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ASPECTS OF SCIENTIFIC EXPLANATION

And Other Essays in the Philosophy of Science

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11. THE LOGIC OF FUNCTIONAL ANALYSIS

1. INTRODUCTION

EMPIRICAL SCIENCE, in all its major branches, seeks not only to *describe* the phenomena in the world of our experience, but also to *explain* or *understand* them. While this is widely recognized, it is often held, however, that there exist fundamental differences between the explanatory *methods* appropriate to the different fields of empirical science. In the physical sciences, according to this view, all explanation is achieved ultimately by reference to causal or correlational antecedents; whereas in psychology and the social and historical disciplines—and, according to some, even in biology—the establishment of causal or correlational connections, while desirable and important, is not sufficient. Proper understanding of the phenomena studied in these fields is held to require other types of explanation.

One of the explanatory methods that have been developed for this purpose is that of functional analysis, which has found extensive use in biology, psychology sociology, and anthropology. This procedure raises problems of considerable interest for the comparative methodology of empirical science. The present essay is an attempt to clarify some of these problems; its object is to examine the logical structure of functional analysis and its explanatory and predictive significance by means of a confrontation with the principal characteristics of the explanatory procedures used in the physical sciences. We begin therefore with a brief examination of the latter.

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2. NOMOLOGICAL EXPLANATION: DEDUCTIVE AND INDUCTIVE

In a beaker filled to the brim with water at room temperature, there floats a chunk of ice which partly extends above the surface. As the ice gradually melts, one might expect the water in the beaker to overflow. Actually the water level remains unchanged. How is this to be explained? The key to an answer is provided by Archimedes' principle, according to which a solid body floating in a liquid displaces a volume of liquid which has the same weight as the body itself. Hence the chunk of ice has the same weight as the volume of water its submerged portion displaces. Since melting does not affect the weights involved, the water into which the ice turns has the same weight as the ice itself, and hence, the same weight as the water initially displaced by the submerged portion of the ice. Having the same weight, it also has the same volume as the displaced water; hence the melting ice yields a volume of water that suffices exactly to fill the space initially occupied by the submerged part of the ice. Therefore, the water level remains unchanged.

This account (which deliberately disregards certain effects of small magnitude) is an example of an argument intended to explain a given event. Like any explanatory argument, it falls into two parts, which will be called the *explanans* and the *explanandum*.[1] The latter is the statement, or set of statements, describing the phenomenon to be explained; the former is the statement, or set of statements, adduced to provide an explanation. In our illustration, the explanandum states that at the end of the process, the beaker contains only water, with its surface at the same level as at the beginning. To explain this, the explanans adduces, first of all, certain laws of physics; among them, Archimedes' principle; laws to the effect that at temperatures above 0°C. and atmospheric pressure, a body of ice turns into a body of water having the same weight; and the law that, at any fixed temperature and pressure, amounts of water that are equal in weight are also equal in volume.

1. These terms are given preference over the more familiar words 'explicans' and 'explicandum,' in order to reserve the latter for use in the context of philosophical explication in the technical sense proposed by R. Carnap; see, for example, his *Logical Foundations of Probability* (Chicago: University of Chicago Press, 1950), secs. 1-3. The terms 'explanans' and 'explanandum' were introduced, for this reason, in an earlier article: Carl G. Hempel and P. Oppenheim, "Studies in the Logic of Explanation," *Philosophy of Science*, 15 (1948), pp. 135-75 (reprinted in the present volume). While that article does not deal explicitly with inductive explanation, its first four sections contain various further considerations on deductive explanation that are relevant to the present study. For a careful critical examination of some points of detail discussed in the earlier article, such as especially the relation between explanation and prediction, see the essay by I. Scheffler, "Explanation, Prediction, and Abstraction," *The British Journal for the Philosophy of Science*, 7 (1957), pp. 293-309, which also contains some interesting comments bearing on functional analysis.

In addition to these laws, the explanans contains a second group of statements; these describe certain particular circumstances which, in the experiment, precede the outcome to be explained; such as the facts that at the beginning, there is a chunk of ice floating in a beaker filled with water; that the water is at room temperature; and that the beaker is surrounded by air at the same temperature and remains undisturbed until the end of the experiment.

The explanatory import of the whole argument lies in showing that the outcome described in the explanandum was to be expected in view of the antecedent circumstances and the general laws listed in the explanans. More precisely, the explanation may be construed as an argument in which the explanandum is deduced from the explanans. Our example then illustrates what we will call explanation by deductive subsumption under general laws, or briefly, *deductive-nomological explanation*. The general form of such an explanation is given by the following schema:

$$\left.\begin{array}{l} L_1, L_2, \ldots, L_m \\ C_1, C_2, \ldots, C_n \end{array}\right\} \text{Explanans} \qquad (2.1)$$

$$\overline{\qquad\qquad} \qquad \text{Explanandum}$$

$$E$$

Here, $L_1, L_2, \ldots, L_m$ are general laws and $C_1, C_2, \ldots, C_n$ are statements of particular fact; the horizontal line separating the conclusion E from the premises indicates that the former follows logically from the latter.

In our example, the phenomenon to be explained is a particular event that takes place at a certain place and time. But the method of deductive subsumption under general laws lends itself also to the explanation of what might be called "general facts" or uniformities, such as those expressed by laws of nature. For example, the question why Galileo's law holds for physical bodies falling freely near the earth's surface can be answered by showing that the law refers to a special case of accelerated motion under gravitational attraction, and that it can be deduced from the general laws for such motion (namely, Newton's laws of motion and of gravitation) by applying these to the special case where two bodies are involved, one of them the earth and the other the falling object, and where the distance between their centers of gravity equals the length of the earth's radius. Thus, an explanation of the regularities expressed by Galileo's law can be achieved by deducing the latter from the Newtonian laws and from statements specifying the mass and the radius of the earth; the latter two yield the value of the constant acceleration of free fall near the earth.

It might be helpful to mention one further illustration of the role of deductive-nomological explanation in accounting for particular facts as well as

for general uniformities or laws. The occurrence of a rainbow on a given occasion can be deductively explained by reference to (1) certain particular determining conditions, such as the presence of raindrops in the air, sunlight falling on these drops, the observer facing away from the sun, etc., and (2) certain general laws, especially those of optical reflection, refraction, and dispersion. The fact that these laws hold can be explained in turn by deduction from the more comprehensive principles of, say, the electromagnetic theory of light.

Thus, the method of deductive-nomological explanation accounts for a particular event by subsuming it under general laws in the manner represented by the schema (2.1); and it can similarly serve to explain the fact that a given law holds by showing that the latter is subsumable, in the same fashion, under more comprehensive laws or theoretical principles. In fact, one of the main objectives of a theory (such as, say, the electromagnetic theory of light) is precisely to provide a set of principles—often expressed in terms of "hypothetical," not directly observable, entities (such as electric and magnetic field vectors)—which will deductively account for a group of antecedently established "empirical generalizations" (such as the laws of rectilinear propagation, reflection, and refraction of light). Frequently, a theoretical explanation will show that the empirical generalizations hold only approximately. For example, the application of Newtonian theory to free fall near the earth yields a law that is like Galileo's except that the acceleration of the fall is seen not to be strictly constant, but to vary slightly with geographical location, altitude above sea level, and certain other factors.

The general laws or theoretical principles that serve to account for empirical generalizations may in turn be deductively subsumable under even more comprehensive principles; for example, Newton's theory of gravitation can be subsumed, as an approximation, under that of the general theory of relativity. Obviously, this explanatory hierarchy has to end at some point. Thus, at any time in the development of empirical science, there will be certain facts which, at that time, are not explainable; these include the most comprehensive general laws and theoretical principles then known and, of course, many empirical generalizations and particular facts for which no explanatory principles are available at the time. But this does not imply that certain facts are intrinsically unexplainable and thus must remain unexplained forever: any particular fact as yet unexplainable, and any general principle, however comprehensive, may subsequently be found to be explainable by subsumption under even more inclusive principles.

Causal explanation is a special type of deductive nomological explanation; for a certain event or set of events can be said to have caused a specified "effect"

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only if there are general laws connecting the former with the latter in such a way that, given a description of the antecedent events, the occurrence of the effect can be deduced with the help of the laws. For example, the explanation of the lengthening of a given iron bar as having been caused by an increase in its temperature amounts to an argument of the form (2.1) whose explanans includes (*a*) statements specifying the initial length of the bar and indicating that the bar is made of iron and that its temperature was raised, (*b*) a law pertaining to the increase in the length of any iron bar with rising temperature.[2]

Not every deductive-nomological explanation is a causal explanation, however. For example, the regularities expressed by Newton's laws of motion and of gravitation cannot properly be said to *cause* the free fall of bodies near the earth's surface to satisfy Galileo's laws.

Now we must consider another type of explanation, which again accounts for a given phenomenon by reference to general laws, but in a manner which does not fit the deductive pattern (2.1). When little Henry catches the mumps, this might be explained by pointing out that he contracted the diesase from a friend with whom he played for several hours just a day before the latter was confined with a severe case of mumps. The particular antecedent factors here invoked are Henry's exposure and, let us assume, the fact that Henry had not had the mumps before. But to connect these with the event to be explained, we cannot adduce a general law to the effect that under the conditions just mentioned, the exposed person invariably contracts the mumps: what can be asserted is only that the disease will be transmitted with high statistical probability. Again, when a neurotic trait in an adult is psychoanalytically explained by reference to critical childhood experiences, the argument explicitly or implicitly claims that the case at hand is but an exemplification of certain general laws governing the development of neuroses. But surely, whatever specific laws of this kind might be adduced at present can purport, at the very best, to express probabilistic trends rather than deterministic uniformities: they may be construed as *laws of statistical form*, or briefly as *statistical laws*, to the effect that, given the childhood experiences in question—plus, presumably, certain particular environmental conditions in later life—there is such and such a statistical probability that a specified kind of neurosis will develop. Such

2. An explanation by means of laws which are causal in the technical sense of theoretical physics also has the form (2.1) of a deductive-nomological explanation. In this case, the laws invoked must meet certain conditions as to mathematical form, and $C_1, C_2, \ldots, C_n$ express so-called boundary conditions. For a fuller account of the concepts of causal law and of causality as understood in theoretical physics, see, for example, H. Margenau, *The Nature of Physical Reality* (New York: McGraw-Hill Book Company, Inc., 1950), Chapter 19; or Ph. Frank, *Philosophy of Science* (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1957), Chapters 11, 12.

statistical laws differ in form from strictly universal laws of the kind mentioned in our earlier examples of explanatory arguments. In the simplest case, a *law of strictly universal form*, or briefly, a *universal law*, is a statement to the effect that in *all* cases satisfying certain antecedent conditions A (e.g., heating of a gas under constant pressure), an event of a specified kind B (e.g., an increase in the volume of the gas) will occur; whereas a law of statistical form asserts that the probability for conditions A to be accompanied by an event of kind B has some specific value p.

