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PSYCHOLOGY AND EVOLUTION

In the psychology of human perception it is customary to distinguish between Empiristic and Nativistic interpretations of given facts. What do these terms mean? The answer seems obvious: an Empirist favors explanations of perceptual facts in terms of learning, while a Nativist prefers explanations in terms of inherited mechanisms which are located in the nervous system.1 If there are any major difficulties in the Empirist's way of theorizing, such difficulties will not be discussed in these pages. Rather, I propose to analyze what is commonly supposed to be the Nativist's program; because the characterization of this program which I have just mentioned, and which would probably be regarded as

1The term "Empirist" may sound unusual to English and American psychologists. But we need a special name for theorists who tend to give bewildering facts in perception an interpretation in terms of learning. The word "Empiricist" does not refer to such theorists. A phillosopher of the Empiricist school might actually prefer Nativistic to Empiristic theories of perception; his principles do not compel him to prefer the latter. Again, philosophers who are Rationalists rather Empiricists often reason in the Empiristic fashion when they deal with problems of perception. We should therefore confuse two different issues if we were to use the name "Empiricist" both when we mean a particular school in epistemology and when we talk of what I prefer to call the Empiristic trend in the explanation of perceptual facts.

adequate by many psychologists, seems to me to be most seriously misleading.

The main point is this. When referring to inherited particularities of the nervous system, we clearly mean histological facts, even if in a given case we may be unable to indicate precisely what these facts are. Thus, when it appears that a certain phenomenon in perception is not brought about by learning, we conclude that it is such histological conditions which are responsible for its occurrence. I should like to show that this inference is by no means generally justified. A phenomenon in perception which is unlearned need not, for this reason, depend upon the existence of special histological factors. Nativism is a dangerous term; it covers several theoretical possibilities. Unfortunately, we are for the most part aware only of the one toward which the expression "inherited" points. It is important that we know what other factors may be involved in unlearned function. For our issue is by no means restricted to a form of theorizing in perception. Even the intellectual life of man will easily be given a wrong interpretation if we do not realize that Nativistic theories tend to include a far too special premise.

At the present time, all biologists agree that, if a nervous system exhibits certain histological conditions, the cells of the species (and, in particulars, those of the individual) are ultimately responsible for the fact. It is the chromosomic equipment of the cells which has forced morphogenetic processes to establish those structures. The chromosomic equipment of a species, on the other hand, is assumed to be a product of evolution. Hence, if a theorist gives us a Nativistic explanation of certain phenomena, and if his theory is of the kind to which the name "Nativistic" commonly refers, he always assumes that, in the last analysis, those phenomena are made possible by particular achievements of evolution.

It seems to me that this procedure is incompatible with the very meaning of evolution. For the principle of evolution implies that all biological events, including the functions of the brain, have some characteristics on which evolution has never had any influence whatsoever.

In its most consistent form, the postulate of evolution maintains that once the behavior of the inanimate world is sufficiently known it must be possible to derive all biological facts from principles which hold for nonliving systems. At the present time, nobody can be forced to accept this radical postulate. I will nevertheless adopt it for my present purpose, because in this fashion my task will be greatly simplified. It follows, of course, that I cannot try to convince Vitalists or those who believe in Emergent Evolution. In a sense, this does not affect my argument. The error which I propose to discuss is often made by authors who regard the postulate as a necessary part of modern scientific thinking.

Evolution is commonly regarded as a principle of change or development, and this is also the natural meaning of the term. Nonetheless, the postulate which I have just mentioned is a postulate of invariance. It does not indicate what actually happens when organisms develop from inanimate systems, or when new species arise. Rather, it states that, however such changes may be brought about, the same principles, as hold in physics and chemistry apply also to these transformations, and to the forms of life which thus originate. Of course, those who agree with this thesis will readily admit that present formulations of those principles may have to be modified when attempts are made to apply them to living systems. General formulations which excellently serve the physicist's purposes may not explicitly refer to situations which play a particularly important role in biology. In biological theory, principles of science may therefore have to be stated in a way to which the physicist is not accustomed. It goes without saying that reformulations of this kind are entirely compatible with the postulate of invariance in evolution.

