# THE PRESENT STATUS OF THE MECHANISM-VITALISM CONTROVERSY

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by
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## Purpose of the Study

The purpose of the study was twofold: firstly, to investigate the adequacy of the mechanistic-vitalistic grouping and where the classification was found inadequate propose modifications; and secondly, to present a possible solution to the controversy as to the nature of a living thing.

## Findings of the Study

The mechanistic-vitalistic grouping was found inadequate. Consequently, the following classification was proposed:

(1) Materialism: Both life and non-life are material or physical.

(2) Dualism: The living thing consists of two coexistent factors--a physical and a psychical--while the non-living thing consists only of one factor, a physical.

(3) Emergentism: Because life has emerged from matter, it contains a new organization or relatedness of matter that is not found in a non-living thing.

(4) Pan-psychism: Both non-life and life are psychical as well as physical.

Moreover, two methodological approaches are inherent in the four theories. Inherent in materialism is physicalism which method relies upon the physical concepts alone. The methodological approach inherent in dualism, emergentism and pan-psychism is

physico-teleologism which relies also upon the concept of purpose.

If physicalism and physico-teleologism are taken as metaphysical assertions, there is no known means of deciding upon one or the other. Kant, however, proposed a possible solution to this controversy when he set aside metaphysical assertions and considered instead how we, due to the particular constitution of our own understanding, must deal with living things. We must utilize the concept of purpose as a "regulative" concept. We cannot say that purpose actually exists in a living thing, but it does show us how to seek to determine the constitution and connections of the phenomena within a living thing. Life must be approached holistically.

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# INTRODUCTION

According to the ordinary man, the question whether living things are different from non-living things can immediately be answered in the affirmative. For, after all, do not living things have certain distinctive features? And the ordinary man, to substantiate his affirmation, will proceed to enumerate the unique characteristics of life.

Firstly, a living thing moves about. Life may move about as rapidly as a bird on the wing or as slowly as a plant reaching for light. Furthermore, this movement appears different from the movement of dust particles in a shaft of sunlight observed by the idle dreamer or the movement of sand particles of the beach observed by the drowsy sunbather. Movement of a living thing seems to be a response to an inner impulse, while movement of a non-living thing appears to be a response to an external driving-force, such as wind or waves. The biologist has supplied a technical term, "irritability", to designate this vital characteristic of movement.

Secondly, a living thing feeds; and because it feeds, it grows. The living thing takes up matter from without into itself and changes this matter. From these changes, it derives energy for movement and growth. This feeding and growth also is different from the feeding and growth of a

non-living thing. Crystals "grow" into a marvelously intricate pattern, but only by additions--by the fitting-in of particles--without any changes in the matter accruing. The biologist again has provided a technical term, "metabolism", to specify this vital behavior which consists in taking in, assimilating and using matter.

Finally, a living thing produces other living things. Life seems to have an innate disposition or impulse to reproduce itself even under adverse conditions. Moreover, reproduction appears to be according to a plan. Each of the various parts of the new living thing is capable of a special function. It is true that drops of water and oil break up and "grow". But they do so only under suitable conditions and their reproduction seems to lack impulsiveness and orderliness. This final characteristic is called by the biologist, as well as the ordinary man, "reproduction".

Yet the biologist at work in the laboratory has become increasingly aware of similarities between living and non-living things. The same elements appear to make up life as well as non-life. Prior to 1828, there was doubt as to this similarity. There seemed to be a gap between organic and inorganic substances. However, in that year Woehler succeeded in producing synthetically the organic substance, urea, out of inorganic materials and the gap was bridged. Organic substances, after all, were not a breed apart. The

distinction was relative and consequently, the laws of chemistry held in the realm of living things as well as in the realm of non-living things.

Today, no one doubts that physico-chemical laws apply to living things. However, the question still remains as to their adequacy in the explanation of all biological phenomena. Can such distinctive vital phenomena as irritability, metabolism, and reproduction--of which even the ordinary man is cognizant--be explained by means of physical concepts alone? Controversy results as to how this question should be answered. It is the purpose of this study to set forth some of the answers given to this question by outstanding biologists and philosophers; that is, to set forth their theories as to the nature of a living thing with their concomitant methods or rules of procedure for the explanation of biological phenomena.