Explanatory arguments which, in the manner just illustrated, account for a phenomenon by reference to statistical laws are not of the strictly deductive type (2.1). For example, the explanans consisting of information about Henry's exposure to the mumps and of a statistical law about the transmission of this disease does not logically imply the conclusion that Henry catches the mumps; it does not make that conclusion necessary, but, as we might say, more or less probable, depending upon the probability specified by the statistical laws. An argument of this kind, then, accounts for a phenomenon by showing that its occurrence is highly probable in view of certain particular facts and statistical laws specified in the explanans. An account of this type will be called an *explanation by inductive subsumption under statistical laws*, or briefly, an *inductive explanation*.

Closer analysis shows that inductive explanation differs from its deductive counterpart in several important respects;[3] but for the purposes of the following discussion, our sketchy account of explanation by statistical laws will suffice.

The two types of explanation we have distinguished will both be said to be varieties of *nomological explanation;* for either of them accounts for a given phenomenon by "subsuming it under laws," i.e., by showing that its occurrence could have been inferred—either deductively or with a high probability—by applying certain laws of universal or of statistical form to specified antecedent circumstances. Thus, a nomological explanation shows that we might in fact have *predicted* the phenomenon at hand, either deductively or with a high probability, if, at an earlier time, we had taken cognizance of the facts stated in the explanans.

But the predictive power of a nomological explanation goes much farther than this: precisely because its explanans contains general laws, it permits

3. For details, see section 3 of the essay "Aspects of Scientific Explanation" in this volume. Some stimulating comments on explanation by means of statistical laws will be found in S. E. Gluck, "Do Statistical Laws Have Explanatory Efficacy?" *Philosophy of Science*, 22 (1955), 34-38. For a much fuller analysis of the logic of statistical inference, see R. B. Braithwaite, *Scientific Explanation* (Cambridge: Cambridge University Press, 1953), chapters V, VI, VII. For a study of the logic of inductive inference in general, Carnap's *Logical Foundations of Probability*, *op. cit.*, is of great importance.

predictions concerning occurrences other than that referred to in the explanandum. In fact, such predictions provide a means of testing the empirical soundness of the explanans. For example, the laws invoked in a deductive explanation of the form (2.1) imply that the kind of event described in E will recur whenever and wherever circumstances of the kind described by C_1, $C_2, \ldots, C_n$ are realized; e.g., when the experiment with ice floating in water is repeated, the outcome will be the same. In addition, the laws will yield predictions as to what is going to happen under certain specifiable conditions which differ from those mentioned in $C_1, C_2, \ldots, C_n$. For example, the laws invoked in our illustration also yield the prediction that if a chunk of ice were floating in a beaker filled to the brim with concentrated brine, which has a greater specific gravity than water, some of the liquid would overflow as the ice was melting. Again, the Newtonian laws of motion and of gravitation, which may be used to explain various aspects of planetary motion, have predictive consequences for a variety of totally different phenomena, such as free fall near the earth, the motion of a pendulum, the tides, and many others.

This kind of account of further phenomena which is made possible by a nomological explanation is not limited to future events; it may refer to the past as well. For example, given certain information about the present locations and velocities of the celestial bodies involved, the principles of Newtonian mechanics and of optics yield not only predictions about future solar and lunar eclipses, but also "postdictions," or "retrodictions," about past ones. Analogously, the statistical laws of radioactive decay, which can function in various kinds of predictions, also lend themselves to retrodictive use; for example, in the dating, by means of the radiocarbon method, of a bow or an ax handle found in an archaeological site.

A proposed explanation is scientifically acceptable only if its explanans is capable of empirical test, i.e., roughly speaking, if it is possible to infer from it certain statements whose truth can be checked by means of suitable observational or experimental procedures. The predictive and postdictive implications of the laws invoked in a nomological explanation clearly afford an opportunity for empirical tests; the more extensive and varied the set of implications that have been borne out by empirical investigation, the better established will be the explanatory principles in question.

3. THE BASIC PATTERN OF FUNCTIONAL ANALYSIS

Historically speaking, functional analysis is a modification of teleological explanation, i.e., of explanation not by reference to causes which "bring about" the event in question, but by reference to ends which determine its course. Intuitively, it seems quite plausible that a teleological approach might be

required for an adequate understanding of purposive and other goal-directed behavior; and teleological explanation has always had its advocates in this context. The trouble with the idea is that in its more traditional forms, it fails to meet the minimum scientific requirement of empirical testability. The neovitalistic idea of entelechy or of vital force is a case in point. It is meant to provide an explanation for various characteristically biological phenomena, such as regeneration and regulation, which according to neovitalism cannot be explained by physical and chemical laws alone. Entelechies are conceived as goal-directed nonphysical agents which affect the course of physiological events in such a way as to restore an organism to a more or less normal state after a disturbance has occurred. However, this conception is stated in essentially metaphorical terms: no testable set of statements is provided (i) to specify the circumstances in which an entelechy will supervene as an agent directing the course of events otherwise governed by physical and chemical laws, and (ii) to indicate precisely what observable effects the action of an entelechy will have in such a case. And since neovitalism thus fails to state general laws as to when and how entelechies act, it cannot explain any biological phenomena; it can give us no grounds to expect a given phenomenon, no reasons to say: "Now we see that the phenomenon had to occur." It yields neither predictions nor retrodictions: the attribution of a biological phenomenon to the supervention of an entelechy has no testable implications at all. This theoretical defect can be thrown into relief by contrasting the idea of entelechy with that of a magnetic field generated by an electric current, which may be invoked to explain the deflection of a magnetic needle. A magnetic field is not directly observable any more than an entelechy; but the concept is governed by strictly specifiable laws concerning the strength and direction, at any point, of the magnetic field produced by a current flowing through a given wire, and by other laws determining the effect of such a field upon a magnetic needle in the magnetic field on the earth. And it is these laws which, by their predictive and retrodictive import, confer explanatory power upon the concept of magnetic field. Teleological accounts referring to entelechies are thus seen to be pseudo-explanations. Functional analysis, as will be seen, though often formulated in teleological terms, need not appeal to such problematic entities and has a definitely empirical core.

The kind of phenomenon that a functional analysis[4] is invoked to explain

4. For the account of functional analysis presented in this section, I have obtained much stimulation and information from the illuminating essay "Manifest and Latent Functions" in R. K. Merton's book, *Social Theory and Social Structure* (New York: The Free Press; revised and enlarged edition, 1957), 19-84. Each of the passages from this work which is referred to in the present essay may also be found in the first edition (1949), on a page with approximately the same number.

is typically some recurrent activity or some behavior pattern in an individual or a group, such as a physiological mechanism, a neurotic trait, a culture pattern or a social institution. And the principal objective of the analysis is to exhibit the contribution which the behavior pattern makes to the preservation or the development of the individual or the group in which it occurs. Thus, functional analysis seeks to understand a behavior pattern or a sociocultural institution by determining the role it plays in keeping the given system in proper working order or maintaining it as a going concern.

By way of a simple and schematized illustration, consider first the statement:

(3.1) The heartbeat in vertebrates has the function of circulating blood through the organism.

Before examining the possibilities of its explanatory use, we should ask ourselves: What does the statement *mean*? What is being asserted by this attribution of function? It might be held that all the information conveyed by a sentence such as (3.1) can be expressed just as well by substituting the word "effect" for the word "function." But this construal would oblige us to assent also to the statement:

(3.2) The heartbeat has the function of producing heart sounds; for the heartbeat has that effect.

Yet a proponent of functional analysis would refuse to assert (3.2), on the ground that heart sounds are an effect of the heartbeat which is of no importance to the functioning of the organism; whereas the circulation of the blood effects the transportation of nutriment to, and the removal of waste from, various parts of the organism—a process that is indispensable if the organism is to remain in proper working order, and indeed if it is to stay alive. Thus understood, the import of the functional statement (3.1) might be summarized as follows:

(3.3) The heartbeat has the effect of circulating the blood, and this ensures the satisfaction of certain conditions (supply of nutriment and removal of waste) which are necessary for the proper working of the organism.

We should notice next that the heart will perform the function here attributed to it only if certain conditions are met by the organism and by its environment. For example, circulation will fail if there is a rupture of the aorta; the blood can carry oxygen only if the environment affords an adequate supply of oxygen and the lungs are in proper condition; it will remove certain kinds of waste only if the kidneys are reasonably healthy; and so forth. Most of the conditions that would have to be specified here are usually left unmentioned, partly no doubt because they are assumed to be satisfied as a matter of course in situations in which the organism normally finds itself. But in part, the omission reflects lack of relevant knowledge, for an explicit specification of the relevant conditions would require a theory in which (*a*) the possible states of

organisms and of their environments could be characterized by the values of certain physicochemical or perhaps biological "variables of state," and in which (*b*) the fundamental theoretical principles would permit the determination of that range of internal and external conditions within which the pulsations of the heart would perform the function referred to above.[5] At present, a general theory of this kind, or even one that could deal in this fashion with some particular class of organisms, is unavailable, of course.

