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The conflict between aristotelian and galileian modes of thought in contemporary psychology[1]

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In the discussion of several urgent problems of current experimental and theoretical psychology I propose to review the development of the concepts of physics, and particularly the transition from the Aristotelian to the Galileian mode of thought. My purpose is not historical; rather do I believe that certain questions, of considerable importance in lhe reconstruction of concepts in present-day psychology, may be clarified and more precisely stated through such a comparison, which provides a view beyond the difficulties of the day.

I do not intend to infer by deduction from the history of physics what psychology ought to do. I am not of the opinion that there is only one empirical science, namely, physics; and the question whether psychology, as a part of biology, is reducible to physics or is an independent science may here be left open.

Since we are starting from the point of view of the researcher, we shall, in our contrast of Aristotelian and Galileian concept formation, be less concerned with personal nuances of theory in Galileo and Aristotle than with certain ponderable differences in the modes of thought that determined the actual research of the medieval Aristotelians and of the post-Galileian physicists. Whether some particular investigator had previously shown the later sort of thinking in respect to some special point or whether some very modern speculations of the relativity theory should accord in some way with Aristotle's is irrelevant in the present connection.

In order to provide a special setting for the theoretical treatment of the dynamic problems, I shall consider first the general characteristics of Aristotelian and Galileian physics and of modern psychology.

GENERAL CHARACTER OF THE TWO MODES OF THOUGHT

In Physics

If one asks what the most characteristic difference between «modern» post-Galileian and Aristotelian physics is, one receives, as a rule, the following reply, which has had an important influence upon the scientific ideals of the psychologist: the concepts of Aristotelian physics were anthropomorphic and inexact. Modern physics, on the contrary, is quantitatively exact, and pure mathematical, functional relations now occupy the place of former anthropomorphic explanations. These have given to physics that abstract appearance in which modern physicists are accustomed to take special pride.

This view of the development of physics is, to be sure, pertinent. But if one fixes one's attention less upon the style of the concepts employed and more upon their actual functions as instruments for under-

1. Jour. Gen. Psychol., 1931, 5, 141-177, edited by Carl Murchison.

standing the world, these differences appear to be of a secondary nature, consequences of a deeplying difference in the conception of the relation between the world and the task of research.

Aristotelian Concepts.

Their Valuative Character. As in all sciences, the detachment of physics from the universal matrix of philosophy and practice was only gradually achieved. Aristotelian physics is full of concepts which today are considered not only as specifically biological, but preeminently as valuative concepts. It abounds in specifically normative concepts taken from ethics, which occupy a place between valuative and nonvaluative concepts: the highest forms of motions are circular and rectilinear, and they occur only in heavenly movements, those of the stars; the earthly sublunar world is endowed with motion of inferior types. There are similar valuative differences between causes: on one side there are the good or, so to speak, authorized forces of a body which come from its tendency toward perfection (τελος), and on the other side the disturbances due to chance and to the opposing forces (βια) of other bodies.

This kind of classification in terms of values plays an extraordinarily important part in medieval physics. It classes together many things with very slight or unimportant relation and separates things that objectively are closely and importantly related.

It seems obvious to me that this extremely «anthropomorphic» mode of thought plays a large role in psychology, even to the present day. Like the distinction between earthly and heavenly, the no less valuative distinction between «normal» and «pathological» has for a long time sharply differentiated two fields of psychological fact and thus separated the phenomena which are fundamentally most nearly related.

No less important is the fact that value concepts completely dominate the conceptual setting of the special problems, or have done so until very recently. Thus, not till lately has psychology begun to investigate the structural (Gestalt) relations concerned in perception, thus replacing the concept of optical illusion, a concept which, derived not from psychological but from epistemological categories, unwarrantedly lumps together all these «illusions» and sets them apart from the other phenomena of psychological optics. Psychology speaks of the «errors» of children, of «practice», of «forgetting», thus classifying whole groups of processes according to the value of their products, instead of according to the nature of the psychological processes involved. Psychology is, to be sure, beyond classifying events *only* on the basis of value when it speaks of disturbances, of inferiority and superiority in development, or of the quality of performance on a test. On all sides there are tendencies to attack actual psychological processes. But there can hardly be any doubt that we stand now only at the beginning of this stage, that the same transitional concepts that we have seen in the Aristotelian physics to lie between the valuative and the nonvaluative are characteristic of such antitheses as intelligence and feeble-mindedness or drive and will. The detachment of the conceptual structure of psychology from the utilitarian concepts of pedagogy, medicine, and ethics is only partly achieved.

It is quite possible, indeed I hold it to be probable, that the utility or performance concepts, such as a «true» cognition versus an «error», may later acquire a legitimate sense. If that is the case, however, an «illusion» will have to be characterized not epistemologically but biologically.

Abstract Classification. When the Galileian and post-Galileian physics disposed of the distinction between heavenly and earthly and thereby extended the field of natural law enormously, it was not due solely to the exclusion of value concepts, but also to a changed interpretation of classification. For Aristotelian physics the membership of an object in a given class was of critical importance, because for Aristotle the class defined the essence or essential nature of the object and thus determined its behavior in both positive and negative respects.

This classification often took the form of paired opposites, such as cold and warm, dry and moist, and compared with present-day classification had a rigid, absolute character. In modern quantitative physics dichotomous classifications have been entirely replaced by continuous gradations. Substantial concepts have been replaced by functional concepts.

Here also it is not difficult to point out the analogous stage of development in contemporary psychology. The separation of intelligence, memory, and impulse bears throughout the characteristic stamp of Aristotelian classification; and in some fields, for example, in the analysis of feelings (pleasantness and

unpleasantness), or of temperaments,[1] or of drives,[2] such dichotomous classifications as Aristotle's are even today of great significance. Only gradually do these classifications lose their importance and yield to a conception which seeks to derive the same laws for all these fields, and to classify the whole field on the basis of other, essentially functional, differences.

The Concept of Law. Aristotle's classes are abstractly defined as the sum total of those characteristics which a group of objects have in common. This circumstance is not merely a characteristic of Aristotle's logic, but largely determines his conception of *lawfulness* and *chance,* which seems to me so important to the problems of contemporary psychology as to require closer examination.

For Aristotle those things are lawful, conceptually intelligible, which occur *without exception.* Also, and this he emphasizes particularly, those are lawful which occur *frequently.* Excluded from the class of the conceptually intelligible as mere chance are those things which occur only *once,* individual events as such. Actually since the behavior of a thing is determined by its essential nature, and this essential nature is exactly the abstractly defined class *(i.e.,* the sum total of the common characteristics of a whole group of objects), it follows that each event, as a particular event, is chance, undetermined. For in these Aristotelian classes individual differences disappear.

The real source of this conception may lie in the fact that for Aristotelian physics not all physical processes possess the lawful character ascribed to them by post-Galileian physics. To the young science of physics the universe it investigated appeared to contain as much that was chaotic as that was lawful. The lawfulness, the intelligibility of physical processes was still narrowly limited. It was really present only in certain processes, for example, the courses of the stars, but by no means in all the transitory events of the earth. Just as for other young sciences, it was still a question for physics, whether physical processes were subject to law and if so how far. And this circumstance exercised its full effect on the formation of physical concepts, even though in philosophical principle the idea of general lawfulness already existed. In post-Galileian physics, with the elimination of the distinction between lawful and chance events, the necessity also disappeared of proving that the process under consideration was lawful. For Aristotelian physics, on the contrary, it was necessary to have criteria to decide whether or not a given event was of the lawful variety. Indeed the regularity with which similar events occurred in nature was used essentially as such a criterion. Only such events, as the celestial, which the course of history proves to be regular, or at least frequent, are subject to law; and only in so far as they are frequent, and hence more than individual events, are they conceptually intelligible. In other words, the ambition of science to understand the complex, chaotic, and unintelligible world, its faith in the ultimate decipherability of this world, were limited to such events as were certified by repetition in the course of history to possess a certain persistence and stability.

In this connection it must not be forgotten that Aristotle's emphasis on frequency (as a further basis for lawfulness, besides absolute regularity) represents, relative to his predecessors, a tendency toward the extension and concrete application of the principle of lawfulness. The «empiricist» Aristotle, insists that not only the regular but the frequent is lawful. Of course, this only makes clearer his antithesis of individuality and law, for the individual event as such still lies outside the pale of the lawful and hence, in a certain sense, outside the task of science. Lawfulness remains limited to cases in which events recur and classes (in Aristotle's abstract sense) reveal the essential nature of the events.

