ He considered it essential for anything psychic "to have an object": the subjective contents of perception do "mean" something, which is distinguishable from them, as their object; so, for instance, my impressions of the table are pointing toward the real table. When we love, hate or fear, we love, hate or fear something; and so on for all conscious contents. This relation of the given contents to certain objects has been called "intentionality." Thus the real table would be the "intentional object" of the corresponding perceptual content.

Having in this way started a fruitful point of view, Brentano in some other respects failed to meet the decisive empirical questions, as formulated in the constancy problem. He was troubled by something he called different ontological status or "way of existence" (*Seinsweise*) of content and object, the former being subjective and phenomenal, the latter objective and real. Therefore,

¹⁸ F. Brentano, *Psychologie vom empirischen Standpunkt*, Leipzig, 1874.

he hesitated to call intentionality (or "meaning") a genuine relation, since a relation may not link together entities which in some essential respect are incomparable. Meaning or intentionality should, according to Brentano, rather be called something (quasi-relational ("*ein Relativliches*")), and in any case has to be considered as a relationship of its own original type, which by no means could be analysed with regard to its properties or be reduced to any other type of relation. Many other philosophers have followed Brentano in this point.

Brentano entitled his main work "Psychologie vom empirischen Standpunkt," but his notion of what is empirical—not very dissimilar from that of other "act-psychologists" and "phenomenologists" (like Meinong or Husserl)—was a quite introspective one: the actual object of any "act," or of its "content," has to be found by an immanent phenomenological analysis of this content itself. What the object of my perception is, may be read from this conscious phenomenon itself. It seems to me that this definition of the concept of "object" is a good example of what has been called "unnecessary duplication" of the world into phenomenon and reality. If the object of a perception is completely clear from an analysis of that content which is considered merely to represent it, there is no forceful reason to separate these two entities at all. Corresponding to his (partially) wrong beginning Brentano's work lost itself in a kind of dogmatic phenomenalism which did not yield useful empirical results.

As may be seen from the former considerations, the present writer would agree with Brentano in defining the subject-matter of psychology by the *bipolar, diadic concept of intentionality*. But we would maintain a further step of development of this concept beyond act-psychology, abandoning the immanent-phenomenalistic trait in its definition. In order to get in touch with exact work in psychology, an *objective re-definition of intentionality and an indirect method of detecting the actual object* of any content has already been outlined above. For the sake of convenience, the couplings found in constancy-research would be called "intentional," indicating the life-sustaining effects of their establishment and their functional pointing towards something present in

244 Psychology as Objective Science

the environment.¹⁹ Instead of the older notion of an “intentional *in-existence*” of the “intentional object” in the (conscious) response we might, then, better talk of an “intentional *co-existence*” of the object attained with the response.

In order to discriminate from Brentano’s “*intentional objects*,” those types of physical objects for which perceptual constancy holds should be called “intentionally attained” objects. Psychology in terms of objects would, then, as far as problems of cognition are concerned, not be a description of the terminal limits of the “intentional causal couplings,” i.e. of the organism’s reactions (contents), in terms of properties of their own or of their “immanent intentional objects,” but a description of the initial limits of these couplings, i.e. of the organism’s actual cognitive achievements, in terms of the “*objects intentionally attained*.” (To indicate an effort made towards the attainment of an object this object may be called “*intended*.”)

The statement about the nature of the actual object of any reacting organism or observer (subject) could not any longer be made by the subject himself on the basis of an immanent introspective analysis of his actual content as such, but would be made by the experimenter—or at least by the subject in a changed rôle with additional empirical measurement support—on the basis of the outcome of an experiment, and therefore would gain objectivity. In cases where, by means of these indirect methods, equal reactions (or phenomena) should be found to correspond with equalities in certain (retinal) stimulus-values, these proximal stimuli would have to be called the intentionally attained object of perception; whereas, if reactional equalities should correspond to equalities of the distant bodies these bodies (or their abstract physical characteristics) would be called intentionally obtained objects. In fact, the outcome of such an object-critical analysis could be repeated, and therefore would have to be acknowledged, by everybody, just like the outcome of any other physical experiment.²⁰

¹⁹ Thus the new concept of intentionality seems to be closely related to what Tolman meant in defining in objective terms the “purposive” character of behavior.