Also, a full restatement of (3.1) in the manner of (3.3) calls for criteria of what constitutes "proper working," "normal functioning," and the like, of the organism at hand; for the function of a given trait is here construed in terms of its causal relevance to the satisfaction of certain necessary conditions of proper working or survival of the organism. Here again, the requisite criteria are often left unspecified—an aspect of functional analysis whose serious implications will be considered later (in section 5).

The considerations here outlined suggest the following schematic characterization of a functional analysis:

(3.4) *Basic pattern of a functional analysis:* The object of the analysis is some "item" *i*, which is a relatively persistent trait or disposition (e.g., the beating of the heart) occurring in a system *s* (e.g., the body of a living vertebrate); and the analysis aims to show that *s* is in a state, or internal condition, c_i and in an environment representing certain external conditions c_e such that under conditions c_i and c_e (jointly to be referred to as *c*) the trait *i* has effects which satisfy some "need" or "functional requirement" of *s*, i.e., a condition *n* which is necessary for the system's remaining in adequate, or effective, or proper, working order.

Let us briefly consider some examples of this type of analysis in psychology and in sociological and anthropological studies. In psychology, it is especially psychoanalysis which shows a strong functional orientation. One clear instance is Freud's functional characterization of the role of symptom formation. In *The Problem of Anxiety*, Freud expresses himself as favoring a conception according to which "all symptom formation would be brought about solely in order to avoid anxiety; the symptoms bind the psychic energy which otherwise would be discharged as anxiety."[6] In support of this view, Freud points out that if an agoraphobic who has usually been accompanied when going out is left alone in the street, he will suffer an attack of anxiety, as will the compulsion neurotic, who, having touched something, is prevented from washing

5. For a fuller statement and further development of this point, see the essay "A Formalization of Functionalism" in E. Nagel, *Logic Without Metaphysics* (New York; The Free Press, 1957), 247–83. Part I of that study offers a detailed analysis of Mertons' essay mentioned in Note 4.

6. S. Freud, *The Problem of Anxiety* (Transl. by H. A. Bunker. New York: Psychoanalytic Quarterly Press, and W. W. Norton & Company, Inc., 1936), p. 111.

his hands. "It is clear, therefore, that the stipulation of being accompanied and the compulsion to wash has as their purpose, and also their result, the averting of an outbreak of anxiety."[7] In this account, which is put in strongly teleological terms, the system *s* is the individual under consideration; *i* his agoraphobic or compulsive behavior pattern; *n* the binding of anxiety, which is necessary to avert a serious psychological crisis that would make it impossible for the individual to function adequately.

In anthropology and sociology the object of functional analysis is, in Merton's words, "a *standardized* (i.e., patterned and repetitive) item, such as social roles, institutional patterns, social processes, cultural pattern, culturally patterned emotions, social norms, group organization, social structure, devices for social control, *etc.*"[8] Here, as in psychology and biology, the function, i.e., the stabilizing or adjusting effect, of the item under study may be one not consciously sought (and indeed, it might not even be consciously recognized) by the agents; in this case, Merton speaks of *latent* functions—in contradistinction to *manifest* functions, i.e., those stabilizing objective effects which are intended by participants in the system.[9] Thus, e.g., the rain-making ceremonials of the Hopi fail to achieve their manifest meteorological objective, but they "may fulfill the latent function of reinforcing the group identity by providing a periodic occasion on which the scattered members of a group assemble to engage in a common activity."[10]

Radcliffe-Brown's functional analysis of the totemic rites of certain Australian tribes illustrates the same point:

> To discover the social function of the totemic rites we have to consider the whole body of cosmological ideas of which each rite is a partial expression. I believe that it is possible to show that the social structure of an Australian tribe is connected in a very special way with these cosmological ideas and that the maintenance of its continuity depends on keeping them alive, by their regular expression in myth and rite.
>
> Thus, any satisfactory study of the totemic rites of Australia must be based not simply on the consideration of their ostensible purpose . . . , but on the discovery of their meaning and of their social function.[11]

7. *Ibid.*, p. 112.

8. Merton, *op. cit.*, p. 50 (Author's italics).

9. *Ibid.*, p. 51. Merton defines manifest functions as those which are both intended and recognized, and latent functions as those which are neither intended nor recognized, But this characterization allows for functions which are neither manifest nor latent; e.g., those which are recognized though not intended. It would seem to be more in keeping with Merton's intentions, therefore, to base the distinction simply on whether or not the stabilizing effect of the given item was deliberately sought.

10. *Ibid.*, pp. 64-65.

11. A. R. Radcliffe-Brown, *Structure and Function in Primitive Society* (London: Cohen and West Ltd., 1952), 145.

Malinowski attributes important latent functions to religion and to magic: he argues that religious faith establishes and enhances mental attitudes such as reverence for tradition, harmony with environment, and confidence and courage in critical situations and at the prospect of death—attitudes which, embodied and maintained by cult and ceremonial, have "an immense biological value." He points out that magic, by providing man with certain ready-made rituals, techniques, and beliefs, enables him "to maintain his poise and his mental integrity in fits of anger, in the throes of hate, of unrequited love, of despair and anxiety. The function of magic is to ritualize man's optimism, to enhance his faith in the victory of hope over fear."[12]

There will soon be occasion to add to the preceding examples from psychoanalysis and anthropology some instances of functional analysis in sociology. To illustrate the general character of the procedure, however, the cases mentioned so far will suffice: they all exhibit the basic pattern outlined in (3.4). From our examination of the form of functional analysis we now turn to an appraisal of its significance as a mode of explanation.

4. THE EXPLANATORY IMPORT OF FUNCTIONAL ANALYSIS

Functional analysis is widely considered as achieving an *explanation* of the "items" whose functions it studies. Malinowski, for example, says of the functional analysis of culture that it "aims at the explanation of anthropological facts at all levels of development by their function . . ."[13] and he adds, in the same context: "To explain any item of culture, material or moral, means to indicate its functional place within an institution, . . ."[14] At another place, Malinowski speaks of the "functional explanation of art, recreation, and public ceremonials."[15]

Radcliffe-Brown, too, considers functional analysis as an explanatory

12. B. Malinowski, *Magic, Science and Religion, and Other Essays* (Garden City, N.Y.: Doubleday Anchor Books, 1954), p. 90. For an illuminating comparison of Malinowski's views on the functions of magic and religion with those advanced by Radcliffe-Brown, see G. C. Homans, *The Human Group* (New York: Harcourt, Brace & World, Inc., 1950), 321 ff. (Note also Homan's general comments on "the functional theory," *ibid.*, pp. 268-72.) This issue and other aspects of functional analysis in anthropology are critically examined in the following article, which confronts some specific applications of the method with programmatic declarations by its proponents: Leon J. Goldstein, "The Logic of Explanation in Malinowskian Anthropology," *Philosophy of Science*, 24 (1957), 156-66.

13. B. Malinowski, "Anthropology," *Encyclopaedia Britannica*, First Supplementary volume (London and New York: The Encyclopaedia Britannica, Inc., 1926), 132.

14. *Ibid.*, p. 139.

15. B. Malinowski, *A Scientific Theory of Culture, and Other Essays* (Chapel Hill: University of North Carolina Press, 1944), 174.

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method, though not as the only one suited for the social sciences: "Similarly one 'explanation' of a social system will be its history, where we know it—the detailed account of how it came to be what it is and where it is. Another 'explanation' of the same system is obtained by showing (as the functionalists attempt to do) that is it a special exemplification of laws of social physiology or social functioning. The two kinds of explanation do not conflict, but supplement one another."[16]

Apart from illustrating the attribution of explanatory import to functional analysis, this passage is of interest because it stresses that a functional analysis has to rely on general laws. This is shown also in our schematic characterization (3.4): the statements that i, in the specified setting c, has effects that satisfy n, and that n is a necessary condition for the proper functioning of the system, both involve general laws. For a statement of causal connection this is well known; and the assertion that a condition n constitutes a functional prerequisite for a state of some specified kind (such as proper functioning) is tantamount to the statement of a law to the effect that whenever condition n fails to be satisfied, the state in question fails to occur. Thus, explanation by functional analysis requires reference to laws.[17]

What explanatory import may properly be claimed for functional analysis? Suppose, then, that we are interested in explaining the occurrence of a trait i in

16. Radcliffe-Brown, *op. cit.*, p. 186. For an analysis of the idea of historic-genetic explanation, referred to in this passage, see section 7 of the essay "Aspects of Scientific Explanation", in this volume.

17. Malinowski, at one place in his writings, endorses a pronouncement which might appear to be at variance with this conclusion: "Description cannot be separated from explanation, since in the words of a great physicist, 'explanation in nothing but condensed description'." (Malinowski, "Anthropology," *op. cit.*, p. 132.) He seems to be referring here to the views of Ernst Mach or of Pierre Duhem, who took a similar position on this point. Mach conceived the basic objective of science as the brief and economic description of recurrent phenomena and considered laws as a highly efficient way of compressing, as it were, the description of an infinitude of potential particular occurrences into a simple and compact formula. But, thus understood, the statement approvingly quoted by Malinowski is, of course, entirely compatible with our point about the relevance of laws for functional explanation.