This attitude toward the problem of lawfulness in nature, which dominated medieval physics and from which even the opponents of Aristotelian physics, such as Bruno and Bacon, escaped only gradually, had important consequences in several respects.

As will be clear from the preceding text, this concept of lawfulness had throughout a quasi-statistical character. Lawfulness was considered as equivalent to the highest degree of generality, as that which occurs very often in the same way, as the extreme case of regularity, and hence as the perfect antithesis of the infrequent or of the particular event. The statistical determination of the concept of lawfulness is still clearly marked in Bacon, as when he tries to decide through his *tabula praesentia* whether a given association of properties is real (essential) or fortuitous. Thus he ascertains, for example, the numerical frequency of the cases in which the properties warm and

1 R. SOMMER, Über Persönlichkeitstypen, *Ber. Kong. f. exper. Psychol.,* 1925.

2 LEWIN, *Die Entwicklung der experimentellen Willenspsychologie und die Psychotherapie,* S. Hirzel, Leipzig, 1929.

dry are associated in everyday life. Less mathematically exact, indeed, but no less clear is this statistical way of thinking in the whole body of Aristotelian physics.

At the same time — and this is one of the most important consequences of the Aristotelian conception — regularity or particularity was understood entirely in *historical* terms.

The complete freedom from exceptions, the «always» which is found also in the later conceptions of physical lawfulness, still has here its original connections with the frequency with which similar cases have occurred in the actual, historical course of events in the everyday world. A crude example will make this clearer: light objects, under the conditions of everyday life, relatively frequently go up; heavy objects usually go down. The flame of the fire, at any rate under the conditions known to Aristotle, almost always goes upward. It is these frequency rules, within the limits of the climate, mode of life, etc., familiar to Aristotle, that determine the nature and tendency to be ascribed to each class of objects and lead in the present instance to the conclusion that flames and light bodies have a tendency upward.

Aristotelian concept formation has yet another immediate relation to the geographically-historically given, in which it resembles, as do the valuative concepts mentioned above, the thinking of primitive man and of children.

When primitive man uses different words for «walking», depending upon its direction, north or south, or upon the sex of the walker, or upon whether the latter is going into or out of a house,[1] he is employing a reference to the historical situation that is quite similar to the putatively absolute descriptions (upward or downward) of Aristotle, the real significance of which is a sort of geographic characterization, a place definition relative to the earth's surface.[2]

The original connection of the concepts with the «actuality», in the special sense of the given historic-geographic circumstances, is perhaps the most important feature of Aristotelian physics. It is from this almost more even than from its teleology that his physics gets its general anthropomorphic character. Even in the minute particulars of theorizing and in the actual conduct of research it is always evident not only that physical and normative concepts are still undifferentiated, but that the formulation of problems and the concepts that we would today distinguish, on the one hand, as historic[3] and, on the other, as nonhistoric or systematic are inextricably interwoven. (Incidentally, an analogous confusion exists in the early stages of other sciences, for example in economics.)

From these conceptions also the attitude of Aristotelian physics toward lawfulness takes a new direction. So long as lawfulness remained limited to such processes as occurred repeatedly in the same way, it is evident not only that the young physics still lacked the courage to extend the principle to all physical phenomena, but also that the concept of lawfulness still had a fundamentally historic, a temporally particular significance. Stress was laid not upon the general validity which modern physics understands by lawfulness, but upon the events in the historically given world which displayed the required stability. The highest degree of lawfulness, beyond mere frequency, was characterized by the idea of always, eternal (αει as against επι τό πλύ). That is, the stretch of historic time for which constancy was assumed was extended to eternity. General validity of law was not yet clearly distinguished from eternity of process. Only permanence, or at least frequent repetition, was proof of more than momentary validity. Even here in the idea of eternity, which seems to transcend the historical, the connection with immediate historic actuality is still obvious, and this close connection was characteristic of the «empiricist» Aristotle's method and concepts.

Not only in physics but in other sciences — for example, in economics and biology — it can be clearly seen how in certain early stages the tendency to empiricism, to the collection and ordering of facts,

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1 L. LÉVY-BRUHL, *La Mentalité primitive*, Alcan, Paris, 1922, (5th ed., 1927).

2 In the following pages we shall frequently have to use the term «historicgeographic». This is not in common usage, but it seems to me inaccurate to contrast historic and systematic questions. The real opposition is between «type» (of object, process, situation) and «occurrence». And for concepts that deal with occurrence, the reference to absolute geographic space-coordinates is just as characteristic as that to absolute time-coordinates by means of dates.

At the same time, the concept of the geographic should be understood in such a general sense as to refer to juxtaposition, correlative to historical succession, and as to be applicable to psychical events.

3 There is no term at present in general use to designate nonhistoric problem formulations. I here employ the term «systematic», meaning thereby, not «ordered», but collectively nonhistoric problems and laws such as those which form the bulk of present-day physics (see p. 12).

carries with it a tendency to historical concept formation, to excessive valuation of the historical.

Galileian Physics.

From the point of view of this sort of empiricism the concept formation of Galileian and post-Galileian physics must seem curious and even paradoxical.

As remarked above, the use of mathematical tools and the tendency to exactness, important as they are, cannot be considered the real substance of the difference between Aristotelian and Galileian physics. It is indeed quite possible to recast in mathematical form the essential content of, for example, the dynamic ideas of Aristotelian physics. It is conceivable that the development of physics could have taken the form of a mathematical rendition of Aristotelian concepts such as is actually taking place in psychology today. In reality, however, there were only traces of such a tendency, such as Bacon's quasi-statistical methods, mentioned above. The main development took another direction and proved to be a change of content rather than a mere change of form.

The same considerations apply to the exactness of the new physics. It must not be forgotten that in Galileo's time there were no clocks of the sort we have today, that these first became possible through the knowledge of dynamics founded upon Galileo's work.[1] Even the methods of measurement used by Faraday in the early investigations of electricity show how little exactness, in the current sense of precision to such and such a decimal place, had to do with these critical stages in the development of physics.

The real sources of the tendency to quantification lie somewhat deeper, namely in a new conception by the physicist of the nature of the physical world, in an extension of the demands of physics upon itself in the task of understanding the world, and in an increased faith in the possibility of their fulfillment. These are radical and far-reaching changes in the fundamental ideas of physics, and the tendency to quantification is simply one of their expressions.

Homogenization. The outlook of a Bruno, a Kepler, or a Galileo is determined by the idea of a comprehensive, all-embracing unity of the physical world. The same law governs the courses of the stars, the falling of stones, and the flight of birds. This homogenization of the physical world with respect to the validity of law deprives the division of physical objects into rigid abstractly defined classes of the critical significance it had for Aristotelian physics, in which membership in a certain conceptual class was considered to determine the physical nature of an object.

Closely related to this is the loss in importance of logical dichotomies and conceptual antitheses. Their places are taken by more and more fluid transitions, by gradations which deprive the dichotomies of their antithetical character and represent in logical form a transition stage between the class concept and the series concept.[2]

Genetic Concepts. This dissolution of the sharp antitheses of rigid classes was greatly accelerated by the coeval transition to an essentially functional way of thinking, to the use of conditional-genetic concepts. For Aristotle the immediate perceptible appearance, that which present-day biology terms the *phenotype,* was hardly distinguished from the properties that determine the object's dynamic relations. The fact, for example, that light objects relatively frequently go upward sufficed for him to ascribe to them an upward tendency. With the differentiation of phenotype from *genotype* or, more generally, of descriptive from conditional-genetic[1] concepts and the shifting of emphasis to the latter, many old class distinctions lost their significance. The orbits of the planets, the free falling of a stone, the movement of a body on an inclined plane, the oscillation of a pendulum, which if classified according to their phenotypes would fall into quite different, indeed into antithetical classes, prove to be simply various expressions of the same law.

Concreteness. The increased emphasis upon the quantitative which seems to lend to modern physics a formal and abstract character is not derived from any tendency to logical formality. Rather, the tendency to a full description of the concrete actuality, even that of the particular case, was influential, a circumstance which should be especially emphasized in connection with present-day psychology. The particular object in all departments of science not only is determined in kind and thereby qualitatively, but it possesses each of

1 E. MACH, *Die Mechanik in ihrer Entwicklung,* Leipzig, 1921.
2 E. CASSIRER. *op. cit.*

1 LEWIN, *Gesetz und Experiment in der Psychologie,* Weltkreis verlag, Berlin-Schlachtensee, 1927.

its properties in a special intensity or to a definite degree. So long as one regards as important and conceptually intelligible only such properties of an object as are common to a whole group of objects, the individual differences of degree remain without scientific relevance, for in the abstractly defined classes these differences more or less disappear. With the mounting aspirations of research toward an understanding of actual events and particular cases, the task of describing the differences of degree that characterized individual cases had necessarily to increase in importance and finally required actual quantitative determination.