When referring to principles, I have in mind such general propositions as the First and the Second Laws of Thermodynamics, but also the Law of Dynamic Direction, a law which is implied rather than explicitly formulated in physics.2 But the postulate of invariance applies not only to general principles. It also demands that no forces and elementary processes occur in organisms which do not also occur in physics and chemistry. By forces I mean such vectors as electric and gravitational fields. Examples of elementary processes are electric currents and currents of diffusion. It does not, of course, follow from the postulate that all forces and elementary processes which are known in physics must also play a part in living systems. What is meant is merely that such forces and processes as are actually encountered in organisms invariably have counterparts in the inanimate world. It will be realized that all concepts to which the postulate of invariance refers, namely, general principles, forces, and elementary processes, are concerned with action. Obviously, as I am now using this word, it applies not only to events which involve changes but also to steady states.3

2. Cf. W. Köhler, The Place of Value in a World of Facts. New York: Liveright, 1938, pp. 306 ff.

3. I am aware of the fact that, in physics, the term action has also a much more technical meaning. In the present connection, we are not concerned with action in this sense.

If so much is supposed to have remained invariant in evolution, what can have varied while evolution took place? There must be factors in nature which can change irrespective of the fact that the general principles, the forces, and the elementary processes of all action remain the same. Any textbook of physics can tell us what these factors are. The same principles apply, the same forces operate, and the same processes occur under conditions which vary widely from one system to another. Take mechanics, the discipline which deals with the movements of objects. It is a form of action that objects in the neighborhood of our planet tend to approach its surface. But objects may either be free to follow the direction of the gravitational vector, or given conditions may restrict this freedom. When placed on an oblique plane which is rigid and solid, an object still approaches the earth, but it does so in the direction of the plane and more slowly, because the resistance of the plane eliminates the component of gravitation which would operate at right angles to the plane, and only the component parallel to the plane accelerates the object. Given conditions which exclude certain possibilities of action are called constraints. The mechanics of solid objects is not the only part of physics in which constraits modify action. If a gas is surrounded by the firm walls of a container, these walls are constraints. Many processes can occur in the gas, but all those are prevented from taking place which would involve a displacement of the walls, and thus the gas cannot expand as it would otherwise do. In hydrodynamics, a rigid tube in which a liquid is enclosed is obviously a constraint; in contact with the inner surface of the tube, the liquid can move only in the direction of the surface. It is perhaps not customary to use the same term in the case of electric phenomena; actually, however, when a nonconducting substance surrounds a material in which electric currents spread, this substance plays the part of a constraint.

No constraint in the sense in which we have just used the concept makes a positive contribution to the action upon which it is imposed. In is sense (although not in others) the role of such constraints is negative. They serve to exclude certain actions which would be possible if the constraints were not present. But while in this fashion some components of forces and of elementary processes are eliminated, the remaining components do not change their behavior. The laws which hold for forces and processes are formulated in general terms so that, when certain possibilities of action can no longer be realized, the same laws still apply to such actions as are not prevented by constraints. On an oblique plane, for instance, the component of gravitation which operates in the direction of the plane accelerates an object in precisely the same way as it would if the constraint were absent. The general principle which is here involved is the principle of the conservation of energy. On the oblique plane, increments of kinetic energy and losses of potential energy are smaller for a given period than they would be in the absence of the plane. Since both changes are of the same size, the principle holds in this situation just as it does in the case of free fall.4 Similar considerations apply to the other instances of action under constraint which have been mentioned in the preceding paragraph.

We can now return to our discussion of evolution. While the general postulate of invariance in evolution claims that no essentially new kind of action appears in living systems, it imposes no limits upon the constraints which may develop when certain inanimate systems assume the characteristics of organisms, and when the various species acquire their distinguishing traits. In this respect, the postulate demands only that such constraints be established in a way which is compatible with the laws of physics and chemistry. In organisms, many different forms of action are, of course, combined (and mutually interrelated) which seldom occur together in the simpler systems commonly studied by physicists and chemists. Apart from this peculiarity of life, it can, according to our postulate, be only specific constraints by which the living world has been made possible. No examples of such constraints will here be needed, since most histological structures may be considered from this point of view. But, although the world of living creatures would not exist if evolution had not introduced these structures, action in the organisms can never be explained solely by the constraints to which it is subjected. Constraints alone, I repeat, never cause any action; they merely serve to modify actions which, as such, owe nothing to constraint. Thus, if our general postulate is accepted, any action in any organism involves the operation of factors which are entirely independent of evolution. We have seen that these factors are the forces and the elementary processes of nature, and such more general facts as are formulated in the principles of science.