Besides, a law can be called a description only in a Pickwickian sense. For even so simple a generalization as "All vertebrates have hearts" does not describe any particular individual, such as Rin-Tin-Tin, as being a vertebrate and having a heart; rather, it asserts of Rin-Tin-Tin and of any other object, whether vertebrate or not—that *if* it is a vertebrate *then* it has a heart. Thus, the generalization has the import of an indefinite set of conditional statements about particular objects. In addition, a law might be said to imply statements about "potential events" which never actually take place. The gas law, for example, implies that if a given body of gas were to be heated under constant pressure at time t, its volume would increase. But if in fact the gas is not heated at t this statement can hardly be said to be a description of any particular event.

a system s (at a certain time t), and that the following functional analysis is offered:

(4.1)
- (a) At t, s functions adequately in a setting of kind c (characterized by specific internal and external conditions)
- (b) s functions adequately in a setting of kind c only if a certain necessary condition, n, is satisfied
- (c) If trait i were present in s then, as an effect, condition n would be satisfied
- (d) (Hence), at t, trait i is present in s

For the moment, let us leave aside the question as to what precisely is meant by statements of the types (a) and (b), and especially by the phrase "s functions adequately"; these matters will be examined in section 5. Right now, we will concern ourselves only with the *logic* of the argument; i.e., we will ask whether (d) formally follows from (a), (b), (c), just as in a deductive-nomological explanation the explanandum follows from the explanans. The answer is obviously in the negative, for, to put it pedantically, the argument (4.1) involves the fallacy of affirming the consequent in regard to premise (c). More explicitly, the statement (d) could be validly inferred if (c) asserted that *only* the presence of trait i could effect satisfaction of condition n. As it is, we can infer merely that condition n must be satisfied in some way or other at time t; for otherwise, by reason of (b), the system s could not be functioning adequately in its setting, in contradiction to what (a) asserts. But it might well be that the occurrence of any one of a number of alternative items would suffice no less than the occurrence of i to satisfy requirement n, in which case the account provided by the premises of (4.1) simply fails to explain why the trait i rather than one of its alternatives is present in s at t.

As has just been noted, this objection would not apply if premise (c) could be replaced by the statement that requirement n can be met *only* by the presence of trait i. And indeed, some instances of functional analysis seem to include the claim that the specific item under analysis is, in this sense, functionally indispensable for the satisfaction of n. For example, Malinowski makes this claim for magic when he asserts that "magic fulfills an indispensable function within culture. It satisfies a definite need which cannot be satisfied by any other factors of primitive civilization," and again when he says about magic that "without its power and guidance early man could not have mastered his practical difficulties as he has done, nor could man have advanced to the higher stages of culture. Hence the universal occurrence of magic in primitive societies and its enormous sway. Hence we do find magic an invariable adjunct of all important activities."[18]

18. Malinowski, "Anthropology," *op. cit.*, p. 136; and *Magic, Science and Religion, and Other Essays, op. cit.*, p. 90. (Note the explanatory claim implicit in the use of the word "hence.")

However, the assumption of functional indispensability for a given item is highly questionable on empirical grounds: in all concrete cases of application, there do seem to exist alternatives. For example, the binding of anxiety in a given subject might be effected by an alternative symptom, as the experience of psychiatrists seems to confirm. Similarly, the function of the rain dance might be subserved by some other group ceremonial. And interestingly, Malinowski himself, in another context, invokes "the principle of limited possibilities, first laid down by Goldenweiser. Given a definite cultural need, the means of its satisfaction are small in number, and therefore the cultural arrangement which comes into being in response to the need is determined within narrow limits."[19] This principle obviously involves at least a moderate liberalization of the conception that every cultural item is functionally indispensable. But even so, it may still be too restrictive. At any rate, sociologists such as Parsons and Merton have assumed the existence of "functional equivalents" for certain cultural items; and Merton, in his general analysis of functionalism, has insisted that the conception of the functional indispensability of cultural items be replaced explicitly by the assumption of "functional alternatives, or functional equivalents, or functional substitutes."[20] This idea, incidentally, has an interesting parallel in the "principle of multiple solutions" for adaptational problems in evolution. This principle, which has been emphasized by functionally oriented biologists, states that for a given functional problem (such as that of perception of light) there are usually a variety of possible solutions, and many of these are actually used by different—and often closely related—groups of organisms.[21]

It should be noted here that, in any case of functional analysis, the question whether there are functional equivalents to a given item i has a definite meaning only if the internal and external conditions c in (4.1) are clearly specified. Otherwise, any proposed alternative to i, say i', could be denied the status of a functional equivalent on the ground that, being different from i, the item i' would have certain effects on the internal state and the environment of s which would not be brought about by i; and that therefore, if i' rather than i were realized, s would not be functioning in the same internal and external situation. Suppose, for example, that the system of magic of a given primitive

19. B. Malinowski, "Culture," *Encyclopedia of the Social Sciences*, IV (New York: The Macmillan Company, 1931), 626.

20. Merton, *op. cit.*, p. 34. Cf. also T. Parsons, *Essays in Sociological Theory, Pure and Applied* (New York: The Free Press, 1949), 58. For an interesting attempt to establish the existence of functional alternatives in a specific case, see R. D. Schwartz, "Functional alternatives to inequality," *American Sociological Review*, 20 (1955), 424-30.

21. See G. G. Simpson, *The Meaning of Evolution* (New Haven: Yale University Press, 1949), 164 ff., 190, 342-43; and G. G. Simpson, C. S. Pittendrigh, L. H. Tiffany, *Life* (New York: Harcourt, Brace & World, Inc., 1957), 437.

group were replaced by an extension of its rational technology plus some modification of its religion, and that the group were to continue as a going concern. Would this establish the existence of a functional equivalent to the original system of magic? A negative answer might be defended on the ground that as a result of adopting the modified pattern, the group had changed so strongly in regard to some of its basic characteristics (i.e., its internal state, as characterized by c_i, had been so strongly modified) that it was not the original kind of primitive group any more; and that there simply was no functional equivalent to magic which would leave all the "essential" features of the group unimpaired. Consistent use of this type of argument would safeguard the postulate of the functional indispensability of every cultural item against any conceivable empirical disconfirmation—but at the cost of turning it from an empirical hypothesis into a covert definitional truth.

That unilluminating procedure certainly must be eschewed. But what can a functional analysis in the general manner of (4.1) establish if the possibility of functional equivalents of i is not thus ruled out by definitional fiat?[22] Let I be the class of all those items which are empirically sufficient for n under the circumstances indicated in (4.1), so that an item j will be included in I just in case its realization in system s under conditions of kind c would be empirically sufficient to ensure the satisfaction of requirement n. (The qualification 'empirically' is to indicate that the satisfaction of n by j must be a matter of empirical fact and not just of pure logic. This proviso excludes from I trivial items, such as n itself.) The class I will then be a class of functional equivalents in the sense mentioned above. Let us now replace premise (c) in (4.1) by the following statement:

(c') I is the class of all empirically sufficient conditions for the fulfillment of requirement n in the context determined by system s in setting c.

What the premises (a), (b), and (c') enable us to infer is then at best this:

(4.2) Some one of the items included in class I is present in system s at time t

But this conclusion offers no grounds for expecting the occurrence of any particular item from I rather than of one of its functional equivalents. And strictly, even the weak conclusion (4.2) is warranted only on the further premise that the class I is not empty, i.e., that there is at least one item whose occurrence would, by law, ensure satisfaction of n.

Thus, functional analysis surely does not account in the manner of a deductive argument for the presence of the particular item i that it is meant to explain. Perhaps, then, it could more adequately be construed as an inductive argument which exhibits the occurrence of i as highly probable under the circumstances

22. (Added in 1964.) The balance of this section has been revised to remedy a flaw in the original version, called to my attention by Professor John R. Gregg.

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described in the premises? Might it not be possible, for example, to add to the premises of (4.1) a further statement to the effect that the functional prerequisite *n* can be met only by *i* and by a few specifiable functional alternatives? And might not these premises make the presence of *i* highly probable? This course is hardly promising, for in most, if not all, concrete cases it would be impossible to specify with any precision the range of alternative behavior patterns, institutions, customs, or the like that would suffice to meet a given functional prerequisite or need. And even if that range could be characterized, there is no satisfactory method in sight for dividing it into some finite number of cases and assigning a probability to each of these.

Suppose, for example, that Malinowski's general view of the function of magic is correct: how are we to determine, when trying to explain the system of magic of a given group, all the different systems of magic and alternative cultural patterns which would satisfy the same functional requirements for the group as does the actually existing system of magic? And how are we to ascribe probabilities of occurrence to each of these potential functional equivalents? Clearly, there is no satisfactory way of answering these questions, and practitioners of functional analysis do not claim to achieve their explanation in this extremely problematic fashion.

Nor is it any help to construe the general laws implicit in the statements (*b*) and (*c*) in (4.1) as statistical rather than strictly universal in form, i.e., as expressing connections that are very probable, but do not hold universally; for the premises thus obtained again would not preclude functional alternatives of *i* (each of which would make satisfaction of *n* highly probable), and thus the basic difficulty would remain: the premises taken jointly could still not be said to make the presence just of *i* highly probable.

In sum then, the information typically provided by a functional analysis of an item *i* affords neither deductively nor inductively adequate grounds for expecting *i* rather than one of its alternatives. The impression that a functional analysis does provide such grounds, and thus explains the occurrence of *i*, is no doubt at least partly due to the benefit of hindsight: when we seek to explain an item *i*, we presumably know already that *i* has occurred.

As was noted a moment ago, however, functional analysis might be construed as a deductive explanation with a very weak explanandum, thus:

(4.3)
- (*a*) At time *t*, system *s* functions adequately in a setting of kind *c*
- (*b*) *s* functions adequately in a setting of kind *c* only if requirement *n* is satisfied
- (*c'*) *I* is the class of empirically sufficient conditions for *n*, in the context determined by *s* and *c*; and *I* is not empty
- (*d'*) Some one of the items included in *I* is present in *s* at *t*

This kind of inference is rather trivial, however, except when we have additional knowledge about the items contained in class *I*. Suppose for example that at time *t*, a certain dog (system *s*) is in good health in a "normal" kind of setting *c* which precludes the use of such devices as artificial hearts, lungs, and kidneys. Suppose further that in a setting of kind *c*, the dog can be in good health only if his blood circulates properly (condition *n*). Then schema (4.3) leads in effect only to the conclusion that in some way or other, the blood is being kept circulating properly in the dog at *t*—hardly a very illuminating result. If, however, we have additional knowledge of the ways in which the blood may be kept circulating under the circumstances and if we know, for example, that the only feature that would ensure proper circulation (the only item in class *I*) is a properly working heart, then we may draw the much more specific conclusion that at *t* the dog has a properly working heart. But if we make explicit the further knowledge here used by expressing it as an additional premise, then our argument can be restated in the form (4.1), except that premise (*c*) has been replaced by the statement that *i* is the *only* trait by which *n* can be satisfied in setting *c*; and, as was pointed out above, the conclusion (*d*) of (4.1) does follow in this case.