It was the increased desire, and also the increased ability, to comprehend concrete particular cases, and to comprehend them fully, which, together with the idea of the homogeneity of the physical world and that of the continuity of the properties of its objects, constituted the main impulse to the increasing quantification of physics.

Paradoxes of the New Empiricism. This tendency toward the closest possible contact with actuality, which today is usually regarded as characteristic and ascribed to an antispeculative tendency, led to a mode of concept formation diametrically opposed to that of Aristotle, and, surprisingly enough, involved also the direct antithesis of his «empiricism».

The Aristotelian concepts show, as we have seen above, an immediate reference to the historically given reality and to the actual course of events. This immediate reference to the historically given is lacking in modern physics. The fact, so decisively important for Aristotelian concepts, that a certain process occurred only once or was very frequently or invariably repeated in the course of history, is practically irrelevant to the most essential questions of modern physics.[1] This circumstance is considered fortuitous or merely historical.

The law of falling bodies, for example, does not assert that bodies very frequently fall downward. It does not assert that the event to which the formula $s = 1/2\ gt^2$ applies, the «free and unimpeded fall» of a body, occurs regularly or even frequently in the actual history of the world. Whether the event described by the law occurs rarely or often has nothing to do with the law. Indeed, in a certain sense, the law refers only to cases that are never realized, or only approximately realized, in the actual course of events. Only in experiment, that is, under artificially constructed conditions, do cases occur which approximate the event with which the law is concerned. The propositions of modern physics, which are often considered to be antispeculative and empirical, unquestionably have in comparison with Aristotelian empiricism a much less empirical, a much more constructive character than the Aristotelian concepts based immediately upon historical actuality.

In Psychology

Here we are confronted by questions which, as problems of actual research and of theory, have strongly influenced the development of psychology and which constitute the most fundamental grounds of its present crisis.

The concepts of psychology, at least in certain decisive respects, are thoroughly Aristotelian in their actual content, even though in many respects their form of presentation has been somewhat civilized, so to speak. The present struggles and theoretical difficulties of psychology resemble in many ways, even in their particulars, the difficulties which culminated in the conquest over Aristotelian ways of thinking in physics.

Aristolelian Concepts.

Fortuitousness of the Individual Case. The concept formation of psychology is dominated, just as was that of Aristotelian physics, by the question of regularity in the sense of frequency. This is obvious in its immediate attitude toward particular phenomena as well as in its attitude toward lawfulness. If, for example, one show a film of a concrete incident in the behavior of a certain child, the first question of the psychologist usually is: «Do all children do that, or is it at least common?» And if one must answer this question in the negative the behavior involved loses for that psychologist all or almost all claim to scientific interest. To pay attention to such an «exceptional case» seems to him a scientifically unimportant bit of folly.

The real attitude of the investigator toward particular events and the problem of individuality is perhaps more clearly expressed in this actual behavior

1 So far as it is not immediately concerned with an actual «History of the Heavens and the Earth» or a geography.

than in many theories. The individual event seems to him fortuitous, unimportant, scientifically indifferent. It may, however, be some extraordinary event, some tremendous experience, something that has critically determined the destiny of the person involved or the appearance of an historically significant personality. In such a case it is customary to emphasize the «mystical» character of all individuality and originality, comprehensible only to «intuition», or at least not to science.

Both of these attitudes toward the particular event lead to the same conclusion: that that which does not occur repeatedly lies outside the realm of the comprehensible.

Lawfulness as Frequency. The esteem in which frequency is held in present-day psychology is due to the fact that it is still considered a question whether, and if so how far, the psychical world is lawful, just as in Aristotelian phycics this esteem was due to a similar uncertainty about lawfulness in the physical world. It is not necessary here to describe at length the vicissitudes of the thesis of the lawfulness of the psychic in philosophical discussion. It is sufficient to recall that even at present there are many tendencies to limit the operation of law to certain «lower» spheres of psychical events. For us it is more important to note that the field which is considered lawful, not in principle, but in the actual research of psychology — even of experimental psychology — has only been extended very gradually. If psychology has only very gradually and hesitantly pushed beyond the bounds of sensory psychology into the fields of will and affect, it is certainly due not only to technical difficulties, but mainly to the fact that in this field actual repetition, a recurrence of the same event, is not to be expected. And this repetition remains, as it did for Aristotle, to a large extent the basis for the assumption of the lawfulness or intelligibility of an event.

As a matter of fact, any psychology that does not recognize lawfulness as inherent in the nature of the psychical, and hence in all psychical processes, even those occurring only once, must have criteria to decide, like Aristotelian physics, whether or not it has in any given case to deal with lawful phenomena. And, again, just as in Aristotelian physics, frequency of recurrence is taken as such a criterion. It is evidence of the depth and momentum of this connection (between repetition and lawfulness) that it is even used to define experiment, a scientific instrument which, if it is not directly opposed to the concepts of Aristotelian physics, has at least become significant only in relatively modern times.[1] Even for Wundt repetition inhered in the concept of experiment. Only in recent years has psychology begun to give up this requirement, which withholds a large field of the psychical from experimental investigation.

But even more important perhaps than the restriction of experimental investigation is the fact that this extravagant valuation of repetition *(i. e.,* considering frequency as the criterion and expression of lawfulness) dominates the formation of the concepts of psychology, particularly in its younger branches.

Just as occurs in Aristotelian physics, contemporary child psychology regards as characteristic of a given age, and the psychology of emotion as characteristic of a given expression, that which a group of individual cases have in common. This abstract Aristotelian conception of the class determines the kind and dominates the procedure of classification.

Class and Essence. Present-day child psychology and affect psychology also exemplify clearly the Aristotelian habit of considering the abstractly defined classes as the essential nature of the particular object and hence as an explanation of its behavior. Whatever is common to children of a given age is set up as the fundamental character of that age. The fact that three-year-old children are quite often negative is considered evidence that negativism is inherent in the nature of three-year-olds, and the concept of a negativistic age or stage is then regarded as an explanation (though perhaps not a complete one) for the appearance of negativism in a given particular case!

Quite analogously, the concept of drives — for example, the hunger drive or the maternal instinct — is nothing more than the abstract selection of the features common to a group of acts that are of relatively frequent occurrence. This abstraction is set up as the essential reality of the behavior and is then in turn used to explain the frequent occurrence of the instinctive behavior, for example, of the care of infant progeny. Most of the explanations of expression, of character, and of temperament are in a similar state. Here, as in a great many other fundamental concepts, such as that of ability, talent, and similar concepts employed by the intelligence testers, present-day psychology is really reduced to explanation in terms of Aristotelian essences, a sort of explanation which has long been attacked as faculty psychology and as

1 The Greeks, of course, *knew* of experiment.

circular explanation, but for which no other way of thinking has been substituted.

Statistics. The classificatory character of its concepts and the emphasis on frequency are indicated methodologically by the commanding significance of statistics in contemporary psychology. The statistical procedure, at least in its commonest application in psychology, is the most striking expression of this Aristotelian mode of thinking. In order to exhibit the common features of a given group of facts, the average is calculated. This average acquires a representative value, and is used to characterize (as mental age) the properties of «the» two-year-old child. Outwardly, there is a difference between contemporary psychology, which works so much with numbers and curves, and the Aristotelian physics. But this difference, characteristically enough, is much more a difference in the technique of execution than in the actual content of the concepts involved. Essentially, the statistical way of thinking, which is a necessary consequence of Aristotelian concepts, is also evident in Aristotelian physics, as we have already seen. The difference is that, owing to the extraordinary development of mathematics and of general scientific method, the statistical procedure of psychology is clearer and more articulate.

All the efforts of psychology in recent years toward exactness and precision have been in the direction of refinement and extension of its statistical methods. These efforts are quite justified in so far as they indicate a determination to achieve an adequate comprehension of the full reality of mental life. But they are really founded, at least in part, on the ambition to demonstrate the scientific status of psychology by using as much mathematics as possible and by pushing all calculations to the last possible decimal place.