Only so many answers can be given to any one question. Therefore, the theories can be grouped on the basis of similarity and a general theory can be abstracted for each group. Traditionally, the theories have been classified as vitalistic or mechanistic. There are those theorists, who in the spirit of Woehler, have attempted to reduce the differences noted by the ordinary man to misleading appearances. Living things are material just as non-living things and the categories of physics and chemistry are applicable to them. These theorists are usually designated "mechanists". On the

other hand, there are those theorists who, in the spirit of the ordinary man, admit the differences. Living things contain a vital force while non-living things do not; and consequently, the categories of physics and chemistry are inadequate. We must also call upon the concept of purpose. These theorists are usually called "vitalists". It is the aim of this study to investigate the adequacy of the mechanistic-vitalistic grouping and where the classification is found inadequate propose modifications.

Finally, it is the purpose of this study to present a possible solution to the controversy.

# CHAPTER I

## MATERIALISTIC THEORIES

### Origins of the Materialistic Theories

The origins of the materialistic theories of the nature of life can be traced to the speculations of Leucippus and Democritus, Greek philosophers of the fifth century B.C. They postulated that, although the universe may appear to contain more than the physical or material, atoms and empty space are all that really exist. Everything else is the result of the human way of looking at things.

> By convention sweet is sweet, by convention bitter is bitter, by convention hot is hot, by convention cold is cold, by convention color is color. But in reality there are only atoms and the void. That is, the objects of sense are supposed to be real and it is customary to regard them as such, but in truth they are not. Only the atoms and the void are real.[1]

As a result of the assumption that there is material continuity in nature or the universe, a materialistic theory of the nature of life was born. All nature is made up of a single kind of material entity. Since living things are

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[1]Charles M. Bakewell, Source Book in Ancient Philosophy (New York: Charles Scribner's Sons, 1907), p. 60.

a part of nature, they are also physical or material.

Epicurus, in the late fourth and early third century B.C., returned to the principles of Democritus. The Roman poet Lucretius, the disciple of Epicurus, restated the principle of the material nature of the universe:

> ...the nature of the mind and soul is bodily; for when it is seen to push the limbs, rouse the body from sleep, and alter the countenance and guide and turn about the whole man, and when we see that none of these effects can take place without touch nor touch without body, must we not admit that the mind and the soul are of a bodily nature? Again you perceive that our mind in our body suffers together with the body and feels in unison with it. When a weapon with a shudder-causing force has been driven in and has laid bare bones and sinews within the body, if it does not take life, yet there ensues a faintness and a lazy sinking to the ground and on the ground the turmoil of mind which arises, and sometimes a kind of undecided inclination to get up. Therefore the nature of the mind must be bodily, since it suffers from bodily weapons and blows.[1]

Thomas Hobbes, an English philosopher of the seventeenth century, furnishes us with a vigorous statement of the material nature of the universe:

> The world, (I mean not the earth only...but the universe, that is, the whole mass of all things that are), is corporeal, that is to say, body; and hath the dimensions of magnitude, namely, length, breadth, and depth: also every part of the universe, is body, and that which is not body, is no part of the universe: and because the universe is all, that which is no part of it is nothing; and consequently no where.[2]

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[1]Lucretius, T. Lucreti Cari "De Rerum Natura," trans. H. A. J. Munro (London: George Bell and Sons, 1910), Book III, p. 61.

[2]Thomas Hobbes, The English Works of Thomas Hobbes, collected and edited by Sir William Molesworth, Bart. (London: John Bohn, Henrietta Street, Covent Garden, 1839), Vol. III, Leviathan, Chap. 46, p. 672.

Furthermore, Hobbes maintains that all that occurs is motion, for "nature worketh by motion".[1] Hence the materialistic theory of the nature of life was extended. Not only is there material continuity in nature, but there is only one kind of change in the material entities, that is, change in position or motion. Not only is life material, but all changes within a living thing are changes in position.

As a result of the consideration of how motion occurred, the materialistic theory of the nature of life was still further extended. Change of position or motion is determined; that is, by means of laws the future can be predicted from the present. Given certain conditions in the present--given a cause--definite conditions in the future will follow; that is, a certain effect will follow. Final causes or purposes are not necessary to explain change in entities, since the cause of a phenomenon is found in its immediately preceding physical conditions. The French astronomer of the late eighteenth and early nineteenth centuries, De Laplace, states this deterministic thesis as follows:

> We ought to regard the present state of the universe as the effect of its antecedent state and as the cause of the state that is to follow. An intelligence, who for a given instant should be acquainted with all the forces by which Nature is animated and with the several positions of the beings composing it, if further his intellect were vast enough to submit these data to analysis, would include in one and the same formula the movements of the

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[1] Ibid., p. 669.