In general, however, additional knowledge of the kind here referred to is not available, and the explanatory import of functional analysis is then limited to the precarious role schematized in (4.3).

5. THE PREDICTIVE IMPORT OF FUNCTIONAL ANALYSIS

We noted earlier the predictive significance of nomological explanation; now we will ask whether functional analysis can be put to predictive use.

First of all, the preceding discussion shows that the information which is typically provided by a functional analysis yields at best premises of the forms (*a*), (*b*), (*c*) in (4.1); and these afford no adequate basis for the deductive or inductive prediction of a sentence of the form (*d*) in (4.1). Thus, functional analysis no more enables us to predict than it enables us to explain the occurrence of a particular one of the items by which a given functional requirement can be met.

Second, even the much less ambitious explanatory schema (4.3) cannot readily be put to predictive use; for the derivation of the weak conclusion (*e*) relies on the premise (*a*); and if we wish to infer (*e*) with respect to some future time *t*, that premise is not available, for we do not know whether *s* will or will not be functioning adequately at that time. For example, consider a person developing increasingly severe anxieties, and suppose that a necessary condition for his adequate functioning is that his anxiety be bound by neurotic symptoms, or be overcome by other means. Can we predict that one or another of the

modes of "adjustment" in the class I thus roughly characterized will actually come to pass? Clearly not, for we do not know whether the person in question will in fact continue to function adequately or will suffer some more or less serious breakdown, perhaps to the point of self-destruction.

It is of interest to note here that a somewhat similar limitation exists also for the predictive use of nomological explanations, even in the most advanced branches of science. For example, if we are to predict, by means of the laws of classical mechanics, the state in which a given mechanical system will be at a specified future time t, it does not suffice to know the state of the system at some earlier time t_0, say the present; we also need information about the boundary conditions during the time interval from t_0 to t, i.e., about the external influences affecting the system during that time. Similarly, the "prediction," in our first example, that the water level in the beaker will remain unchanged as the ice melts assumes that the temperature of the surrounding air will remain constant, let us say, and that there will be no disturbing influences such as an earthquake or a person upsetting the beaker. Again when we predict for an object dropped from the top of the Empire State Building that it will strike the ground about eight seconds later, we assume that during the period of its fall, the object is acted upon by no forces other than the gravitational attraction of the earth. In a full and explicit formulation then, nomological predictions such as these would have to include among their premises statements specifying the boundary conditions obtaining from t_0 up to the time t to which the prediction refers. This shows that even the laws and theories of the physical sciences do not actually enable us to predict certain aspects of the future exclusively on the basis of certain aspects of the present: the prediction also requires certain assumptions about the future. But in many cases of nomological prediction, there are good inductive grounds, available at t_0, for the assumption that during the time interval in question the system under study will be practically "closed," i.e., not subject to significant outside interference (this case is illustrated, for example, by the prediction of eclipses) or that the boundary conditions will be of a specified kind—a situation illustrated by predictions of events occurring under experimentally controlled conditions.

The predictive use of (4.3) likewise requires a premise concerning the future, namely (a); but there is often considerable uncertainty as to whether (a) will in fact prove to be true. Furthermore, if in a particular instance there should be good inductive grounds for considering (a) as true, the forecast yielded by (4.3) is still rather weak; for the argument then leads from the inductively warranted assumption that the system will be properly functioning at t to the "prediction" that a certain condition n, which is empirically necessary for such functioning, will be satisfied at t in some way or other.

The need to include assumptions about the future among the premises of predictive arguments can be avoided, in nomological predictions as well as in those based on functional analysis, if we are satisfied with predictive conclusions which are not categorical, but only conditional, or hypothetical, in character. For example, (4.3) may be replaced by the following argument, in which premise (*a*) is avoided at the price of conditionalizing the conclusion:

(5·1)
(*b*) System *s* functions adequately in a setting of kind *c* only if condition *n* is satisfied
(*c'*) *I* is the class of empirically sufficient conditions for *n* in the context determined by *s* and *c*; and *I* is not empty
(*d''*) If *s* functions adequately in a setting of kind *c* at time *t*, then some one of the items in class *I* is present in *s* at *t*

This possibility deserves mention because it seems that at least some of the claims made by advocates of functional analysis may be construed as asserting no more than that functional analysis permits such conditional predictions. This may be the intent, for example, of Malinowski's claim: "If such [a functional] analysis discloses to us that, taking an individual culture as a coherent whole, we can state a number of general determinants to which it has to conform, we shall be able to produce a number of predictive statements as guides for field-research, as yardsticks for comparative treatment, and as common measures in the process of cultural adaptation and change."[23] The statements specifying the determinants in question would presumably take the form of premises of type (*b*); and the "predictive statements" would then be hypothetical.

Many of the predictions and generalizations made in the context of functional analysis, however, do not have this conditional form. They proceed from a statement of a functional prerequisite or need to the categorical assertion of the occurrence of some trait, institution, or other item presumably sufficient to meet the requirement in question. Consider, for example, Sait's functional explanation of the emergence of the political boss: "Leadership is necessary; and *since* it does not develop readily within the constitutional framework, the boss provides it in a crude and irresponsible form from the outside."[24] Or take Merton's characterization of one function of the political machine: referring to various specific ways in which the political machine can serve the interests of business, he concludes, "These 'needs' of business, as presently constituted, are not adequately provided for by conventional and culturally approved social structures; *consequently*, the extra-legal but more-or-less efficient organization

23. Malinowski, *A Scientific Theory of Culture, and Other Essays, op. cit.*, p. 38.

24. E. M. Sait, "Machine, Political," *Encyclopedia of the Social Sciences*, IX (New York: The Macmillan Company, 1933), p. 659. (Italics supplied.)

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of the political machine comes to provide these services."[25] Each of these arguments, which are rather typical of the functionalist approach, is an inference from the existence of a certain functional prerequisite to the categorical assertion that the prerequisite will be satisfied in some way. What is the basis of the inferential claims suggested by the words, 'since' and 'consequently' in the passages just quoted? When we say that *since* the ice cube was put into warm water it melted; or that the current was turned on, and *consequently*, the ammeter in the circuit responded, these inferences can be explicated and justified by reference to certain general laws of which the particular cases at hand are simply special instances; and the logic of the inferences can be exhibited by putting them into the form of the schema (2.1). Similarly, each of the two functionalist arguments under consideration clearly seems to presuppose a general principle to the effect that, within certain limits of tolerance or adaptability, a system of the kind under analysis will—either invariably or with high probability—satisfy, by developing appropriate traits, the various functional requirements (necessary conditions for its continued adequate operation) that may arise from changes in its internal state or in its environment. Any assertion of this kind, no matter whether of strictly universal or of statistical form, will be called a (*general*) *hypothesis of self-regulation*.

Unless functional analyses of the kind just illustrated are construed as implicitly proposing or invoking suitable hypotheses of self-regulation, it remains quite unclear what connections the expressions 'since,' 'consequently,' and others of the same character are meant to indicate, and how the existence of those connections in a given case is to be objectively established.

Conversely, if a precise hypothesis of self-regulation for systems of a specified kind is set forth, then it becomes possible to explain, and to predict categorically, the satisfaction of certain functional requirements simply on the basis of information concerning antecedent needs; and the hypothesis can then be objectively tested by an empirical check of its predictions. Take, for example, the statement that if a hydra is cut into several pieces, most of these will grow into complete hydras again. This statement may be considered as a hypothesis concerning a specific kind of self-regulation in a particular kind of biological system. It can clearly be used for explanatory and predictive purposes, and indeed the success of the predictions it yields confirms it to a high degree.

We see, then, that whenever functional analysis is to serve as a basis for categorical prediction or for generalizations of the type quoted from Sait and from Merton, it is of crucial importance to establish appropriate hypotheses of self-regulation in an objectively testable form.

25. Merton, *op. cit.*, p. 76. (Italics supplied.)

The functionalist literature does contain some explicitly formulated generalizations of the kind here referred to. Merton, for example, after citing the passage from Sait quoted above, comments thus: "Put in more generalized terms, *the functional deficiencies of the official structure generate an alternative (unofficial) structure to fulfill existing needs somewhat more effectively.*"[26] This statement seems clearly intended to made explicit a hypothesis of self-regulation that might be said to underlie Sait's specific analysis and to provide the rationale for his 'since'. Another hypothesis of this kind is suggested by Radcliffe-Brown: "it may be that we should say that . . . a society that is thrown into a condition of functional disunity or inconsistency . . . will not die, except in such comparatively rare instances as an Australian tribe overwhelmed by the white man's destructive force, but will continue to struggle toward . . . some kind of social health. . . ."[27]

But, as was briefly suggested above, a formulation proposed as a hypothesis of self-regulation can serve as a basis for explanation or prediction only if it is sufficiently definite to permit objective empirical test. And indeed many of the leading representatives of functional analysis have expressed their concern to develop hypotheses and theories which meet this requirement. Malinowski, for example, in his essay significantly entitled "A Scientific Theory of Culture," insists that "each scientific theory must start from and lead to observation. It must be inductive and it must be verifiable by experience. In other words, it must refer to human experiences which can be defined, which are public, that is, accessible to any and every observer, and which are recurrent, hence fraught with inductive generalizations, that is, predictive."[28] Similarly, Murray and Kluckhohn have this to say about the basic objective of their functionally oriented theory, and indeed about any scientific "formulation," of personality: "the general purposes of formulation are three: (1) to *explain* past and present events; (2) to *predict* future events (the conditions being specified); and (3) to serve, if required, as a basis for the selection of effective measures of *control.*"[29]

Unfortunately, however, the formulations offered in the context of concrete functional analyses quite often fall short of these general standards. Among the various ways in which those conditions may be violated, two call for special consideration because of their pervasiveness and central importance in functional analysis. They will be referred to as (i) *inadequate specification of scope*, and

26. Merton, *op. cit.*, p. 73. (Author's italics.)
27. Radcliffe-Brown, *op. cit.*, p. 183.
28. Malinowski, *A Scientific Theory of Culture, and Other Essays*, *op. cit.*, p. 67.
29. Henry A. Murray and Clyde Kluckhohn, "Outline of a Conception of Personality," in Clyde Kluckhohn and Henry A. Murray, eds., *Personality in Nature, Society, and Culture* (New York: Knopf, 1950), pp. 3-32; quotation from p. 7; authors' italics.