²⁰ For a concrete example of the difference between the phenomenological and the object-critical method of object-finding see page 246.

The revised operational definition of intentionality as an objective diadic relationship between individual and environment would also abolish its irreducibility and make it capable of a logical analysis in terms of the general relational theory as outlined by Whitehead and Russell.²¹ According to our previous analysis of the couplings involved (see section I), the ideally perfect intentional relation would possess the character of a one-to-one (i.e. reversibly univocal), interruptable (i.e. multiply and variably mediated) causal relationship.

Furthermore, the intentional relationship shows some similarity with the marital relationship between husband and wife. Though this relationship is in both directions univocal—since each husband may have only one wife and each wife only one husband—it is yet “*asymmetrical*”: the wife of the husband is not the husband of the wife. This attaches to the relationship a certain direction. In the same way it will hold for an intentional coupling—at least so long as it proves to be an ideal one—that, e.g., an 8-cm. stick will under all conditions look like 8 cm. long and anything that looks like 8 cm. long will also be found in measurement to have this particular length. But nevertheless reaction and object are not interchangeable, their relation possesses a certain direction, it is “*asymmetrical*.”²²

Finally, the objectively defined intentional causal coupling—besides being diadic, reversibly univocal, “interruptable” and asymmetric—would possess a certain kind of *transitivity*. For, all objects staying in a univocal relationship to a type of object which is intentionally attained could be considered even themselves as intentionally attained. This feature would become especially important in all kinds of “understanding” of representation of facts by the means of language or any type of “expression.” The logical traits mentioned yield a complete analytical concep-

²¹ B. Russell, *Introduction to Mathematical Philosophy*, New York, Macmillan, 1919.

²² The intentional relation thereby might be defined as positive either in the direction from the object as initial term to the reaction as terminal limit—following the direction of the causal chains—, or in the opposite direction, from the reaction to the object as end-term. This latter would be more in accordance with the character of the perceptual reaction as a preparation to overt action towards the body in question as a manipulable means-object, and would also follow the direction of the immediately experienced “meaning” or conscious intentionality of the Brentano-type.

246 Psychology as Objective Science

tual reduction of the operationally re-defined concept of "intentionality."

III

Constancy-research, or the investigation of intentional couplings, is concerned with practical achievements of living beings. Therefore, it may not be expected to find as ideal results as have been assumed in the previous chapters. In fact, empirical investigations showed certain characteristic deviations from univocality which need for their precise representation a further differentiation of the conceptual system of objects in order to make possible a description of the achieved relationships in terms of their object-ends.

A simple size-constancy experiment is the following. A cube of 8 cm. height is set up in front of the observer at 1 m. distance. At 6 m. distance a variable series of cubes can be presented. Under usual everyday circumstances, in the average, not an 8 cm. but an $8\frac{1}{2}$ cm. cube will be found to be the apparent equivalent to the standard 8 cm. cube in front. This can be considered as a slight, but nevertheless noticeable, influence of the diminished visual angle under which the cube far away is projected on the retina.

On the other hand, the objective projective equivalent of the standard cube in the plane of the comparison series would be a 48 cm. cube. But under usual conditions (excluding the case of retinal coincidence as mentioned above) even in the case of a strong effort toward an antagonistic analytic ("pictorial") attitude, an observer, not especially trained, will fall far short of attaining this value. Let us assume—in accordance with experimental findings—that the apparent projective equivalent will lie around 12 cm. In terms of an achievement analysis, this result indicates the inability of the perceptual system to get away in a satisfactory degree from its deep-rooted habit of bodysize-constancy; the deviation of the apparent value (12) from the true (48) has to be accounted for, again, as a mutual interference of the two different viewpoints of comparison: body size and projective size.

What perception really attains in both cases is a kind of compromise between two different types of "objects." In no case is the gross perceptual efficiency following an all-or-none principle in terms of relationships to environmental entities. But in the former case the attainment of the "intended" type of object is obviously much closer to the aspiration than in the latter, since $8\frac{1}{2}$ is nearer to 8 than is 12 to 48.