> largest bodies in the universe and those of the lightest atom. Nothing would be uncertain for him; the future as the past would be present to his eyes.[1]

Changes in living things would also be determined. Knowledge of the antecedent state of a living thing would be the only prerequisite for the prediction of its consequent state.

The formulation of the laws necessary for prediction was the result of the genius of Newton. Newton knew of many isolated laws, such as Kepler's laws of planetary motion. He saw, however, that if we suppose that every piece of matter in the universe attracts every other piece of matter we can show that all the diverse phenomena of motion are necessary consequences of this attraction. The strength of the attraction depends on the masses of the bodies involved and their distances apart. Newton gave the precise formula according to which the attraction varies. From his formula he deduced Kepler's laws of planetary motion. He showed that all phenomena of motion followed from this one general principle.

The concepts of Newton came to be regarded as ultimate and exhaustive. It was believed that every phenomenon would prove to be explicable in terms of matter, motion, and the laws governing such motion. Life, too, would be explicable in terms of the Newtonian concepts. This method for dealing with biological phenomena came to be known as "mechanism".

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[1]M. Le Marquis de Laplace, Théorie Analytique Des Probabilités (Paris: Mme Ve Courcier, Imprimeur Libraire pour les Mathématiques, rue du Jardinet, n° 12, 1820), p. ii. The quotation was translated by me.

Thus it was that a biological method emerged from a materialistic view of reality. If only matter[1] is real or operative, then the physical concepts alone are necessary in dealing with a living thing.

## Thomas Huxley's "Mechanism"

Thomas Huxley (1825-1895), an English biologist, was a foremost advocate of Darwin's theory of evolution. He was also famous for his extensive biological writings which included Origin of the Vertebrate Skull, Essays on Evolution and Ethics and texts on physiology and biology. That he was a mechanist can be seen from the following quotation: "We know that the phaenomena of vitality are not something apart from other physical phaenomena, but one with them, and matter and force are the two names of the one artist who fashions the living as well as the lifeless. Hence living bodies should obey the same great laws as other matter..."[2]

Huxley arrived at this materialistic view because he could see no reason for postulating the presence of a vital force in the living thing which guides matter into its living form. We do not hesitate to believe that the properties of water result from the properties of the component elements

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[1]"Matter" is defined as "the object of physical science".

[2]Thomas H. Huxley, "The Origin of Species," Essays (New York: The Macmillan Company, 1929), p. 87.

of water. We do not assume that "'aquosity' entered into and took possession of the oxidated hydrogen as soon as it was formed, and then guided the aqueous particles to their places in the facets of the crystal..."[1] The properties of water result from the nature and disposition of its molecules. Is living matter any different? Huxley thought not. "...I can find no intelligible ground for refusing to say that the properties of protoplasm result from the nature and disposition of its molecules."[2]

Since he asserted that a living thing is of the same nature as a non-living thing, Huxley vigorously applied the method of mechanism to the explanation of biological phenomena. The vigor of application can be noted in his attempt to explain heredity and mental phenomena.

Heredity can be viewed in terms of physical forces. The characteristics of the male and of the female, which are transmitted by means of the spermatozoon and ovum to the offspring, were conceived as vectors or physical forces. When the spermatozoon and the ovum unite to produce the offspring, summation of the vectors occurs. Consequently, the characteristics of the offspring are the resultant of the "male vector" and the "female vector" and reflect a similar tendency. Observations of various children and their parents led Huxley to conclude that his interpretation was correct.

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[1]Thomas H. Huxley, "On the Physical Basis of Life," Essays (New York: The Macmillan Company, 1929), p. 150.

[2]Ibid., p. 151.

The characteristics of the offspring deviated only slightly from the characteristics of either the male or the female just as a resultant deviates only slightly from either of the forces.[1]

The manifestation of intellect, feeling and will, that is, mental phenomena, are merely changes in position of the parts of the living body. Huxley contended that this is borne out by the fact that everyone but the subject of such manifestations knows them as "transitory changes in the relative positions of parts of the body."[2] Thus it was that Thomas Huxley placed his hope in the mechanistic method as the only method needed to eventually make explicit all the phenomena of life.