(ii) *nonempirical use of functionalist key terms* (such as 'need,' 'functional requirement,' 'adaptation,' and others). We will consider these two defects in turn: the former in the balance of the present section, the latter in the next.

Inadequate specification of scope consists in failure to indicate clearly the kind of system to which the hypothesis refers, or the range of situations (the limits of tolerance) within which those systems are claimed to develop traits that will satisfy their functional requirements. Merton's formulation, for example, does not specify the class of social systems and of situations to which the proposed generalization is meant to apply; as it stands, therefore, it cannot be put to an empirical test or to any predictive use.

The generalization tentatively set forth by Radcliffe-Brown has a similar shortcoming. Ostensibly, it refers to any society whatever, but the conditions under which social survival is claimed to occur are qualified by a highly indefinite "except" clause, which precludes the possibility of any reasonably clear-cut test. The clause might even be used to protect the proposed generalization against any conceivable disconfirmation: If a particular social group should "die," this very fact might be held to show that the disruptive forces were as overwhelming as in the case of the Australian tribe mentioned by Radcliffe-Brown. Systematic use of this methodological strategy would, of course, turn the hypothesis into a covert tautology. This would ensure its truth, but at the price of depriving it of empirical content: thus construed, the hypothesis can yield no explanation or prediction whatever.

A similar comment is applicable to the following pronouncement by Malinowski, in which we italicize the dubious qualifying clause: "When we consider any culture *which is not on the point of breaking down or completely disrupted, but which is a normal going concern*, we find that need and response are directly related and tuned up to each other."[30]

To be sure, Radcliffe-Brown's and Malinowski's formulations do not *have to* be construed as covert tautologies, and their authors no doubt intended them as empirical assertions; but, in this case, the vagueness of the qualifying clauses still deprives them of the status of definite empirical hypotheses that might be used for explanation or prediction.

6. THE EMPIRICAL IMPORT OF FUNCTIONALIST TERMS AND HYPOTHESES

A second flaw that may vitiate the scientific role of a proposed hypotheses of self-regulation consists in using key terms of functional analysis, such as

30. Malinowski, *A Scientific Theory of Culture, and Other Essays*, *op. cit.*, p. 94.

'need' and 'adequate (proper) functioning'[31] in a nonempirical manner, i.e., without giving them a clear "operational definition," or more generally, without specifying objective criteria of application for them.[32] If functionalist terms are used in this manner, then the sentences containing them have no clear empirical meaning; they lead to no specific predictions and thus cannot be put to an objective test; nor, of course, can they be used for explanatory purposes.

A consideration of this point is all the more important here because the functionalist key terms occur not only in hypotheses of self-regulation, but also in functionalist sentences of various other kinds, such as those of the types (*a*), (*b*), and (*d''*) in (4.1), (4.3), and (5.1). Nonempirical use of functionalist terms may, therefore, bar sentences of these various kinds from the status of scientific hypotheses. We turn now to some examples.

Consider first the terms 'functional prerequisite' and 'need,' which are used as more or less synonymous in the functionalist literature, and which serve to define the term 'function' itself. "Embedded in every functional analysis is some conception, tacit or expressed, of the functional requirements of the system under observation",[33] and indeed, "a definition [of function] is provided by showing that human institutions, as well as partial activities within these, are related to primary, that is, biological, or derived, that is, cultural needs. Function means, therefore, always the satisfaction of a need. . . ."[34]

How is this concept of need defined? Malinowski gives an explicit answer: "By need, then, I understand the system of conditions in the human organism, in the cultural setting, and in the relation of both to the natural environment, which are sufficient and necessary for the survival of group and organism."[35] This definition sounds clear and straightforward; yet it is not even quite in accord with Malinowski's own use of the concept of need. For he distinguishes,

31. In accordance with a practice followed widely in contemporary logic, we will understand by terms certain kinds of words or other linguistic expressions, and we will say that a term expresses or signifies a concept. For example, we will say that the term 'need' signifies the concept of need. As this illustration shows, we refer to, or mention, a linguistic expression by using a name for it which is formed by simply enclosing the expression in single quotes.

32. A general discussion of the nature and significance of "operational" criteria of application for the terms used in empirical science, and references to further literature on the subject, may be found in C. G. Hempel, *Fundamentals of Concept Formation in Empirical Science* (University of Chicago Press, 1952), sections 5-8; and in the symposium papers on the present state of operationalism by G. Bergmann, P. W. Bridgman, A. Grunbaum, C. G. Hempel, R. B. Lindsay, H. Margenau, and R. J. Seeger, which form chapter II of Philipp G. Frank, ed., *The Validation of Scientific Theories* (Boston: The Beacon Press, 1956).

33. Merton, *op. cit.*, p. 52.

34. Malinowski, *A Scientific Theory of Culture, and other Essays*, *op. cit.*, p. 159.

35. Malinowski, *ibid.*, p. 90.

very plausibly, a considerable number of different needs, which fall into two major groups: primary biological needs and derivative cultural ones; the latter include "technological, economic, legal, and even magical, religious, or ethical"[36] needs. But if every single one of these needs did actually represent not only a necessary condition of survival but also a sufficient one, then clearly the satisfaction of just one need would suffice to ensure survival, and the other needs could not constitute necessary conditions of survival at all. It seems reasonable to assume, therefore, that what Malinowski intended was to construe the needs of a group as a set of conditions which are individually necessary and jointly sufficient for its survival.[37]

However, this correction of a minor logical flaw does not remedy a more serious defect of Malinowski's definition, which lies in the deceptive appearance of clarity of the phrase "survival of group and organism." In reference to a biological organism, the term 'survival' has a fairly clear meaning, though even here, there is need for further clarification. For when we speak of biological needs or requirements—e.g., the minimum daily requirements, for human adults, of various vitamins and minerals—we construe these, not as conditions of just the barest survival but as conditions of persistence in, or return to, a "normal," or "healthy" state, or to a state in which the system is a "properly functioning whole." For the sake of objective testability of functionalist hypotheses, it is essential, therefore, that definitions of needs or functional prerequisites be supplemented by reasonably clear and objectively applicable criteria of what is to be considered a healthy state or a normal working order of the systems under consideration; and that the vague and sweeping notion of survival then be construed in the relativized sense of survival in a healthy state as specified. Otherwise, there is definite danger that different investigators will use the concept of functional prerequisite—and hence also that of function—in different ways, and with valuational overtones corresponding to their diverse conceptions of what are the most "essential" characteristics of "genuine" survival for a system of the kind under consideration.

Functional analyses in psychology, sociology, and anthropology are even

36. Malinowski, *ibid.*, p. 172; see also *ibid.*, pp. 91 ff.

37. In some of his statements Malinowski discards, by implication, even the notion of function as satisfaction of a condition that is at least *necessary* for the survival of group or organism. For example, in the essay containing the two passages just quoted in the text, Malinowski comments as follows on the function of some complex cultural achievements: "Take the airplane, the submarine, or the steam engine. Obviously, man does not need to fly, nor yet to keep company with fishes, and move about within a medium for which he is neither anatomically adjusted nor physiologically prepared. In defining, therefore, the function of any of those contrivances, we can not predicate the true course of their appearance in any terms of metaphysical necessity." (*Ibid.*, pp. 118–19.)

more urgently in need of objective empirical criteria of the kind here referred to; for the characterization of needs as necessary conditions of psychological or emotional survival for an individual, or of survival of a group is so vague as to permit, and indeed invite, quite diverse subjective interpretations.

Some authors characterize the concept of functional prerequisite or the concept of function without making use of the term 'survival' with its misleading appearance of clarity. Merton, for example, states: "*Functions* are those observed consequences which make for the adaptation or adjustment of a given system; and *dysfunctions*, those observed consequences which lessen the adaptation or adjustment of the system."[38] And Radcliffe-Brown characterizes the function of an item as its contribution to the maintenance of a certain kind of unity of a social system, "which we may speak of as a functional unity. We may define it as a condition in which all parts of the social system work together with a sufficient degree of harmony or internal consistency, i.e., without producing persistent conflicts which can neither be resolved nor regulated."[39] But like the definitions in terms of survival, these alternative characterizations, though suggestive, are far from giving clear empirical meanings to the key terms of functional analysis. The concepts of adjustment and adaptation, for example, require specification of some standard; otherwise, they have no definite meaning and are in danger of being used tautologically or else subjectively, with valuational overtones.