This formal extension of the method has not changed the underlying concepts in the slightest: they are still thoroughly Aristotelian. Indeed, the mathematical formulation of the method only consolidates and extends the domination of the underlying concepts. It unquestionably makes it more difficult to see the real character of the concepts and hence to supplant them with others; and this is a difficulty with which Galileian physics did not have to contend, inasmuch as the Aristotelian mode of thought was not then so intrenched and obscured in mathematics.

Limits of Knowledge. Exceptions. Lawfulness is believed to be related to regularity and considered the antithesis of the individual case. (In terms of the current formula, lawfulness is conceived as a correlation approaching $r = \pm 1$.) So far as the psychologist agrees at all to the validity of psychological propositions, he regards them as only regularly valid, and his acceptance of them takes such a form that one remains aware of a certain distinction between mere regularity and full lawfulness; and he ascribes to biological and, above all, to psychological propositions (in contrast to physical) only regularity. Or else lawfulness is believed to be only the extreme case of regularity,[1] in which case all differences (between lawfulness and regularity) disappear in principle while the necessity of determining the degree of regularity still remains.

The fact that lawfulness and individuality are considered antitheses has two sorts of effect on actual research. It signifies in the first place a limitation of research. It makes it appear hopeless to try to understand the real, unique, course of an emotion or the actual structure of a particular individual's personality. It thus reduces one to a treatment of these problems in terms of mere averages, as exemplified by tests and questionnaires. Anyone to whom these methods appear inadequate usually encounters a weary skepticism or else a maudlin appreciation of individuality and the doctrine that this field, from which the recurrence of similar cases in sufficient numbers is excluded, is inaccessible to scientific comprehension and requires instead sympathetic intuition. In both cases the field is withdrawn from experimental investigation, for qualitative properties are considered as the direct opposite of lawfulness. The manner in which this view is continually and repeatedly advanced in the discussion of experimental psychology resembles, even to its particulars, the arguments against which Galileian physics had to struggle. How, it was urged at that time, can one try to embrace in a single law of motion such qualitatively different phenomena as the movements of the stars, the flying of leaves in the wind, the flight of birds, and the rolling

1. As is well known, the concept of possible exceptions and the merely statistical validity of laws has very recently been revived in physical discussion. Even if this view should finally be adopted, it would not in any way mean a return to Aristotelian concepts. It suffices here to point out that, even in that event, it would not involve setting apart within the physical world a class of events on the basis of its degree of lawfulness, but the whole physical universe would be subject only to a statistical lawfulness. On the relation of this statistical view to the problem of precision of measurement, see Lewin, *Gesetz und Experiment in der Psychologie* Weltkreisverlag, Berlin, 1927.

of a stone downhill. But the opposition of law and individual corresponded so well with the Aristotelian conception and with the primitive mode of thinking which constituted the philosophy of everyday life that it appears often enough in the writings of the physicists themselves, not, however, in their physics but in their philosophy.[1]

The conviction that it is impossible wholly to comprehend the individual case as such implies, in addition to this limitation, a certain laxity of research: it is satisfied with setting forth mere regularities. The demands of psychology upon the stringency of its propositions go no farther than to require a validity «in general», or «on the average», or «as a rule». The «complexity» and «transitory nature» of life processes make it unreasonable, it is said, to require complete, exceptionless, validity. According to the old saw that «the exception proves the rule», *psychology does not regard exceptions as counter-arguments so long as their frequency is not too great.*

The attitude of psychology toward the concept of lawfulness also shows clearly and strikingly the Aristotelian character of its mode of thought. It is founded on a very meager confidence in the lawfulness of psychological events and has for the investigator the added charm of not requiring too high a standard of validity in his propositions or in his proofs of them.

Historic-geographic Concepts. For the view of the nature of lawfulness and for the emphasis upon repetition which we have seen to be characteristic of Aristotelian physics, in addition to the motives which we have just mentioned, the immediate reference to the concerned actuality in the historic-geographic sense was fundamental. Likewise, and this is evidence of the intimacy in which these modes of thought are related, present-day psychology is largely dominated by the same immediate reference to the historic-geographic datum. The historical bent of psychological concepts is again not always immediately obvious as such, but is bound up with nonhistoric, systematic concepts and undifferentiated from them. This quasi-historical set forms, in my opinion, the central point for the understanding and criticism of this mode of concept formation.

Although we have criticized the statistical mode of thought, the particular formulas used are not ultimately important to the questions under discussion. It is not the fact that an arithmetic mean is taken, that one adds and divides, that is the object of the present critique. These operations will certainly continue to be used extensively in the future of psychology. The critical point is not that statistical methods are applied, but how they are applied and, especially, what cases are combined into groups.

In contemporary psychology the reference to the historic-geographic datum and the dependence of the conclusions upon frequency of actual occurrence are striking. Indeed, so far as immediate reference to the historic datum is concerned, the way in which the nature of the one-, two-, or three-year-old child is arrived at through the calculation of statistical averages corresponds exactly to Bacon's collection of the given cases of dryness in his *tabulae praesentiae*. To be sure, there is a certain very crude concession made in such averages to the requirements of nonhistoric concepts: patently pathological cases, and sometimes even cases in which an unusual environment is concerned, are usually excluded. Apart from this consideration, the exclusion of the most extreme abnormalities, the determination of the cases to be placed in a statistical group is essentially on historic-geographic grounds. For a group defined in historic-geographic terms, perhaps the one-year-old children of Vienna or New York in the year 1928, averages are calculated which are doubtless of the greatest significance to the historian or to the practical school man, but which do not lose their dependence upon the accidents of the historic-geographic given even though one go on to an average of the children of Germany, of Europe, or of the whole world, or of a decade instead of a year. *Such an extension of the geographic and historic basis does not do away with the specific dependence of this concept upon the frequency with which the individual cases occur within historically-geographically defined fields.*

Mention should have been made earlier of that refinement of statistics which is founded upon a restriction of the historic-geographic basis, such as a consideration of the one-year-old children of a proletarian quarter of Berlin in the first years after the War. Such groupings usually are based on the qualitative individuality of the concrete cases as well as upon historic-geographic definitions. But even such limitations really contradict the spirit of statistics founded on frequency. Even they signify methodologically a certain shift to the concrete particulars.

1 To avoid misunderstanding, the following should be emphasized: when we criticize the opposition of individual and law, as is customary in psychology, it does not mean that we are unaware of the complex problems of the concept of individuality.

Incidentally, one must not forget that even in the extreme case of such refinement, perhaps in the statistical investigation of the only child, the actual definition is in terms of historic-geographic or at best of sociological categories; that is, according to criteria which combine into a single group cases that psychologically are very different or even antithetical. Such statistical investigations are consequently unable as a rule to give an explanation of the dynamics of the processes involved.

The immediate reference to the historically given actuality which is characteristic of Aristotelian concept formation is evident also in the discussion of experiment and nearness to life conditions. Certainly one may justly criticize the simple reaction experiments, the beginnings of the experimental psychology of the will, or the experiments of reflexology on the ground of their wide divergence from the conditions of life. But this divergence is based in large part upon the tendency to investigate such processes as do not present the individual peculiarities of the particular case but which, as «simple elements» (perhaps the simplest movements), are common to all behavior, or which occur, so to speak, in everything. In contrast to the foregoing, approximation to life conditions is often demanded of, for example, the psychology of will. By this is usually meant that it should investigate those cases, impossible to produce experimentally, in which the most important decisions of life are made. And here also we are confronted by an orientation toward the historically significant. It is a requirement which, if transferred to physics, would mean that it would be incorrect to study hydrodynamics in the laboratory; one must rather investigate the largest rivers in the world. Two points then stand out: in the field of theory and law, the high valuation of the historically important and disdain of the ordinary; in the field of experiment, the choice of processes which occur frequently (or are common to many events). Both are indicative in like measure of that Aristotelian mixing of historical and systematic questions which carries with it for the systematic the connection with the abstract classes and the neglect of the full reality of the concrete case.

Galileian Concept Formation.

Opposed to Aristotelian concept formation, which I have sought briefly to characterize, there is now evident in psychology a development which appears occasionally in radical or apparently radical tendencies, more usually in little half steps, sometimes falling into error (especially when it tries most exactly to follow the example of physics), but which on the whole seems clearly and irresistibly to be pushing on to modifications that may ultimately mean nothing less than a transition from Aristotelian to Galileian concept formation.