## Jacques Loeb's "Physico-chemicalism"

Jacques Loeb (1859-1924), a German biophysiologist, is noted for his theory of tropism which he postulated to account for instincts. He also did pioneer work on artificial parthenogenesis and conducted researches in comparative physiology and psychology. As a result of his consideration of the life processes which had already yielded to physico-chemical analysis and of those which had not done so, he held

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[1]Huxley, "The Origin of the Species," op. cit., p. 8.

[2]Huxley, "On the Physical Basis of Life," op. cit., p. 134.

a materialistic theory of the nature of life and embraced the mechanistic method.

What, then, were the biological processes which had yielded to the mechanistic method? Loeb cited the phenomenon of fertilization which could be reduced to physico-chemical analysis. Certain physico-chemical agencies can completely imitate the developmental effect of a spermatozoon; that is, a compound like butyric acid can destroy the superficial cortical layer in a sea-urchin egg and induce membrane formation and consequent development just as a spermatozoon does.[1] Furthermore, he cited various facts of heredity which could be reduced to physico-chemical terms. For example, for the formation of a certain black pigment the cooperation of tryosin and tyrosinase is required. The hereditary transmission of the black color must occur by chromosomal substances which determine the formation of tyrosin and tyrosinase.[2] "We may, therefore, say that the solution of the riddle of heredity has succeeded to the extent that all further development will take place purely in...physico-chemical terms."[3] Finally, Loeb considered the facts of the beginning and end of life and concluded that they are physico-chemically clear. In the case of the sea-urchin, life begins with an acceleration of oxidation after the destruction of

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[1]Jacques Loeb, The Mechanistic Conception of Life (Chicago: University of Chicago Press, 1912), p. 8.

[2]Ibid., p. 23. [3]Loc. cit.

the cortical layer.[1] "It is therefore, unwarranted to continue the statement...that the beginning of life is determined by the entrance of a metaphysical 'life principle' into the egg."[2] Life of man and other life ends with the cessation of oxidation in the body. "It is therefore, unwarranted to continue that statement...that death is determined by the departure of this 'principle' [metaphysical principle] from the body."[3]

What of the life processes that had not yielded to physico-chemical analysis? Particularly our inner life--our hopes, efforts, struggles, etc.--seem to defy mechanistic treatment. Loeb, however, felt that this inner life would eventually be explicable in physico-chemical terms because we can explain cases of simple manifestations of animal instinct and "will" on a physico-chemical basis. Consider the tendency of certain animals to fly or creep to the light. This animal tropism can be explained in physico-chemical terms. These animals which are positively heliotropic--that is, the animals which go instinctively to the source of light--have in their eyes, and occasionally also in their skin, photosensitive substances which undergo chemical changes due to light. The substances formed thus affect the central nervous system which in turn influences the contraction of muscles.

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[1] Ibid., p. 14. [2] Ibid., pp. 14-5.

[3] Loc. cit.

If the animal is illuminated on one side only, he will turn toward the light due to greater muscular contraction on the side illuminated. As soon as he turns, both sides become equally illuminated and equal contraction occurs with consequent motion in a straight line toward the source of light. Thus "we may safely state that the apparent will or instinct of these animals resolves itself into a modification of the action of muscles through the influence of light; and for the metaphysical term 'will' we may in these instances safely substitute the chemical term 'photochemical action of light'."[1]

> Our wishes and hopes, disappointments and sufferings have their source in instincts which are comparable to the light instinct of the heliotropic animals. The need of and the struggle for food, the sexual instinct with its poetry and its chain of consequences, the maternal instincts with the felicity and the suffering caused by them, the instinct of workmanship, and some other instincts are the roots from which our inner life develops. For some of these instincts the chemical basis is at least sufficiently indicated to arouse the hope that their analysis, from the mechanistic point of view, is only a question of time.[2]

Well aware that the harmonious character or unity of life was advanced as a refutation of a materialistic theory of life, Loeb discussed this issue:

> If the structure and the mechanism of the atoms were known to us we should probably also get an insight into a world of wonderful harmonies and apparent adaptations of the parts to the whole. But in this case we should quickly understand that the chemical elements are only the few durable systems among a large number of possible but not durable combinations. Nobody doubts that the durable chemical elements are only the product of blind forces. There is no reason for conceiving otherwise the durable systems in living nature.[3]

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[1] Ibid., p. 30.