An exact quantification, in terms of objects, of the "degree" of bodysize-constancy in both cases can easily be afforded by introducing a new scale which has its zero point at the value where not even a slight deviation away from a correct retinal comparison—which is, from a biological standpoint, a cheap but "bad" truth—towards size constancy would be realized, that is, in our example, at 48 cm. The point of unity, or of a "100% constancy," would, in our example, correspond with 8 cm.²³ For different reasons, not to be discussed here, the scale has to be subdivided in a logarithmic manner. According to a simple "constancy-ratio,"²⁴ the location of $8\frac{1}{2}$ and 12 on this scale would then be computed as .96 and .76 respectively indicating a remarkably high bodysize-constancy in the former case, guided by an intentional attitude towards it, and a respectable remainder in the latter case, where the individual made an opposite intentional effort.

A similar general way of response, but usually with less high degrees of constancy, has been found in the field of color constancy as well as in gestalt-constancy. The apparent size of the moon also follows the same principle of perceptual compromise. It has been found, furthermore, that the attainment of both types of objects—body-properties as well as retinal stimulus values—will increase slowly but steadily with repeated performance of the task, thus increasing the shift-span between the achievements of the two antagonistic perceptual attitudes (or modes or evaluation of the stimulus-configuration) in question.

²³ This scale could equally well also have its ends mutually exchanged.

²⁴ Cf. E. Brunswik, Zur Entwicklung der Albedowahrnehmung, *Zeitschr. f. Psychol.*, 1928, 109, 40-115, and *l.c.* The degree of failure with respect to body-size is indicated by deviations either below or above 100.—Cf. also R. H. Thouless, Phenomenal Regression to the "Real" Object, I, *Brit. J. Psychol.*, 1931, 21, 339-359.

248 Psychology as Objective Science

The problem of perceptual constancy is not limited to alternatives of "independent" body-properties vs. projective stimulation properties. It can be generalized and transferred to perceptual "confrontations" and various other kinds of objects.

Let us take, e.g., a standard body weighing 15 grams and compare it with a set of comparison bodies of varying weight but each of them of equal volume, which might be twice the volume of the standard. Among this comparison series, therefore, the 15 gram object will be equal in weight to the standard, but different in density, whereas the 30 gram object will be equal to it in density and not equal in weight. The question put before the perceptual system is quite analogous to the alternatives discussed above. Perception has to decide whether it will acknowledge the type of equality holding between the standard and the 15 gram comparison-object; then we would have to draw the conclusion that "weight" was its intentionally attained object. Or perception may decide for a reactional recognition of the type of equality holding between the standard and the 30 gram object; then "density" has been the object of perception.

As could already be expected from the outcome of the other types of constancy experiments, perception even in the case of the new alternative—weight vs. density—does not yield responses which could be called "clean" (or all-or-none) in terms of the object attained. Neither weight- nor density-constancy has been found ideal under the conditions under which the experiment was performed. As has been found by Izzet, *l.c.*, in average, instead of the 15 gram object, the 17 gram object has been chosen as apparent weight-equivalent; and instead of the 30 gram, the 21 gram object as apparent density equivalent. Therefore, the same type of interference as above could be found again between different kinds of physical objects even in weight- and density-perception, showing a weight-constancy of about .80 and a density-constancy of about .50.²⁵

²⁵ In a quite analogous way, in experiments with figures, interferences have been found between area and length of the edges, etc. (see below).

Some of these interferences, especially those occurring in the field of the original type of constancy research (as size-constancy, etc.), may be satisfactorily accounted

It may again be pointed out that a traditional psychophysical weight-threshold experiment would not allow such a decision as to the kind of object actually perceived, since volumes would all be kept equal, and therefore the objective weight- and density-equivalents would coincide. It would leave open the question of "what" we perceive and give merely an account of the precision of perception as a measuring device under certain especially favorable conditions.

What should properly be called the intentionally attained object in cases like those mentioned, where neither the one nor the other correct "*pole*" of intention, i.e. no perfect constancy, is attained? An answer from the standpoint of an either-or would be: none; but this would not seem very reasonable, considering the clear-cut nature of the empirical results. The right proposition to make seems to be the following: In cases of interference or compromise of two (or more) different kinds of possible viewpoints of comparison, let us call an "*in-between object*" (*Zwischengegenstand*) the object of perception, as determined quantitatively by the constancy-ratio mentioned above.