No Value Concepts. No Dichotomies. Unification of Fields. The most important general circumstances which paved the way for Galileian concepts in physics are clearly and distinctly to be seen in present-day psychology.

The conquest over *valuative,* anthropomorphic classifications of phenomena on bases other than the nature of the mental process itself is not by any means complete, but in many fields, especially in sensory psychology, at least the chief difficulties are past.

As in physics, the grouping of events and objects into paired opposites and similar logical dichotomies is being replaced by groupings with the aid of serial concepts which permit of continuous variation, partly owing simply to wider experience and the recognition that transition stages are always present.

This has gone furthest in sensory psychology, especially in psychological optics and acoustics, and lately also in the domain of smell. But the tendency toward this change is also evident in other fields, for example, in that of feeling.

Freud's doctrine especially — and this is one of its greatest services — has contributed largely to the abolition of the boundary between the normal and the pathological, the ordinary and the unusual, and hereby furthered the *homogenization* of all the fields of psychology. This process is certainly still far from complete, but it is entirely comparable to that introduced in modern physics by which heavenly and earthly processes were united.

Also in child and animal psychology the necessity is gradually disappearing of choosing between two alternatives — regarding the child as a little adult and the animal as an undeveloped inferior human, or trying to establish an unbridgeable gap between lhe child and adult, animal and man. This homogenization is becoming continually clearer in all fields, and it is not a purely philosophical insistence upon some sort of abstract fundamental unity but influences concrete research in which differences are fully preserved.

Unconditional General Validity of Psychological Laws. The clearest and most important expression of increasing homogeneity, besides the transition from class to serial concepts, is the fact that the validity of particular psychological laws is no longer limited to particular fields, as it was once limited to the normal human adult on the ground that anything might be expected of psychopathics or of geniuses, or that in such cases the same laws do not hold. It is coming to be realized that every psychological law must hold without exception.

In actual content, this transition to the concept of strict exceptionless lawfulness signifies at once the same final and all-embracing homogenization and harmonization of the whole field that gave to Galileian physics its intoxicating feeling of infinite breadth, because it does not, like the abstract class concepts, level out the rich variety of the world and because a single law embraces the whole field.

Tendencies toward a homogeneity based upon the exceptionless validity of its laws have become evident in psychology only very recently, but they open up an extraordinarily wide perspective.[1]

The investigation of the laws of structure — particularly the experimental investigation of wholes — has shown that the same laws hold not only within different fields of psychological optics but also in audition and in sensory psychology in general. This in itself constitutes a large step in the progress toward homogeneity.

Further, the laws of optical figures and of intellectual insight have turned out to be closely related. Important and similar laws have been discovered in the experimental investigation of behavioral wholes, of will processes, and of psychological needs. In the fields of memory and expression, psychological development appears to be analogous. In short, the thesis of the general validity of psychological laws has very recently become so much more concrete, particular laws have shown such capacity for fruitful application to fields that at first were qualitatively completely separated, that the thesis of the homogeneity of psychic life in respect to its laws gains tremendously in vigor and is destroying the boundaries of the old separated fields.[2]

Mounting Ambitions. Methodologically also the thesis of the exceptionless validity of psychological laws has a far-reaching significance. It leads to an extraordinary increase in the demands made upon proof. It is no longer possible to take exceptions lightly. They do not in any way «prove the rule», but on the contrary are completely valid disproofs, even though they are rare, indeed, so long as one single exception is demonstrable. The thesis of general validity permits of no exceptions in the entire realm of the psychic, whether of child or adult, whether in normal or pathological psychology.[2]

On the other hand, the thesis of exceptionless validity in psychological laws makes available to investigation, especially to experiment such processes as do not frequently recur in the same form, as, for example, certain affective processes.

From the Average to the Pure Case. A clear appreciation of this circumstance is still by no means habitual in psychology. Indeed, from the earlier, Aristotelian point of view the new procedure may even seem to conceal the fundamental contradiction we have mentioned above. One declares that one wants to comprehend the full concrete reality in a higher degree than is possible with Aristotelian concepts and yet considers this reality in its actual historical course and its given geographical setting as really accidental. The general validity, for example, of the law of movement on an inclined plane is not established by taking the average of as many cases as possible of real

1 The association psychology contains an attempt at this sort of homogeneity, and it has really been of essential service in this direction. Similarly, in our time reflexology and behaviorism have contributed to the homogenization of man and animal and of bodily and mental. But the Aristotelian view of lawfulness as regularity (without which it would have been impossible to support the law of association) brought this attempt to nothing. Consequently, the experimental association psychology, in its attempt at the end of the nineteenth century to derive the whole mental life from a single law, displayed the circular and at the same time abstract character that is typical of the speculative early stages of a science, and of Aristotelian class concepts. Indeed, it seems almost as if, because of the great importance of frequency and repetition for Aristotelian methodological concepts, the law of association was designed to make use of these as the actual content of psychological principles, inasmuch as frequert repetition is regarded as the most important cause of mental phenomena.

2 For this section compare especially M. Wertheimer, Untersuchungen zur Lehre von der Gestalt, II, Psychol. Forsch., 1923, 4, 301-350, W. Köhler, *Gestalt: Psychology,* Liveright, New York, 1929. K. Koffka, *The Growth of the Mind: An Introduction to Child Psychology (trans. by R.* M. Ogden), Harcourt, Brace, New York; Kegan Paul, London, 1924, (2d ed., 1928), and Lewin *Vorsatz, Wille und Bedürfnis, mil Vorbemerkungen über die psychischen Kräfte und Energien und die Struktur der Seele,* Springer, Berlin, 1926. A review of the special researches is found in W. Köhler, Gestaltprobleme und Anfänge einer Gestalttheorie, *Jahresber. d. ges. Physiol.,* 1924.

stones actually rolling down hills, and then considering this average as the most probable case.[1] It is based rather upon the frictionless rolling of an ideal sphere down an absolutely straight and hard plane, that is, upon a process that even the laboratory can only approximate and which is most improbable in daily life. One declares that one is striving for general validity and concreteness, yet uses a method which, from the point of view of the preceding epoch, disregards the historically given facts and depends entirely upon individual accidents, indeed upon the most pronounced exceptions.

How physics arrives at this procedure, which strikes the Aristotelian views of contemporary psychology as doubly paradoxical, begins to become intelligible when one envisages the necessary methodological consequences of the change in the ideas of the extent of lawfulness. When lawfulness is no longer limited to cases which occur regularly or frequently but is characteristic of every physical event, the necessity disappears of demonstrating the lawfulness of an event by some special criterion, such as its frequency of occurrence. Even a particular case is then assumed, without more ado, to be lawful. Historical rarity is no disproof, historical regularity no proof of lawfulness. For the concept of lawfulness has been quite detached from that of regularity; the concept of the complete absence of exceptions to laws is strictly separated from that of historical constancy (the «forever» of Aristotle).[2]

1 In psychology it is asserted, often with special emphasis, that one obtains, perhaps from the construction of baby tests, a representation of the «general human», because those processes are selected which occur most frequently in the child's daily life. Then one may expect with sufficient probability that the child will spontaneously display similar behavior in the test.

2 The contrast between Aristotelian and Galileian views of lawfulness and the difference in their methods may be briefly tabulated as follows:

	For Aristotle	For Galileo
1. The regular is	lawful	lawful
The frequent is	lawful	lawful
The individual case is	chance	lawful
2. Criteria of lawfulness are	regularity frequency	not required
3. That which is common to the historically occuring cases is	an expression of the nature of the thing	an accident, only historically conditioned

Further, the content of a law cannot then be determined by the calculation of averages of historically given cases. For Aristotle the nature of a thing was expressed by the characteristics common to the historically given cases. Galileian concepts, on the contrary, which regard historical frequency as accident, must also consider it a matter of chance which properties one arrives at by taking averages of historical cases. If the concrete event is to be comprehended and the thesis of lawfulness without exception is to be not merely a philosophical maxim but determinative of the mode of actual research, there must be another possibility of penetrating the nature of an event, some other way than that of ignoring all individual peculiarities of concrete cases. The solution of this problem may only be obtained by the elucidation of the paradoxical procedures of Galileian method through a consideration of the problems of dynamics.

DYNAMICS

Changes in the Fundamental Dynamic Concepts of Physics

The dynamic problems of physics were really foreign to the Aristotelian mode of thought. The fact that dynamic problems had throughout such great significance for Galileian physics permits us to regard dynamics as a characteristic consequence of the Galileian mode of thought.[3] As always, it involved not merely a superficial shift of interest, but a change in the content of the theories. Even Aristotle emphasized «becoming», as compared with his predecessors. It is perhaps more correct to say that in the Aristotelian concepts statics and dynamics are not yet differentiated. This is due especially to certain fundamental assumptions.