[2] Loc. cit.

[3] Ibid., p. 26.

As the quotation indicates, Loeb held that unity is present in non-living as well as living systems. Moreover, purpose need not be introduced to explain this unity. Unity is the result of blind forces. Consequently, the physical laws are adequate to explain such unity. However, Loeb did not attempt to show how physical laws could explain such unity.

## Charles Child's "Dynamicism"

Charles Child (1869- ), Professor Emeritus in biology at the University of Chicago, is outstanding in the field of physiological research. As a result of such research, he maintains that the fundamental problem of the nature of life is the problem of the nature of the unity which characterizes all living things. He agrees with Loeb that unity is explicable in physico-chemical terms. However, he asserts that explanations of life in terms of chemical reactions, such as Loeb's in which chemical reactions were isolated and then compounded into the whole, cannot explain unity unless something to order the chemical reactions into the unity we call life is introduced. But such an introduction, according to Child, would have teleological implications and thus would place the problem beyond the bounds of science. Instead we must turn to a different kind of physical explanation of life. We must formulate a "dynamic conception"[1] of life. This

[1]Charles Manning Child, Individuality in Organisms (Chicago: University of Chicago Press, Chicago, Illinois, 1915), p. 29.

approach conceives of life in terms of its activity or in terms of all the physico-chemical changes occurring within the living thing. Such an explanation would not have teleological implications because the physico-chemical activity of the living thing would itself be the agent producing the unity which is characteristic of that living thing.

How can the activity of the living thing produce its own unity? We must begin by considering a protoplasmic mass as yet undifferentiated and consequently lacking unity. A stimulus causes a transmission of energy or a spreading of change in the protoplasmic mass. Since the change spreads, there arises a decrement in the change in the course of transmission of the energy. In other words, a metabolic gradient will be produced in the protoplasmic mass. Differentiation will occur since differences in the metabolic rate along the gradient will bring out differences in the character of the protoplasmic mass, and these differences will in turn modify the character of the reactions. One part of the protoplasmic mass, having a higher metabolic rate due to the existence of the metabolic gradient and differing consequently in structure and reaction, will dominate the other parts of the protoplasmic mass. The dominant part will determine and maintain the gradient. In this way, unity emerges from the activity of the living thing. In the words of Child:

> ...the organic individual, as a living entity possessing some degree of physiological--not merely physical--unity and order, consists in its simplest forms of one or more

> gradients in part of a cell, a cell, or a cell mass of specific physico-chemical constitution. The process of individuation is the process of establishment of the gradient or gradients as a more or less persistent condition, and the degree of individuation depends upon the permanency of the gradient...[1]

If then a living thing consists of one or more gradients, is there any experimental and observational evidence for the existence of such gradients? Child examined some fifty species of animals from various groups,[2] either in the adult or embryonic stages or in both, and found that gradients in metabolic conditions are characteristic features.

If Stentor coeruleus, a common ciliate, is immersed in a cyanide solution, certain regions die sooner than other regions. A definite gradient along the apico-basal axis is evident. Death begins at the apical end and is accompanied by the loss of ciliary movement and disintegration. The other portions of the protozoan remain intact and the cilia continue to vibrate. From the apical region, death and disintegration proceed along the apico-basal axis. The progress of death

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[1] Ibid., pp. 40-1.

[2] "The forms examined include twelve species of ciliate infusoria among the protozoa, the post-embryonic or adult stages of the fresh-water hydra, and three species of hydroids among coelentrates; one ctenophore, eleven species of turbellaria, and certain larval stages of one trematode among the flatworms. Dr. L. H. Hyman, working under my direction, has examined in the same way nine species of oligochete annelids and one polychete. Susceptibility studies have been made upon the eggs and embryonic or larval stages of the following forms: starfish, sea-urchin, the polychete annelids Nereis, Chaetopterus, Arenicola, Hydroides among the invertebrates, and two species of fishes and the salamander and frog among the vertebrates." Ibid., p. 53.

ends at the basal end of the body.[1]