Just as to any other biological processes, our reasoning must be applied to the cortical events on which the characteristics of mental facts depend. Generally speaking, cortical action is also modified by constraints, and to this extent evolution is partly responsible for the way in

4. I am, of course, assuming that the influence of friction can be ignored. If this influence is not negligible, the energy balance of the system becomes more complicated, but the principle of the conservation of energy still remains valid.

which this action occurs. But, qua action, it can never be understood only in such terms. For all action is also a matter of processes which evolution has not affected, and which are now not affected by its products, the histological conditions found in nervous systems.

Since this argument may be too abstract to carry full conviction, I will give a simple example. It has recently been suggested that the processes underlying organized perception are steady electric currents which spread in the brain as a continuous medium. If this should prove to be true, the distribution of such currents would partly be determined by histological circumstances which evolution has established in the tissue. Quite irrespective of such special conditions, however, the currents would also follow the general laws which hold for any electric flow in any resisting medium, and cannot have been altered by evolution. If actually some other process plays the part which has just been ascribed to electric currents, our argument must be applied to this other action.

It will now be apparent why we cannot accept the statement that the explanation of all unlearned perceptual facts has to be given in terms of histological conditions. The statement cannot be entirely correct for any perceptual fact. It is only another form of the same mistake if all unlearned functions are attributed to achievements of evolution. For, quite apart from such achievements, unlearned functions are bound to exhibit certain characteristics which they share with actions in the inanimate world.

Although our argument is so simple that it may almost appear as banal, few discussions in which Nativistic explanations are being considered take account of the fact that when we deal with unlearned functions we must always distinguish between action and its constraints. All authors refer to histological conditions upon which such functions depend, and thus, indirectly, to evolution; but few seem to realize that any brain function whatsoever is also an example of actions which do not, as such, depend upon such conditions. One cannot play Hamlet without the Prince of Denmark; on our stage, however, we are consistently trying to do so. The present issue is now becoming particularly important because the belief in the omnipotence of learning, which characterized an earlier period in the development of psychology, is rapidly beginning to weaken under the impact of evidence which points in the opposite direction. A few years ago, a Symposium on Heredity and Environment showed the change of trend in a most impressive fashion.5 It seems, however, that

5. "Symposium on Heredity and Environment". Psychol. Rev., 1947, 54, 297- 352.

the factors involved in unlearned function which owe nothing to evolution, and can therefore hardly be called "inherited," were not explicitly discussed at this conference. We do tend to ignore these factors. In an excellent article on certain phenomena in human perception, a psychologist recently explained that these facts can be interpreted either in the Empiristic fashion or as consequences of the chromosomic equipment of man. Obviously, the chromosomic equipment of man cannot be made responsible for characteristics which action exhibits in inanimate systems as well as in organisms. I do not believe that the author is a Vitalist; most probably, he would accept our general postulate of invariance. Nevertheless, action and the principles which it follows were not mentioned in his paper. It is quite true that in the determination of all events which we study in human perception some inherited conditions and ultimately the constitution of our chromosomes must play a certain role. But they can do so only by influencing processes, the nature of which has not been altered in the least while evolution took its course, and while human chromosomes originated.

Consequently, all facts in human perception have certain characteristics which are unrelated to the specific make-up of human cells. In this respect, only one point is open to debate. To what degree are constraints imposed upon physical actions when these actions occur in human brains?