Teleology and Physical Vectors.

A leading characteristic of Aristotelian dynamics is the fact that it explained events by means of concepts which we today perceive to be specifically

3 E. MACH, *The Science of Mechanics* (Eng. trans., 2d ed., rev.), Chicago, 1902.

biological or psychological: every *object tends, so far as not prevented by other objects, toward perfection,* toward the realization of its own nature. This nature is for Aristotle, as we have already seen, that which is common to the class of the object. So it comes about that the class for him is at the same time the concept and the goal (τελος) of an object.

This teleological theory of physical events does not show only that biology and physics are not yet separated. It indicates also that the dynamics of Aristotelian physics resembles in essential points the animistic and artificial mode of thought of primitive man, which views all movement as life and makes artificial manufacture the prototype of existence. For, in the case of manufactured things, the maker's idea of the object is, in one sense, both the cause and the goal of the event.

Further, for Aristotelian concepts the *cause* of a physical event was very closely related to psychological «drives»: the object strives toward a certain goal; so far as movement is concerned, it tends toward the place appropriate to its nature. Thus heavy objects strive downward, the heavier the more strongly, while light objects strive upward.

It is customary to dismiss these Aristotelian physical concepts by calling them anthropomorphic. But perhaps it would be better, when we consider that the same fundamental dynamic ideas are today completely dominant in psychology and biology, to examine the actual content of the Aristotelian theses as far as possible independently of the style of their presentation.

It is customary to say that teleology assumes a direction of events toward a goal, which causal explanation does not recognize, and to see in this the most essential difference between teleological and causal explanation. But this sort of view is inadequate, for the causal explanation of modern physics uses directed quantities, mathematically described vectors. Physical force, which is defined as «the cause of a physical change», is considered a directed, vectorial factor. In the employment of vectorial factors as the foundation of dynamics there is thus no difference between the modern and the Aristotelian view.

The real difference lies rather in the fact that *the kind and direction of the physical vectors in Aristotelian dynamics are completely determined in advance by the nature of the object concerned.* In modern physics, on the contrary, *the existence of a physical vector always depends upon the mutual relations of several physical facts,* especially upon the relation of the object to its environment.[1]

Significance of the Whole Situation in Aristotelian and Galileian Dynamics.

For Aristotelian concepts, the environment plays a part only in so far as it may give rise to «disturbances», forced modifications of the processes which follow from the nature of the object concerned. The vectors which determine an object's movements are completely determined by the object. That is, they do not depend upon the relation of the object to the environment, and they belong to that object once for all, irrespective of its surroundings at any given time. The tendency of light bodies to go up resided in the bodies themselves; the downward tendency of heavy objects was seated in those objects. In modern physics, on the contrary, not only is the upward tendency of a lighter body derived from the relation of this body to its environment, but the weight itself of the body depends upon such a relation.

This decisive revolution comes to clear expression in Galileo's classic investigations of the law of falling bodies. The mere fact that he did not investigate the heavy body itself, but the process of «free falling or movement on an inclined plane», signifies a transition to concepts which can be defined only by reference to a certain sort of situation (namely, the presence of a plane with a certain inclination or of an unimpeded vertical extent of space through which to fall). The idea of investigating free falling, which is too rapid for satisfactory observation, by resorting to the slower movement upon an inclined plane presupposes that the dynamics of the event is no longer related to the isolated object as such, but is seen to be dependent upon the whole situation in which the event occurs.

Galileo's procedure, in fact, includes a penetrating investigation of precisely the situation factors. The slope of the inclined plane, that is, the proportion of height to length, is defined. The list of situations involved (free falling, movement on an inclined plane, and horizontal movement) is exhausted and, through the varying of the inclination, classified. The dependence of the essential features of the event (for exam-

1 Naturally this applies also to internal causes, which involve the mutual relation of the parts of a physical system.

ple, its velocity) upon the essential properties of the situation (the slope of the plane) becomes the conceptual and methodological center of importance.

This view of dynamics does not mean that the nature of the object becomes insignificant. The properties and structure of the object involved remain important also for the Galileian theory of dynamics. But the situation assumes as much importance as the object. *Only by the concrete whole which comprises the object and the situation are the vectors which determine the dynamics of the event defined.*

In carrying out this view, Galileian physics tried to characterize the individuality of the total situation concerned as concretely and accurately as possible. This is an exact reversal of Aristotelian principles. The dependence of an event upon the situation in which it occurs means for the Aristotelian mode of thought, which wants to ascertain the general by seeking out the like features of many cases, nothing more than a disturbing force. The changing situations appear as something fortuitous that disturbs and obscures the essential nature. It was therefore valid and customary to exclude the influence of the situation as far as possible, to abstract from the situation, in order to understand the essential nature of the object and the direction of its goal.

Getting Rid of the Historical Bent.

The actual investigation of this sort of vectors obviously presupposes that the processes involved occur with a certain regularity or frequency (see page 6). For otherwise an exclusion of the differences of the situation would leave no similarities. If one starts from the fundamental concepts of Aristotelian dynamics, the investigation of the dynamics of a process must be more difficult — one might think here of emotion in psychology — the more it depends upon the nature of the situation concerned. The single event becomes thereby unlawful in principle because there is no way of investigating its dynamics.

The Galileian method of determining the dynamics of a process is directly opposed to this procedure. Since the dynamics of the process depends not only upon the object but also, primarily, upon the situation, it would be nonsensical to try to obtain general laws of processes by excluding the influence of the situations as far as possible. It becomes silly to bring in as many different situations as possible and regard only those factors as generally valid that are observed under all circumstances, in any and every situation. It must, on the contrary, become important to comprehend the whole situation involved, with all its characteristics, as precisely as possible.

The step from particular case to law, from «this» event to «such» an event, no longer requires the confirmation by historical regularity that is characteristic of the Aristotelian mode of thought. This step to the general is automatically and immediately given by the principle of the exceptionless lawfulness of physical events.[1] What is now important to the investigation of dynamics is not to abstract from the situation, but to hunt out those situations in which the determinative factors of the total dynamic structure are most clearly, distinctly, and purely to be discerned. *Instead of a reference to the abstract average of as many historically given cases as possible, there is a reference to the full concreteness of the particular situations.*

We cannot here examine in great detail why not all situations are equally useful for the investigation of dynamics, why certain situations possess a methodological advantage, and why as far as possible these are experimentally set up. Only one circumstance, which seems to me very seldom to be correctly viewed and which has given rise to misunderstandings that have had serious consequences for psychology, requires elucidation.

We have seen above how Galileian concepts separated the previously undifferentiated questions of the historical course of events on one side and of the laws of events on the other. They renounced in systematic problems the immediate reference to the historic-geographic datum. That the procedure instituted does not, as might at first appear, contradict the empirical tendency toward the comprehension of the full reality may already be clear from our last consideration: the Aristotelian immediate relation to the historically regular and its average really means giving up the attempt to understand the particular, always situation-conditioned event. When this immediate relation is completely abandoned, when the place of historic-geographic constancy is taken by the position of the particular in the whole situation, and when (as in experimental method) it is just the same whether the situation is frequent and permanent or rare and transitory, only then does it become possible to

1 It is impossible here to go more fully into the problem of induction. (Cf. Lewin, *Gesetz und Experiment in der Psychologie.*)

undertake the task of understanding the real, always ultimately unique, event.

The Meaning of the Process Differential.