Tautological use could be based on construing *any* response of a given system as an adjustment, in which case it becomes a trivial truth that any system will adjust itself to any set of circumstances. Some instances of functional analysis seem to come dangerously close to this procedure, as is illustrated by the following assertion: "Thus we are provided with an explanation of suicide and of numerous other apparently antibiological effects as so many forms of relief from intolerable suffering. Suicide does not have *adaptive* (survival) value but it does have *adjustive* value for the organism. Suicide is *functional* because it abolishes painful tension."[40]

Or consider Merton's formulation of one of the assumptions of functional analysis: ". . . when *the net balance of the aggregate of consequences* of an existing social structure is clearly dysfunctional, there develops a strong and insistent pressure for change."[41] In the absence of clear empirical criteria of adaptation and thus of dysfunction, it is possible to treat this formulation as a covert tautology and thus to render it immune to empirical disconfirmation. Merton

38. Merton, *op. cit.*, p. 51. (Author's italics.)
39. Radcliffe-Brown, *op. cit.*, p. 181.
40. Murray and Kluckhohn, *op. cit.*, p. 15 (Author's italics.)
41. Merton, *op. cit.*, p. 40.

is quite aware of such danger: in another context he remarks that the notion of functional requirements of a given system "remains one of the cloudiest and empirically most debatable concepts in functional theory. As utilized by sociologists, the concept of functional requirement tends to be tautological or *ex post facto*."[42] Similar warnings against tautological use and against *ad hoc* generalizations about functional prerequisites have been voiced by other writers, such as Malinowski[43] and Parsons.[44]

In the absence of empirical criteria of adjustment or adaptation, there is also the danger of each investigator's projecting into those concepts (and thus also into the concept of function) his own ethical standards of what would constitute a "proper" or "good" adjustment of a given system—a danger which has been pointed out very clearly by Levy.[45] This procedure would obviously deprive functionalist hypotheses of the status of precise objectively testable scientific assertions. And, as Merton notes, "If theory is to be productive, it must be sufficiently *precise* to be *determinate*. Precision is an integral element of the criterion of *testability*."[46]

It is essential, then, for functional analysis as a scientific procedure that its key concepts be explicitly construed as relative to some standard of survival or adjustment. This standard has to be specified for each functional analysis, and it will usually vary from case to case. In the functional study of a given system s, the standard would be indicated by specifying a certain class or range R of possible states of s, with the understanding that s is to be considered as "surviving in proper working order," or as "adjusting properly under changing conditions" just in case s remains in, or upon disturbance returns to, some state within the range R. A need, or functional requirement, of system s relative to R is then a necessary condition for the system's remaining in, or returning to, a state in R; and the function, relative to R, of an item i in s consists in i's effecting the satisfaction of some such functional requirement.

In the field of biology, Sommerhoff's analysis of adaptation, appropriateness, and related concepts, is an excellent illustration of a formal study in which the relativization of the central functionalist concepts is entirely explicit.[47] The

42. Merton, *op. cit.*, p. 52.

43. See, for example, Malinowski, *A Scientific Theory of Culture, and Other Essays*, *op. cit.*, pp. 169-70; but also compare this with pp. 118-19 of the same work.

44. See, for example, T. Parsons, *The Social System* (New York: The Free Press, 1951), 29, n. 4.

45. Marion J. Levy, Jr., *The Structure of Society* (Princeton: Princeton University Press, 1952), 76ff.

46. R. K. Merton, "The Bearing of Sociological Theory on Empirical Research" in Merton, *Social Theory and Social Structure*, *op. cit.*, pp. 85-101; quotation from 98. (Author's italics)

47. See G. Sommerhoff, *Analytical Biology* (New York: Oxford University Press, 1950).

need of such relativization is made clear also by Nagel, who points out that "the claim that a given change is functional or dysfunctional must be understood as being relative to a specified G (or sets of G's)"[48], where the G's are traits whose preservation serves as the defining standard of adjustment or survival. In sociology, Levy's analysis of the structure of society[49] clearly construes the functionalist key concepts as relative in the sense just outlined.

Only if the key concepts of functional analysis are thus relativized can hypotheses involving them have the status of determinate and objectively testable assumptions or assertions; only then can those hypotheses enter significantly into arguments such as those schematized in (4.1), (4.3), and (5.1).

But although such relativization may give definite empirical content to the functionalist hypotheses that serve as premises or conclusions in those arguments, it leaves the explanatory and predictive import of the latter as limited as we found it in sections 4 and 5; for our verdict on the logical force of those arguments depended solely on their formal structure and not on the meaning of their premises and conclusions.

It remains true, therefore, even for a properly relativized version of functional analysis, that its explanatory force is rather limited; in particular, it does not provide an explanation of why a particular item *i* rather than some functional equivalent of it occurs in system *s*. And the predictive significance of functional analysis is practically nil—except in those cases where suitable hypotheses of self-regulation can be established. Such a hypothesis would be to the effect that within a specified range *C* of circumstances, a given system *s* (or: any system of a certain kind *S*, of which *s* is an instance) is self-regulating relative to a specified range *R* of states; i.e., that after a disturbance which moves *s* into a state outside *R*, but which does not shift the internal and external circumstances of *s* out of the specified range *C*, the system *s* will return to a state in *R*. A system satisfying a hypothesis of this kind might be called *self-regulating with respect to R*.

Biological systems offer many illustrations of such self-regulation. For example, we mentioned earlier the regenerative ability of a hydra. Consider the case, then, where a more or less large segment of the animal is removed and the rest grows into a complete hydra again. The class *R* here consists of those states in which the hydra is complete; the characterization of range *C*

48. Nagel, "A Formalization of Functionalism," *op. cit.*, p. 269. See also the concluding paragraph of the same essay (pp. 282-83).

49. Levy speaks of eufunction and dysfunction of a unit (i.e., a system) and characterizes these concepts as relative to "the unit as defined." He points out that relativization is necessary "because it is to the definition of the unit that one must turn to determine whether or not 'adaptation or adjustment' making for the persistence or lack of persistence of the unit is taking place." (Levy, *ibid.*, pp. 77-78).

would have to include (i) a specification of the temperature and the chemical composition of the water in which a hydra will perform its regenerative feat (clearly, this will not be just one unique composition, but a class of different ones: the concentrations of various salts, for example, will each be allowed to take some value within a specified, and perhaps narrow, range; the same will hold of the temperature of the water); and (ii) a statement as to the kind and size of segment that may be removed without preventing regeneration.

It will no doubt be one of the most important tasks of functional analysis in psychology and the social sciences to ascertain to what extent such phenomena of self-regulation can be found, and can be represented by corresponding laws.

7. FUNCTIONAL ANALYSIS AND TELEOLOGY

Whatever specific laws might be discovered by research along these lines, the kind of explanation and prediction made possible by them does not differ in its logical character from that of the physical sciences.

It is true that hypotheses of self-regulation, which would be the results of successful functionalist research, appear to have a teleological character since they assert that within specified conditions systems of some particular kind will tend toward a state within the class R, which thus assumes the appearance of a final cause determining the behavior of the system.

But, first of all, it would be simply untenable to say of a system s which is self-regulating with respect to R that the future event of its return to (a state in) R is a "final cause" which determines its present behavior. For even if s is self-regulating with respect to R and if it has been shifted into a state outside R, the future event of its return to R may never come about: in the process of its return toward R, s may be exposed to further disturbances, which may fall outside the permissible range C and lead to the destruction of s. For example, in a hydra that has just had a tentacle removed, certain regenerative processes will promptly set in; but these cannot be explained teleologically by reference to a final cause consisting in the future event of the hydra being complete again. For that event may never actually come about since in the process of regeneration, and before its completion, the hydra may suffer new, and irreparably severe, damage, and may die. Thus, what accounts for the present changes of a self-regulating system s is not the "future event" of s being in R, but rather the *present disposition* of s to return to R; and it is this disposition that is expressed by the hypothesis of self-regulation governing the system s.

Whatever teleological character may be attributed to a functionalist explanation or prediction invoking (properly relativized) hypotheses of self-regulation lies merely in the circumstance that such hypotheses assert a tendency

of certain systems to maintain, or return to, a certain kind of state. But such laws attributing, as it were, a characteristic goal-directed behavior to systems of specified kinds are by no means alien to physics and chemistry. On the contrary, it is these latter fields which provide the most adequately understood instances of self-regulating systems and corresponding laws. For example, a liquid in a vessel will return to a state of equilibrium, with its surface horizontal, after a mechanical disturbance; an elastic band, after being stretched (within certain limits), will return to its original shape when it is released. Various systems controlled by negative feedback devices, such as a steam engine whose speed is regulated by a governor, or a homing torpedo, or a plane guided by an automatic pilot, show, within specifiable limits, self-regulation with respect to some particular class of states.

In all of these cases, the laws of self-regulation exhibited by the systems in question are capable of explanation by subsumption under general laws of a more obviously causal form. But this is not even essential, for the laws of self-regulation themselves are causal in the broad sense of asserting that for systems of a specified kind, any one of a class of different "initial states" (any one of the permissible states of disturbance) will lead to the same kind of final state. Indeed as our earlier formulations show, functionalist hypotheses, including those of self-regulation, can be expressed without the use of any teleological phraseology at all.[50]

There are, then, no systematic grounds for attributing to functional analysis a character *sui generis* not found in the hypotheses and theories of the natural sciences and in the explanations and predictions based on them. Yet, psychologically, the idea of function often remains closely associated with that of purpose, and some functionalist writing has no doubt encouraged this association, by using a phraseology which attributes to the self-regulatory behavior of a given system practically the character of a purposeful action. For example, Freud, speaking of the relation of neurotic symptoms to anxiety, uses strongly teleological language when he says that "the symptoms are created in order to remove or rescue the ego from the situation of danger";[51] the quotations given in section 3 provide further illustrations. Some instructive examples of sociological and anthropological writings which confound the concepts of function

50. For illuminating discussions of further issues concerning "teleological explanation," especially with respect to self-regulating systems, see R. B. Braithwaite, *Scientific Explanation* (Cambridge: Cambridge University Press, 1953), chapter X; and E. Nagel, "Teleological Explanation and Teleological Systems" in S. Ratner, ed., *Vision and Action: Essays in Honor of Horace Kallen on His Seventieth Birthday* (New Brunswick, N.J.: Rutgers University Press, 1953); reprinted in H. Feigl and M. Brodbeck, eds., *Readings in the Philosophy of Science* (New York: Appleton-Century-Crofts, Inc., 1953).