The concept of an in-between object might at first seem paradoxical from the standpoint of the usual system of objects. In

for *in terms of the causal texture of the environment in its relationships to the organism*. Perceptual cues for remote objects always remain ambiguous, and therefore perception is forced to co-include in its basis for reaction a large number of more or less indirect and unreliable cues which in some cases may stay in but a very low correlation to the type of object which they are admitted to indicate. (This would hold, e.g., for retinal size *per se*, when taken as indicating body size. Indeed, the characteristic odd admixtures found in the results of size-constancy experiments may be represented as functions of the product retinal size times indicated distance [i.e. body-size], on the one hand, and of retinal size, *per se*, on the other.) As has been pointed out in the author's article "Psychology in Terms of Objects" (*l.c.*), the effect of such a general way of functioning is a decrease in the probability of exceedingly large perceptual errors.

For some other types of perceptual compromises an explanation *in terms of the technicalities of the sense-organs* at the command of the perceptual system might be found, by studying physiologically their structure and the way of their functioning. This seems to be especially true for pitch and loudness which both turned out to be joint functions frequency and energy of the sound. Cf. S. S. Stevens, "The relation of pitch to intensity," *J. Acoust. Soc. Amer.*, 1935, 6, 150-154, and E. G. Boring, "The Relation of the Attributes of Sensation to the Dimensions of the Stimulus," *Philos. of Science*, 1935, 2, 236-245.

250 Psychology as Objective Science

physics something may be either a weight or a density, in geometry either a length or an area, etc., but never a hybrid between two or more of these essentially different and in some way incompatible entities of different geometrical or physical dimension. But we are easily able to find analogies from the field of mathematics. The introduction of the complex numbers ($a + bi$)—where $i = \sqrt{-1}$ —is filling up the empty field between the two orthogonal axes constituted by the scales of the real numbers on the one hand and the imaginary on the other, in the same way, as the logical constructs of the in-between objects do with the open gaps within the discrete system of the sharply distinct abstract types of objects, used in physics and geometry, into a continuous system of objects. These constructs are in no fundamental way different from the constructs used in other sciences. And they are also not mere products of speculative fancy, but means for a convenient quantitative representation of the essentials in the results of an empirical psychology, and therefore an outgrowth of a real scientific need.²⁶ In fact, they are nothing but a short means of expression of the finding that the type of perceptual response in question is a function of more than one of the variables as they are conceptualized in the current system of physics and geometry.²⁷

²⁶ Some relationships could also be found with the manivalued logics, in which the absolute alternative of true and false is given up in favor of a continuous scale between these two cases as mere extremes.

²⁷ It could be objected that a presentation of psychological results in terms of functional dependence of the reaction on various stimulus-factors would be as short and less confusing than to talk in terms of "in-between objects." The reason why we believe it more profitable, however, to make this terminological distinction is the following. Strict functional dependence would have to be expressed in terms of proximal stimulation. We would prefer, instead, to *express the (functional) relationship in terms of the remote significate*, instead of using the signifying stimulus, in all cases in which the operational criterion of meaning given in section I is fulfilled. This would necessarily introduce a certain ambiguity. But it may be still considered more favorable to do so from the standpoint of illuminating the essential cue-rôle of the stimuli in establishing the organism's ability to master its environment.

Let us consider an example. For a most direct functional analysis apparent size would be simply one or another function of retinal size and distance-cues, and the case of a perfect constancy would not be especially emphasized as against cases of incomplete achievement. In terms of "objects attained," however, the response would appear to be a "function" of body-size alone (i.e., in strict functional terms, of retinal size times

By an extension of the conditions varied, the reaction has been proved in certain fields to be a function of more than two types of objects, as, e.g., in the case of a comparison of volumes in different forms, or in cases when the numbers of groups of dots, coins, or stamps are to be judged intuitively. In this latter case the size and even the value of the elements will influence the apparent number.