Our distinction has to be made quite generally, not only when problems in perception are being considered. In fact, if the distinction is ignored in certain other parts of psychology, the consequences are actually much more important. In some cases, they may affect our very concept of man, and may thus have repercussions even in philosophy. In the early years of this century, a Naturalistic conception of man was strongly recommended by some philosophers. One topic to which they applied their program was human thinking. More specifically, they maintained that knowledge and the attempts to widen its scope are not primarily concerned with objective cognition. Rather thinking was to be regarded as a particular mechanism which evolution has developed in man, and which helps his species to survive. Now, human thinking which is objectively adequate can hardly fail to have useful consequences; but it does not follow that the usefulness of thinking in a particular environment is its most fundamental characteristic, and that its adequacy, when it is adequate, must be defined in terms of its usefulness. For again, although human thought may to a degree be influenced by special conditions which evolution has established, it is, first of all, a form of action. Consequently, the notion that only such conditions, i.e., histological factors, are responsible for the characteristics of thinking cannot possibly be defended. Thinking no less than perception must also follow principles which are unrelated to the particular circumstances of human life, to evolution, and to histological devices. I sometimes wonder what those philosophers meant by nature when they demanded that man be understood in Naturalistic terms. Surely, they ignored the most important of these terms.

In the meantime, their views have had an immense influence upon the intellectual and emotional climate of our historical period. Generally speaking, there is an optimistic trend in evolutionary reasoning. The changes which have occurred since life first appeared on this planet are commonly regarded as improvements. From this point of view, there is, of course, a great temptation to regard human thinking as the very greatest among all evolutionary achievements, and on this basis to feel more optimistic than ever. The Naturalists did not make this mistake. They realized, and sometimes apparently with a certain satisfaction, that in the evolutionary explanation of human thinking as a useful tool this thinking is actually devalued. There is general agreement among the biologists that of all imaginable devices which might have arisen in evolution those have become stable characteristics of a species which serve to make this species better adapted to its environment. Now, although in a way all adaptation implies improvement, it also has its less attractive phase. To the extent to which the various functions in animals and man are thus usefully conditioned, their value must be regarded as relative to the particular environment in which the adaptation has occurred. This is precisely what the Naturalists actually meant, or what their followers understood them to mean, when they said that human thinking is a product of evolution. When we now refer to "human nature," we use the expression with an unmistakable accent on the adjective. We seem to mean a quite particular part of nature, the one which is merely human, or human in a restrictive sense. This is the point at which evolutionary optimism has turned sour; at which evolution has become a powerful source of the relativistic defeatism from which our intellectual culture is suffering. And yet, if we follow the principle of invariance in evolution, there is no cause for this particular form of our ailment. When man is thinking, he invariably follows, at least in part, some principles of action which hold everywhere, and can therefore not be suspected of being merely relative to his particular environment. To be sure, he would not exist at all, if evolution had not occurred. At present, he would have little to think about if evolution had not given him sense organs, properly conducting nerve fibers, and many other particular devices. But even a modest nerve impulse which travels along one of those fibers obeys some general principles of action no less than the constraints to which it is subjected. Similarly, man's thinking must have some characteristics which are not in any sense determined by evolution and, for this reason, significant only in a relative sense.

In some instances, human thinking may be strongly affected by inherited conditions; in others, it may follow mainly general principles of action rather than such conditions. I have a suspicion that the latter alternative is often realized when human beings grasp relations between objects, and when they derive further relations from those which are given. If this were true, there would still remain unanswered questions as to the cognitive significance of such events. But whatever this significance might be, it would not be limited by the fact that it happens to be human beings in whom the events occur. Moreover, such processes would probably show a certain affinity to the facts which man observes in nature, because, as to certain fundamentals, he would find in such observations what he can also find in himself.

How would a human being be impressed by principles of action if he became aware of them as principles of his thinking? Factual generality, even if it is absolute, need not be related to such concepts as being valid or evident; but it might be so related in the present case. Man might find those principles necessary in the sense in which certain formal principles actually appear to us necessary when we think. Naturally, he would not feel that the recognition of such principles presupposes observation of any particular facts. Rather, their necessity would seem to him to have an a priori character. And yet, no subjectivism would follow, because, as I said before, for excellent reasons an a priori of this kind would tend to fit empirical evidence.

Possibilities such as these fairly obtrude themselves once the postulate of invariance in evolution has been understood and accepted. Even so, it remains to be seen whether principles of action in nature can really be recognized in the way in which human thinking proceeds. Obviously, if attempts in this direction should end in failure, the postulate of invariance could no longer be accepted in its radical form, and a Dualistic view of the world would become unavoidable.