Methodologically there may seem to result here another theoretical difficulty which can perhaps be better elucidated by a simple example than by general discussion. In order that the essentials may be more easily seen, I choose an example not from familiar physics but from problematical psychology. If one attempt to trace the behavior of a child to psychical field forces, among other things — the justification for this thesis is not here under discussion — the following objection might easily be raised. A child stands before two attractive objects (say a toy *T* and a piece of chocolate *C*), which are in different places (see Fig. 1). According to this hypothesis, then, there exist field forces in these directions (*a* and *b*). The proportional strength of the forces is indifferent, and it does not matter whether the physical law of the parallelogram of forces is applicable to psychical field forces or not. So far, then, as a resultant of these two forces is formed, it must take a direction (*r*) which leads neither to *T* nor to *C*. The child would then, so one might easily conclude according to this theory, reach neither *T* nor C.[1]

In reality such a conclusion would be too hasty, for even if the vector should have the direction *r* at the moment of starting, that does not mean that the actual process permanently retains this direction. Instead, *the whole situation changes with the process,* thus changing also, in both strength and direction, the vectors that at each moment determine the dynamics. Even if one assumes the parallelogram of forces and in addition a constant internal situation in the child, the actual process, because of this changing in the situation, will always finally bring the child to one or the other of the attractive objects (Fig. 2).[2]

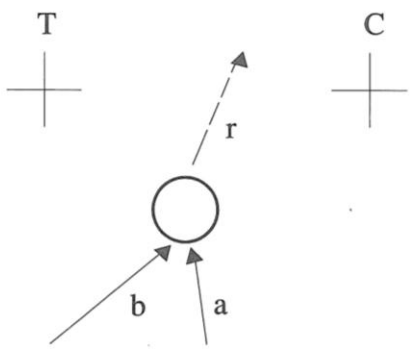

Fig. 1

What I would like to exhibit by this example is this: if one tries to deduce the dynamics of a process, particularly the vectors which direct it, from the actual event, one is compelled to resort to process differentials. In our example, one can regard only the process of the first moment, not the whole course, as the immediate expression of the vector present in the beginning of the situation.

The well-known fact that all, or at least most, physical laws are differential laws[3] does not seem to me, as is often supposed, to prove that physics endeavors to analyze everything into the smallest «elements» and to consider these elements in the most perfect possible isolation. It proceeds rather from the circumstance that physics since Galileo no longer regards the historic course of a process as the immediate expression of the vectors determinative of its dynamics. For Aristotle, the fact that the movement showed a certain total course was proof of the existence of a tendency to that course, for example, toward a perfect circular movement. Galileian concepts, on the contrary, even in the course of a particular process, separate the quasi-historical from the factors deter-

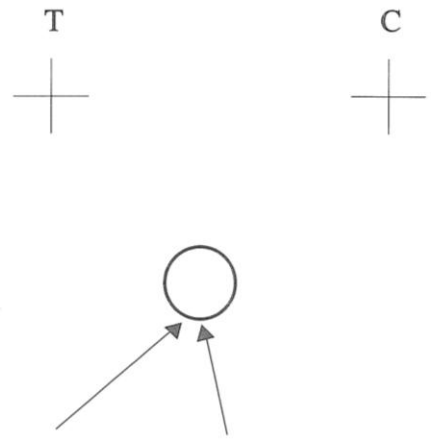

Fig. 2

1 I am neglecting here the possibility that one of the field forces entirely disappears.

2 Even if the distances of the attractive objects and the strength of their attractions were equal, the resulting conflict situation would lead to the same result, owing to the lability of the equilibrium.

3 H. POINCARE, *La Science et l'hypothèse,* Paris, I916.

mining the dynamics. They refer to the whole situation in its full concrete individuality, to the state of the situation at every moment of time.

Further, for Galileian concepts, the forces, the physical vectors which control the situation, are proved by the resulting process. However, it is valid to exclude the quasi-historical in order to get the pure process, and therefore necessary to comprehend the type of process by recourse to the process differential, because only in the latter, and hence unmixed, is it expressed. This recourse to the process differential thus arises not, as is usually supposed, from a tendency to reduce all events to their «ultimate elements», but as a not immediately obvious complementary expression of the tendency to derive the dynamics from therelation of the concrete particular to the concrete whole situation and to ascertain as purely and as unmixed with historic factors as possible the type of event with which this total situation is dynamically related.

Experimentally also it is important to construct such situations as will actually yield this pure event, or at least permit of its conceptual reconstruction.

Methodological.

It remains to examine more closely the logical and methodological consequences of this mode of thought. Since law and individual are no longer antitheses, nothing prevents relying for proof upon historically unusual, rare, and transitory events, such as most physical experiments are. It becomes clear why it is very illuminating, for systematic concepts, to produce such cases, even if not exactly for the sake of their rarity itself.

The tendency to comprehend the actual situation as fully and concretely as possible, even in its individual peculiarities, makes the most precise possible qualitative and quantitative determination necessary and profitable. But it must not be forgotten that only this task, and not numerical precision for its own sake, gives any point or meaning to exactness.

Some of the most essential services to knowledge of the quantitative, and in general of the mathematical, mode of representation are (1) the possibility of using continuous transitions instead of dichotomies in characterization, thereby greatly refining description, and (2) the fact that with such functional concepts it is possible to go from the particular to the general without losing the particular in the general and thereby making impossible the return from the general to the particular.

Finally, reference should be made to the method of approximation in the description of objects and situations, in which the continuous, functional mode of thought is manifest.

Fundamental Dynamic Concepts in Psychology

The dynamic concepts of psychology today are still thoroughly Aristotelian,[1] and indeed the same internal relations and motives seem to me here displayed, even to the details.

Aristotelian Ideas: Independence of the Situation; Instinct.

In content, which is easiest to exhibit and indeed hardly requires exposition, psychological dynamics agrees most completely with Aristotelian concepts: it is teleology in the Aristotelian sense. The traditional mistake of regarding causal explanation as an explanation without the use of directed forces has notably retarded the progress of dynamics, since psychological dynamics, like physical, cannot be understood without the use of vector concepts. It is not the fact that directed quantities are employed in psychological dynamics that gives it its Aristotelian character, but the fact that the process is ascribed to vectors connected with the object of investigation, for example, with the particular person, and *relatively independent of the situation*.

The concept of instinct in its classical form is perhaps the most striking example of this. The instincts are the sum of those vectors conditioned by predispositions which it is thought must be ascribed to an individual. The instincts are determined essentially by finding out what actions occur most frequently or regularly in the actual *life* of the individual or of a group of like individuals. That which is *common* to these frequent acts *(e. g.,* food getting, fighting, mutual aid) is regarded as the *essence* or essential nature

1 The same holds, incidentally, for biology, which I cannot here especially examine, although I regard psychology in general as a field of biology.

of the processes. Again, completely in the Aristotelian sense, these abstract class concepts are set up as at once the goal and the cause of the process. And indeed the instincts obtained in this way, as averages of historical actuality, are regarded as the more fundamental the more abstract the class concept is and the more various the cases of which the average is taken. It is thought that in this way, and only in this way, those «accidents» inherent in the particular case and in the concrete situation can be overcome. For the aim that still completely dominates the procedure of psychology in large fields is founded upon its effort to free itself of the connection to specific situations.

Intrinsic Difficulties and Unlawfulness.

The whole difference between the Aristotelian and Galileian modes of thought becomes clear as soon as one sees what consequences, for a strict Galileian view of the concept of law, follow from this close and fixed connection of the instinct to the individual «in itself». In that case the instinct *(e. g.*, the maternal) must operate continually without interruption; just as the explanation of negativism by the «nature» of the three-year-old child entails for Galileian concepts the consequence that all three-year-old children must be negative the whole day long, twenty-four hours out of the twenty-four.

The general Aristotelian set of psychology is able to dodge these consequences. It is satisfied, even for proof of the existence of the vectors which should explain the behavior, to depend upon the concept of regularity. In this way it avoids the necessity of supposing the vector to be existent in every situation. On the basis of the strict concept of law it is possible to disprove the hypothesis, for example, of the existence of a certain instinct by demonstrating its nonexistence in given concrete cases. Aristotelian concepts do not have to fear such disproofs, inasmuch as they can answer all references to concrete particular cases by falling back on mere statistical validity.

Of course these concepts are thereby also unable to explain the occurrence of a particular case, and by this is meant not the behavior of an abstractly defined «average child», but, for example, the behavior of a certain child at a certain moment.

The Aristotelian bent of psychological dynamics thus not only implies a limitation of explanation to such cases as occur frequently enough to provide a basis for abstracting from the situation, but leaves literally any possibility open in any particular case, even of frequent events.

Attempts at Self-correction: the Average Situation.

The intrinsic difficulties for dynamics which the Aristotelian mode of thought brings with it, namely, the danger of destroying the explanatory value of the theory by the exclusion of the situation, are constantly to be observed in contemporary psychology and lead to the most singular hybrid methods and to attempts to include the concept of the situation somehow. This becomes especially clear in the attempts at quantitative determination. When, for example, the question is raised and an attempt made to decide experimentally how the strengths of various drives in rats (perhaps hunger, thirst, sex, and mother love) compare with each other, such a question (which corresponds to asking in physics which is stronger, gravitation or electromotive force) has meaning only if these vectors are ascribed entirely to the rat and regarded as practically independent of the concrete whole situation, independent of the condition of the rat and its environment at the moment. Such a fixed connection is, of course, ultimately untenable, and one is compelled at least in part to abandon this way of thinking. Thus the first step in this direction consists in taking account of the *momentary condition of the drive* with regard to its state of satiation: the various possible degrees of strength of the several drives are ascertained, and their maximal strengths are compared.