Precise statements as to the minimum number of abstract physical factors ("objects") which have to be considered to participate in the in-between object attained in any particular type of perception will, it is hoped, be available by some application of the mathematical methods used in factor-analysis. The aim would be a *generalized 'multipolar,' or 'multidimensional,' psychophysics*, which would enable us to register the structure of the world as attained by the organism in an exact quantitative inventory.²⁸

After an introspective analysis, Katz²⁹ distinguished two main "modes of appearance" of colors. Either a color looks compact and substantial, as belonging to a solid thing, in which case it appears sharply localized (e.g. at the surface of a paper), or it appears somewhat unreal, a mere sensational "color matter" without reference to a thing, with a spongy texture and not definitely localized in its distance. The colors as seen in a spectro-

indicated distance) in the case of a perfect achievement, and of body size and projective size, *per se*, in the case of an incomplete achievement. In the latter case retinal size would enter the function twice in different rôles, once as a constituent of body-size, then "*per se*" (see the note above).

A further complication for a functional analysis in terms of retinal stimulation seems to be that all equi-potential members of a cue-family (see above), e.g. all stimuli and stimulus-configurations indicating distance, would have to be enumerated explicitly in terms of intrinsic properties of their own instead of simply being comprehensible in terms of their common "significate," as "distance-cues." By using the "object"-terminology the particular kind of environmental-functional direction of interest in stating the dependences found could be indicated at once.

²⁸ Since the ways of mediation will always determine the achievement, the highly abstracted type of object-critical analysis as outlined above would lead, ultimately, to a statement of all psychologically relevant types of "how"-problems and -findings in terms of "what," i.e. of objects attained.

²⁹ D. Katz, *The World of Color*, London, P. Kegan, 1935.

252 Psychology as Objective Science

scope, or the color of a hole in a screen, would appear in this latter way. The first mode of appearance is called "surface-color," the second "film-color."

The appearance of a surface-color would, when applied to Brentano's idea of intentionality, indicate that the (color of the) solid body remote in space is our intentional object. A film-color would represent the case in which no "thing" is supposed to be our object, and which, therefore, sometimes has been called the case of a "non-intentional" experience or of "mere sensation." The vagueness and indistinctness of the phenomenological method of determining the object of perception shows itself, among others, first in the fact that no precisely communicable treatment and no detailed quantification is possible in that kind of analysis.

Similar distinctions to those of Katz were made by Holaday (*l.c.*) and by Eissler (*l.c.*) as to the appearance of sizes and forms: under clear conditions they will appear "thingish" (*dinghaft*), under unfavorable ones in a more ghostlike and essenceless, merely "*figural*" way. Independently of that type of analysis, the main task of transferring of the procedure of object-finding into an objective plane was achieved by conducting constancy-experiments. Having done this, a correlation was found between the "thingish" mode of appearance and high degrees of thing-constancy, on the one hand, and the "figural" appearance and lower degrees of thing-constancy, on the other. But nevertheless the correspondence, as far as it could be ascertained at all, did not seem to be a very close one, showing that immediately experienced intentionality is a rather unreliable indicator for the goodness of perceptual achievement of a type of object in question.

IV

Let us, finally, turn to some applications of the psychology in terms of objects to current, more general questions. It is a frequently repeated statement that the distinction between "immediate experience" and "reality" is an undue duplication of the word. The duality in question is supposed to be merely one of representation. All datum might be described either immediately in terms of qualities or mediatively in quantitative terms. So,

e.g., for "red" a certain range of wave-lengths could be substituted, for "experienced weight" the outcome of a weight-measurement, for "visual space" physical space, etc.³⁰ Both "languages"—it is supposed—can be easily translated into each other and indicate the same thing.

From the standpoint of constancy research, the following objection could be made against this statement. A projection of the immediately given world upon the scientific system of objects does not show a complete parallelism. The representation of the intuitive qualities within the abstract world of objects comes to lie in the empty spaces between the "clean" objects of physics and geometry. Therefore the lines coordinating the two aggregates in question to each other do not show a parallel and unambiguous texture but a complex entanglement. Therefore it is not "the same" (or "nothing but") that is represented once in qualitative and then in quantitative terms, when we describe e.g. the Eddingtonian table once as apparently so and so big, rectangular and black, and then in the abstract measurement terms of physics. As was pointed out above, the intentionally attained object of apparent body-size is not the measured body size, but an "in-between object" between it and retinal size; and the same holds for apparent vs. measured form, color, area, volume, weight, number, etc.