51. Freud, *op. cit.*, p. 112.

and purpose are listed by Merton, who is very explicit and emphatic in rejecting this practice.[52]

It seems likely that precisely this psychological association of the concept of function with that of purpose, though systematically unwarranted, accounts to a large extent for the appeal and the apparent plausibility of functional analysis as a mode of explanation; for it seems to enable us to "understand" self-regulatory phenomena of all kinds in terms of purposes or motives, in much the same way in which we "understand" our own purposive behavior and that of others. Now, explanation by reference to motives, objectives, or the like may be perfectly legitimate in the case of purposive behavior and its effects. An explanation of this kind would be causal in character, listing among the causal antecedents of the given action, or of its outcome, certain purposes or motives on the part of the agent, as well as his beliefs as to the best means available to him for attaining his objectives. This kind of information about purposes and beliefs might even serve as a starting point in explaining a self-regulatory feature in a human artifact. For example, in an attempt to account for the presence of the governor in a steam engine, it may be quite reasonable to refer to the purpose its inventor intended it to serve, to his beliefs concerning matters of physics, and to the technological facilities available to him. Such an account, it should be noted, might conceivably give a probabilistic explanation for the presence of the governor, but it would not explain why it functioned as a speed-regulating safety device: to explain this latter fact, we would have to refer to the construction of the machine and to the laws of physics, not to the intensions and beliefs of the designer. (An explanation by reference to motives and beliefs can be given as well for certain items which do not, in fact, function as intended; e.g., some superstitious practices, unsuccessful flying machines, ineffective economic policies, etc.). Furthermore—and is this the crucial point in our context—for most of the self-regulatory phenomena that come within the purview of functional analysis, the attribution of purposes is an illegitimate transfer of the concept of purpose from its domain of significant applicability to a much wider domain, where it is devoid of objective empirical import. In the context of purposive behavior of individuals or groups, there are various methods of testing whether the assumed motives or purposes are indeed present in a given situation; interviewing the agents in question might be one rather direct way, and there are various alternative "operational" procedures of a more indirect character. Hence, explanatory hypotheses in terms of purposes are here capable of reasonably objective test. But such empirical criteria are lacking in other cases of self-regulating systems, and the attribution of purposes

52. Merton, "Manifest and Latent Functions," *op. cit.*, pp. 23-25, 60ff.

to them has therefore no scientific meaning. Yet, it tends to encourage the illusion that a profound understanding is achieved, that we gain insight into the nature of these processes by likening them to a type of behavior with which we are thoroughly familiar from daily experience. Consider, for example, the law of "adaptation to an obvious end" set forth by the sociologist L. Gumplowicz with the claim that it holds both in the natural and the social domains. For the latter, it asserts that "every social growth, every social entity, serves a definite end, however much its worth and morality may be questioned. For the universal law of adaptation signifies simply that no expenditure of effort, no change of condition, is purposeless on any domain of phenomena. Hence, the inherent reasonableness of all social facts and conditions must be conceded."[53] There is a strong suggestion here that the alleged law enables us to understand social dynamics in close analogy to purposive behavior aimed at the achievement of some end. Yet that law is completely devoid of empirical meaning since no empirical interpretation has been given to such key terms as 'end,' 'purposeless', and 'inherent reasonableness' for the contexts to which it is applied. The "law" asserts nothing whatever, therefore, and cannot possibly explain any social (or other) phenomena.

Gumplowicz's book antedates the writings of Malinowski and other leading functionalists by several decades, and certainly these more recent writers have been more cautious and sophisticated in stating their ideas. Yet, there are certain quite central assertions in the newer functionalist literature which are definitely reminiscent of Gumplowicz's formulation in that they suggest an understanding of functional phenomena in the image of deliberate purposive behavior or of systems working in accordance with a preconceived design. The following statements might illustrate this point: "[Culture] is a system of objects, activities, and attitudes in which every part exists as a means to an end,"[54] and "The functional view of culture insists therefore upon the principle that in every type of civilization, every custom, material object, idea and belief fulfills some vital function, has some task to accomplish, represents an indispensable part within a working whole."[55] These statements express what Merton, in a critical discussion, calls the postulate of universal functionalism.[56] Merton qualifies this postulate as premature;[57] the discussion presented in the previous section shows that, in the absence of a clear empirical interpre-

53. L. Gumplowicz, *The Outlines of Sociology;* translated by F. W. Moore (Philadelphia: American Academy of Policical and Social Science, 1899), pp. 79-80.

54. Malinowski, *A Scientific Theory of Culture, and Other Essays, op. cit.*, p. 150.

55. Malinowski, "Anthrolopogy," *op. cit.*, p. 133.

56. Merton, "Manifest and Latent Functions," *op. cit.*, pp. 30ff.

57. *Ibid.*, p. 31.

tation of the functionalist key terms, it is even less than that, namely, empirically vacuous. Yet formulations of this kind may evoke a sense of insight and understanding by likening sociocultural developments to purposive behavior and in this sense reducing them to phenomena with which we feel thoroughly familiar. But scientific explanation and understanding are not simply a reduction to the familiar: otherwise, science would not seek to explain familiar phenomena at all; besides, the most significant advances in our scientific understanding of the world are often achieved by means of new theories which, like quantum theory, assume some quite unfamiliar kinds of objects or processes which cannot be directly observed, and which sometimes are endowed with strange and even seemingly paradoxical characteristics. A class of phenomena has been scientifically understood to the extent that they can be fitted into a testable, and adequately confirmed, theory or a system of laws; and the merits of functional analysis will eventually have to be judged by its ability to lead to this kind of understanding.

8. THE HEURISTIC ROLE OF FUNCTIONAL ANALYSIS

The preceding considerations suggest that what is often called "functionalism" is best viewed, not as a body of doctrine or theory advancing tremendously general principles such as the principle of universal functionalism, but rather as a program for research guided by certain heuristic maxims or "working hypotheses." The idea of universal functionalism, for example, which becomes untenable when formulated as a sweeping empirical law or theoretical principle, might more profitably be construed as expressing a directive for inquiry, namely to search for specific self-regulatory aspects of social and other systems and to examine the ways in which various traits of a system might contribute to its particular mode of self-regulation (A similar construal as heuristic maxims for empirical research might be put upon the "general axioms of functionalism" suggested by Malinowski, and considered by him as demonstrated by all the pertinent empirical evidence.[58])

In biology, for example, the contribution of the functionalist approach does not consist in the sweeping assertion that all traits of any organism satisfy some need and thus serve some function; in this generality, the claim is apt to be either meaningless or covertly tautologous or empirically false (depending on whether the concept of need is given no clear empirical interpretation at all, or is handled in a tautologizing fashion, or is given a specific empirical interpretation). Instead, functional studies in biology have been aimed at showing, for example, how in different species, specific homeostatic and regenerative processes contribute to the maintenance and development of the

58. Malinowski, *A Scientific Theory of Culture, and Other Essays*, *op. cit.*, p. 150.

living organism; and they have gone on (i) to examine more and more precisely the nature and limits of those processes (this amounts basically to establishing various specific empirical hypotheses or laws of self-regulation), and (ii) to explore the underlying physiological or physicochemical mechanisms, and the laws governing them, in an effort to achieve a more thorough theoretical understanding of the phenomena at hand.[59] Similar trends exist in the study of functional aspects of psychological processes, including, for example, symptom formation in neurosis.[60]

Functional analysis in psychology and in the social sciences no less than in biology may thus be conceived, at least ideally, as a program of inquiry aimed at determining the respects and the degrees in which various systems are self-regulating in the sense here indicated. This conception is clearly reflected in Nagel's essay, "A Formalization of Functionalism,"[61] which develops an analytic scheme inspired by, and similar to, Sommerhoff's formal analysis of self-regulation in biology[62] and uses it to exhibit and clarify the structure of functional analysis, especially in sociology and anthropology.

The functionalist mode of approach has proved illuminating, suggestive, and fruitful in many contexts. If the advantages it has to offer are to be reaped in full, it seems desirable and indeed necessary to pursue the investigation of specific functional relationships to the point where they can be expressed in terms of reasonably precise and objectively testable hypotheses. At least initially, these hypotheses will likely be of quite limited scope. But this would simply parallel the present situation in biology, where the kinds of self-regulation, and the uniformities they exhibit, vary from species to species. Eventually, such "empirical generalizations" of limited scope might provide a basis for a more general theory of self-regulating systems. To what extent these objectives can be reached cannot be decided in *a priori* fashion by logical analysis or philosophical reflection: the answer has to be found by intensive and rigorous scientific research.

59. An account of this kind of approach to homeostatic processes in the human body will be found in Walter B. Cannon, *The Wisdom of the Body* (New York: W. W. Norton & Company, Inc.; revised edition 1939).

60. See, for example, J. Dollard and N. E. Miller, *Personality and Psychotherapy* (New York: McGraw-Hill Book Company, Inc., 1950), chapter XI, "How Symptoms are Learned," and note particularly pp. 165-66.

61. Nagel, "A Formalization of Functionalism," *op. cit.* See also the more general discussion of functional analysis included in Nagel's paper, "Concept and Theory Formation in the Social Sciences," in *Science, Language, and Human Rights;* American Philosophical Association, Eastern Division, Volume 1 (Philadelphia: University of Pennsylvania Press, 1952), pp. 43-64. Reprinted in J. L. Jarrett and S. M. McMurrin, eds., *Contemporary Philosophy* (New York: Henry Holt & Co., Inc., 1954).

62. Sommerhoff, *op. cit.*