It is true, of course, that the Aristotelian attitude is really only slightly ameliorated thereby. The curve expresses the statistical average of a large number of cases, which is not binding for an individual case; and, above all, this mode of thought applies the vector independently of the structure of the situation.

To be sure, it is not denied that the situation essentially determines the instinctive behavior in the actual particular case, but in these problems, as in the question of the child's spontaneous behavior in the baby tests, it is evident that no more is demanded of a law than a behavioral average. The law thus applies to an average situation. It is forgotten that there just is no such thing as an «average situation» any more than an average child.

Practically, if not in principle, the reference to the

concept of an «optimal» situation goes somewhat further. But even here the concrete structure of the situation remains indeterminate: only a maximum of results in a certain direction is required.

In none of these concepts however are the two fundamental faults of the Aristotelian mode of thought eliminated: the vectors determining the dynamics of the process are still attributed to the isolated object, independently of the concrete whole situation; and only very slight demands are made upon the validity of psychological principles and the comprehension of the concrete actuality of the individual single process.

This holds true even for the concepts immediately concerned with the significance of the situation. As mentioned before, the question at the center of the discussion of the situation is, quite in the Aristotelian sense, how far the situation can hinder (or facilitate). The situation is even considered as a constant object and the question is discussed: which is more important, heredity or environment? Thus again, on the basis of a concept of situation gotten by abstraction, a dynamic problem is treated in a form which has none but a statistical historical meaning. The heredity or environment discussion also shows, even in its particulars, how completely these concepts separate object and situation and derive the dynamics from the isolated object itself.

The role of the situation in all these concepts may perhaps be best exhibited by reference to certain changes in painting. In medieval painting at first there was, in general, no environment, but only an empty (often a golden) background. Even when gradually an environment did appear it usually consisted in nothing more than presenting, beside the one person, other persons and objects. Thus the picture was at best an assembling of separate persons in which each had really a separate existence.

Only later did the space itself exist in the painting: it became a whole situation. At the same time this situation as a whole became dominant, and each separate part, so far indeed as separate parts still remain, is what it is (*e. g.*, in such an extreme as Rembrandt) only in and through the whole situation.

Beginnings of a Galileian Mode of Thought.

Opposed to these Aristotelian fundamental ideas of dynamics there are now signs in psychology of the beginnings of a Galileian mode of thought. In this respect the concepts of sensory psychology are farthest advanced.

At first, even in sensory psychology, explanations referred to isolated single perceptions, even to single isolated elements of these perceptions. The developments of recent years have brought about, at first slowly but then more radically, a revolution in the fundamental dynamic ideas by showing that the dynamics of the processes are to be deduced, not from the single elements of the perception, but from its whole structure. For it is impossible by a consideration of the elements to define what is meant by *figure* in the broader sense of the word. Rather, the whole dynamics of sensory psychological processes depends upon the ground[1] and beyond it upon the structure of the whole surrounding field. The dynamics of perception is not to be understood by the abstract Aristotelian method of excluding all fortuitous situations, but — this principle is penetrating today all the fields of sensory psychology — only by *the establishment of a form of definite structure in a definite sort of environment.*

Recently the same fundamental ideas of dynamics have been extended beyond the special field of perception and applied in the fields of higher mental processes, in the psychology of instinct, will, emotion, and expression, and in genetic psychology. The sterility, for example, of the always circular discussion of heredity or environment and the impossibility of carrying through the division, based upon this discussion, of the characteristics of the individual begin to show that there is something radically wrong with their fundamental assumptions. A mode of thought is becoming evident, even though only gradually, which, corresponding somewhat to the biological concept of phenotype and genotype, tries to determine the predisposition, not by excluding so far as possible the influence of the environment, but by accepting in the concept of disposition its necessary reference to a group of concretely defined situations.

Thus in the psychological fields most fundamental to the whole behavior of living things the transition seems inevitable to a Galileian view of dynamics, which derives all its vectors not from single isolated objects, but from the mutual relations of the factors in the concrete whole situation, that is, essentially, from

1 E. RUBIN, *Visuellwahrgenommene Figuren*, Gyldenalske, Copenhagen, 1921.

the momentary condition of the individual and the structure of the psychological situation. *The dynamics of the processes is always to be derived from the relation of the concrete individual to the concrete situation,* and, so far as internal forces are concerned, from the mutual relations of the various functional systems that make up the individual.

The carrying out of this principle requires, to be sure, the completion of a task that at present is only begun: namely, the providing of a workable representation of a concrete psychological situation according to its individual characteristics and its associated functional properties, and of the concrete structure of the psychological person and its internal dynamic facts. Perhaps the circumstance that a technique for such a concrete representation, not simply of the physical but of the psychological situation, cannot be accomplished without the help of topology, the youngest branch of mathematics, has contributed to keeping psychological dynamics, in the most important fields of psychology, in the Aristotelian mode of thought. But more important than these technical questions may be the general substantial and philosophical presuppositions: too meager scientific courage in the question of the lawfulness of the psychical, too slight demands upon the validity of psychological laws, and the tendency, which goes hand in hand with this leaning toward mere regularity, to specifically historic-geographic concepts.

The accidents of historical processes are not overcome by excluding the changing situations from systematic consideration, but only by taking the fullest account of the individual nature of the concrete case. *It depends upon keeping in mind that general validity of the law and concreteness of the individual case are not antitheses, and that reference to the totality of the concrete whole situation must take the place of reference to the largest possible historical collection of frequent repetitions.* This means methodologically that the importance of a case, and its validity as proof, cannot be evaluated by the frequency of its occurrence. Finally, it means for psychology, as it did for physics, a transition from an abstract classificatory procedure to an essentially concrete constructive method.

That psychology at present is not far from the time when the dominance of Aristotelian concepts will be replaced by that of the Galileian mode of thought seems to me indicated also by a more external question of psychological investigation.

It is one of the characteristic signs of the speculative early stage of all sciences that schools, representative of different systems, oppose each other in a way and to an extent that is unknown, for example, in contemporary physics. When a difference of hypotheses occurs in contemporary physics there still remains a common basis that is foreign to the schools of the speculative stage. This is only an external sign of the fact that the concepts of that field have introduced a method that permits step-by-step approximation to understanding. Thereby results a continuous progress of the sciencc which is constantly more narrowly limiting the consequences for the whole structure of differences between various physical theories.

There seems to me much to indicate that even the development of the schools in contemporary psychology is bringing about a transition to a similar sort of constant development, not only in sensory psychology but throughout the entire field.

CHAPTER II

ON THE STRUCTURE OF THE MIND[1]

On the Causes of Psychical Events

The relations to which theory has heretofore looked in experimental psychology, when seeking the causes of a psychical event, belong almost exclusively to one quite specific type of relation. This is a real connection which one may designate as *adhesion* of any sort of object or collection of objects or processes. The fact that certain single objects are connected with each other, or that a whole event sticks together in the sense of adhesion, is given as the cause of a psychical event.

The most pronounced case of such a type of connection is presented by the association between two psychical objects in the sense of the old association theory. The objects a and *b* have entered into an association by reason of earlier contiguity. And this association phenomenon is claimed to be the cause of

1 An excerpt from *Vorsatz, Wille und Bedürfnis, mit Vorbemerkungen über die psychischen Kräfte und Energien und die Struklur der Seele,* pp. 21-39. For use of the word «mind» see translators' note.

the fact that on the occurrence of experience *a*, experience *b* results.

But even when experience is not regarded as the cause of the association and forces are assumed which do not obey the laws of association, such as the determining tendency[1] or any sort of natural coherence,[2] the following fundamental type is still retained: *the stimulus possesses an adhesion with certain reactions*. And this adhesion is regarded as the cause of the course of the event.

1 N. ACH, *Über den Willensakt und das Temperament*, Quelle u. Meyer, Leipzig, 1910.

2 G. E. MÜLLER, *Komplextheorie und Gestalttheorie*, Vanderhoeck u. Ruprecht, Göttingen, 1923.