Under this aspect the "duplication" of the world into an "immediately given" and a reflectively constructed one does not seem any more undue or unnecessary, since their confrontation turned out to be a sincere empirical question, which in each particular case can be decided by experiment. It is true that intuitive perception gives a portrayal of the physical world, but this portrayal is in a certain way imperfect, not completely isomorphic; an investigation of this incompleteness is the very task of psychology.

Therefore, the "intentional," psycho-physical problem which we are dealing with can not be considered to be a mere pseudo-problem, an outgrowth of mere conceptual confusion. From the point of view of an achievement-analysis, the intuitive and dis-

³⁰ As our examples show, we are dealing here with the "psycho-physical," not with the "psycho-physiological" relationship.

254 Psychology as Objective Science

cursive approach to the world do not have the same objects, and all their differences, as well as all differences in qualities, can, ultimately, be expressed in terms of their differences in objects attained. And though these differences are often minute and subtle, they will never fundamentally disappear. They give sufficient support for the type of "dualism" suggested. This dualism at the same time lost all its philosophical disturbances, since at no point of our underlying psychological consideration was any metaphysical question involved. It became a dualism of quick, care-free, stereotyped, intuitive experience vs. a critically selected and logically treated experience. The absolute gap between these two layers disappeared, but the difference became the more clear in quantitative terms of objects. This dualism may be considered to be the harmless and necessary heir of at least some aspects of the historical, unnecessarily troublesome dualism of "mind and body" or however else it has been formulated. It does away with the naive presupposition widely accepted by common sense that each experiential datum refers to but one of the scientifically conceptualized variables of the stimulation-process.

Let us turn to a second point of consideration. Empirical philosophy made much effort in order to find an "*indubitable*" basis of facts. A regress to the phenomena as given in completely naive immediate experience was suggested. Mach considered the mass of sensational elements as primary, Russell the more unitary "aspects" of things. These aspects have been considered to change with the position of the observer toward them. The thing itself would be a sort of collection of all of its different aspects.

From the standpoint of constancy research, it may be objected that both Mach and Russell were still not naive enough in their description of the immediately given. According to the experimental findings, a "thing" practically does not change its appearance with changes in distance, orientation, or illumination, etc., or at least by far not in the same degree as its proximal stimulus-representation does. A table remains, just in its most naive and immediate appearance, under all conditions the same phenomenally identical table as ever; its backside or its weight is phenome-

nally as present as its frontside or its color, no matter whether these phenomena correspond to "truth" (measurement) or not.

The incorrectness committed by Mach and Russell obviously has its causes in an incomplete elimination of functional considerations from phenomenal description (a widespread source of confusion, sharply criticized by Koffka); this was meant above by using the term: incomplete naiveté. In a way similar to their contemporary psychology they did, in essence, unduly overemphasize and absolutize "the skin," i.e. the structure of and the stimulating events on the retina and other stimulation-surfaces. The notion of the sensational elements of Mach cannot belie its descent from the punctiform mosaic structure of the sense-receptors in the retina or other parts of the body. And the "aspects" of Russell correspond to the direct projective patterns reaching the stimulus-surface. The main difference between Mach and Russell is that Russell had in some sense been infiltrated with a totalitarian Gestalt point of view, whereas Mach—though as an empirical scientist himself one of the initiators of the Gestalt movement and of constancy research—remained a psychological atomist in his principal theoretical ideas.

Psychology in terms of objects (which goes, in some respect, a further step beyond the old elementistic sensation psychology as well as beyond Gestaltpsychology) has to stress even more than it has been done before, the relativity of the concept of the immediately given (or the undubitable). Through more or less arbitrary shifts in attitude, a great variety of experiences can become phenomenally indubitable and primary. This was shown in detail by several experimental studies. Mach's famous unique juvenile experience of the world as being "genuinely" nothing but a mosaic of color, taste and smell, is a type of experience which never will happen except in a very extraordinary kind of analytical attitude.

From the standpoint of an achievement-analysis of the organism, in last essence, no fundamental distinction can be drawn between "immediate" and "discursified" responses. From this functional viewpoint it would not even be true that the physical world contains inference, whereas the phenomenal not. The facts

256 Psychology as Objective Science

of thing-constancy—which of course are deeply concerned with the immediately given—could never be accounted for in functional terms without the assumption, most fundamental in psychology, that stimuli of various kinds are used as indicators for something else which causally lies “behind” them (*cf.* our operational criterion of meaning given above).

The formation of such quasi-“hypotheses” within the perceptual system has been studied repeatedly. Stratton was the first to make perception relearn the use of retinal images by turning them upside down through the application of certain lenses in front of the eyes. In recent experiments, the acquirement of artificial new cues by the perceptual system has been studied. Fieandt, in a study which is to appear soon (*l.c.*), succeeded in training perception to use in an intuitive way certain otherwise meaningless stimuli—e.g. even the ringing of a buzzer—as cues indicating the illumination-conditions, in particular a certain area of shadow carefully hidden from the somewhat narrow system of well-established perceptual shadow-cues. In consequence the introduction of this stimulus was followed by a quite immediately given apparent brightening of a certain shadowed disc, establishing its color constancy.³¹

But, nevertheless, all these training effects did not appear in the same sudden and radical way as discursive information would have affected our intellectual knowledge. On the contrary, they needed long-repeated training, and grew up but slowly and incompletely. The brightening effects of the newly established

³¹ It has been found that even *ambiguous cues* (i.e. those of a reliability of their actual indicative value lower than 1) will be conditioned, though the response seems to retain a higher degree of tentativeness (reduced strength). In a recent unpublished study of the present author, conducted in order to throw further light upon this problem, rats were confronted with objectively ambiguous situations, possessing various degrees of probability of success or of punishment (“danger”). Even relatively small differences in probability were discriminated by these animals (whose functioning is, in fact, not very dissimilar to the relatively primitive cognitive system, called perception). As the writer hopes to be able to show later in detail, an evaluation of even some of the slightest correlations between possible cues (symptoms) and more remote traits seems to be true for perception, especially in making accessible the character-traits of other persons in social intercourse. Reactions to mere probability have also been found by Thorndike in some of his recent learning experiments.

shadow-cues did not seem to be affected by the introduction or the lack of any direct "conscious" recognition of the particular stimulus as an indicator for the fact that the disc is shadowed. Similar (relative) functional isolation of perception from abstract knowledge is familiar from many of the well-known "illusions."

The same relative independence from discursive knowledge, and indication for the same more mechanical way of learning, was found in experiments with coins and stamps, where the influence of "value" upon the apparent number did not exceed a certain degree unless a sufficiently deep-rooted "underground" familiarity with the objects as bearers of value was established, even if this rôle was discursively well-known to the subject. On the other hand, these experiments showed that even "unsensual" and "conventional" traits like monetary value may enter the system of perceptual intuition.

In a merely functional sense, therefore, intuitive perception seems to be a somewhat autonomous but more primitive cognitive function (or sub-personality) working in principally the same "constructive" (inductive and—by the means of "transfer"-mechanisms—also deductive) way as the critical instances of verbalized measurement and computation do. The difference seems to be merely one of degree. As also has been shown by experiment, the perceptual system is—as compared, in a functional sense, with discursive methods of knowledge—relatively inertial, stereotyped, superficial, confused, unanalytical, and sometimes narrow in its admission of and its ways of evaluating cues. The biologically required quickness of functioning and the mechanization involved make the contents of perception look more immediate in their appearance than the final outcomes of explicit operations do. In the same way as there is a primitive layer of our action system—the instinctlike "Id" of psychoanalysis—the perceptual system is representing the primitive and in some sense blind, or "stupid," layer of our cognitive system. Perception, like the Id, does not "know" explicitly about its (stimulus-) motives and about the load of past experience functionally involved in each of its acts. There is no "sensual" layer or type of datum except functionally speaking. The functionally

258 Psychology as Objective Science

direct (e.g., the retinal size) may seem phenomenally most unnatural to realize, whereas the phenomenally simplest may be functionally most complex.

It is a merit of the totalitarian ("molar" instead of "molecular") behavioristic school represented by Tolman that purposive consciousness-terms like "expectation" or "hypothesis" (Krechevsky) have been redefined in objective, analytic terms. As was pointed out above, in this way of description of perception vs. physical measurement-approach, both appear to be fundamentally equal in their way of inductive functioning and not more than gradually different with respect to the correctness or "dullness" of their hypotheses, or the reliability and cleanness of intentional attainment of objects.

The possibility may not be excluded of attaining perceptually through sufficient training even types of objects which are mediated very indirectly, that is by very long and complex chains of causes and inference. A highly mechanized physicist may one day reach a point which in some sense could be considered to be a phenomenally immediate perception of remotely inferred constructs like an atom, or of the fulfillment of any conceptual requirement by a certain fact (as, e.g., of constancy of acceleration). This is to emphasize again, in a drastic way, the functional uselessness of the concept of the immediately given. With sufficient mechanization and in proper attitude, any abstract construct may become as accessible and "*anschaulich*" as any of our natural intuitive perceptions. From the standpoint of an instantaneous phenomenal analysis, constructs like atoms, then, would become as indubitable, or as dubitable, as the most "sensual" perception could be. The mediating events, formerly explicitly given, would become lost in their new rôle of mere mediation. And, in most cases, perception would also become able to shift arbitrarily between the two (or more) established ways of focalization, the old and the new. This lability, too, makes it clear that no epistemological (metaphysical) distinction could be successfully based upon the vague and variable phenomenological (introspective) distinction between a (supposedly indubitable) immediate given and a (supposedly dubitable) derived construct.

As a last problem we may touch in short the problem of partition (*Schnitt*) between observer (subject) and observed object as it has been raised in recent publications in physics.³² According to the current view, the boundary between the observer and his object can be arbitrarily displaced.

Considering first a single perceptual act, we would state that no freedom is given at all as to the interpretation of the partition between subject and object, since this layer will be univocally dictated by the findings of constancy-research upon this act. In the case of a complete thing-constancy the partition is placed at the body far away, and the light rays have to be considered to belong to the observer. The same would hold also in the case of a stick touching and correctly mediating the surface qualities of a distant body, whereas at the same time the hand holding the "probe" is completely extinguished in its phenomenal representation. In the opposite case of a complete projective stimulus-constancy, the light rays arriving at the retina or the stick would become the object observed. And in the usual case of an incomplete compromise-solution, the partition would lie—conceptually, but not spatially—in-between the proximal stimulus and the distant body.

Regarding secondly the perceptual system as a whole, however, some arbitrariness in the layer of partition is given by the fact that, by a shift in attitude, the type of object of perception can be changed. But, as it has been pointed out above, this shift-span has its certain narrowly circumscribed limits; so, e.g., no complete shift may be expected along the scale between size-constancy and retinal comparison.

These two criticisms do not touch the correct statement in the theory of partition that a physicist with his set-up of scientific tools and his abstract methods of measurement and computation has a much higher degree of freedom in focalizing and shifting partition than has the more habitual, stereotyped and inertial system of intuitive perception. But even in this case a subsequent description would be predetermined as to the "object" of

³² See the discussion of the problem by V. F. Lenzen, "The interaction of subject and object in observation," Second internat. congress for the unity of science, Copenhagen 1936.

260 Psychology as Objective Science

the procedure by the nature and success of the technical and conceptual operations involved.

In conclusion: the primary subject-matter of psychology is defined by a formal criterion as the objective pattern of couplings which an organism, in its causal intercourse with the environment, was able to focalize in a fairly "constant" way upon more or less remote (life-sustaining) types of "objects," despite the disturbing variability (multiplicity and ambiguity) of the single mediating stimulus-cues and means. Psychology is, therefore, a science of the relational achievements at the command of the organism, of well established far-reaching (cognitive or effective) success—quantifiable in terms of its "objects attained"—, rather than of mediation processes, as such. (In short, psychology is a science in terms of "what" rather than of "how.") Troublesome older "philosophical" problems, or pseudo-problems,—like dualism, meaning, intentionality, subjectivity, totality, immediate given—appear, within this system of a "psychology in terms of objects," in a revised, objectified form; they develop into problems of analytical psychological experimentation and conceptual reduction by an operational shift in their definition, thus disclosing the soundness of feeling underlying the original insufficient statement of these complex problems.