The embryo of a frog, when immersed in a toxic solution, disintegrates first at the anterior end. Disintegration proceeds toward the posterior end. At any level of the body, it begins in the median dorsal region and proceeds laterally and ventrally. In other words, gradients are found along three axes: the longitudinal or apico-basal, the transverse, and the dorso-ventral.[2]

In the early stages of the development of a starfish, Child made an axial metabolic gradient visible by staining. The stain consisted of a colored precipitate formed within the cells as a result of oxidation of substances added to the water containing the starfish. In those cells of the starfish in which the rate of oxidation was highest, the precipitate formed most rapidly and the color was most intense. Thus, the intensity of color indicated the degree of metabolic activity. From his observation of the presence of a color gradient along the apico-basal axis he concluded that there was a metabolic gradient along that axis.[3]

According to Child's theory, the "organic individual is fundamentally a dynamic relation of dominance and subordination, associated with and resulting from the establishment of a metabolic gradient or gradients."[4] To find evidence for

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[1] Ibid., p. 56.
[2] Ibid., p. 57.
[3] Ibid., p. 65.
[4] Ibid., p. 88.

the existence of dominance as a result of a gradient, Child studied Planaria dorotocephala. Planaria is a bilateral symmetrical flatworm with a distinct head and "brain" and two ventral nerve cords, and with definite alimentary and excretory organs. It reproduces by fission. When the animal reaches a certain size, the posterior portion of the animal separates from the anterior portion. The posterior portion becomes a new animal, while the anterior portion grows a new posterior region and fission is sooner or later again repeated. There is no morphological indication of the second individual which is to appear through fission, but there is physiological evidence because a metabolic gradient is present. The apical region of the gradient is the head of the animal and from this head region the metabolic rate decreases to the level where separation will occur. Here a sudden rise in metabolic rate is discernible. This rise is followed by a downward gradient. The level at which there is a sudden rise will become the head region or dominant region when fission occurs. Hence, claimed Child, we can see that the metabolic gradient determines dominance and that dominance does exist.[1]

Child went a step further in indicating the existence of dominance. He demonstrated the variable range of dominance by controlling fission experimentally. If a planarian is stimulated strongly, fission will not occur. Evidently, when

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[1]Ibid., p. 93.

the animal is only slightly active, the posterior region is physiologically isolated and can break away from the anterior region. But when the animal is strongly active, the posterior region comes under the dominance of the anterior region and is subordinate to it. The greater the activity, the greater will be the range of dominance.[1] Activity produces the gradient and the gradient determines the dominance.

This is some of the evidence that Child advances to substantiate his gradient theory of life. The unity, which is life, is explicable in terms of physical concepts if we conceive of life as activity producing its own unity through gradients with their consequent dominance and subordination or ordering of parts.

## George Lakhovsky's "Electricalism"

Due to changes in physico-chemical concepts, theories of the nature of life that utilized such concepts changed accordingly. George Lakhovsky set forth a theory that exemplifies such a change. Life is explained in electrical terms. His theory was the result of his investigations in the field of biophysics. Lakhovsky (1870-1942) is credited as the first scientist to make use of high-frequency electromagnetic waves in the domain of biology. It was largely through the influence of his work that the new science of

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[1] Ibid., p. 95.

Radiobiology emerged.

How did Lakhovsky explain life? "The living cell is an actual oscillator and an electric resonator."[1] The nucleus of the living cell may be compared to an electrical oscillating circuit. It consists of chromosomes and mitochondria which are tubular filaments made up of "organic material or mineral conductors, covered by a membrane of insulating material."[2] The filaments are capable of oscillating according to a specific frequency, inasmuch as they are constructed like conducting filaments and thereby endowed with capacity and self-inductance. In multicellular living things, there would be present many of these cellular circuits. The unity of these cellular circuits would be due to an equilibrium established between the radiations of each oscillator.

Lakhovsky attempted to make this theory of life plausible by describing the possible origin of the cellular circuit. Atoms and molecules were grouped under the influence of chemical activity or electrostatic forces. Each group was contained in a globule of water. These groups or agglomerates on a negatively charged earth became oriented along lines of force from a positively charged astral body. Gravitational force provided the agglomerates with a sheathing of insulating molecules. As the earth rotated through a

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[1]George Lakhovsky, The Secret of Life, trans. Mark Clement (London: William Heinemann Medical Books Ltd., 1939), p. 76.

[2]Ibid., pp. 70-71.

24-hour period, the angle at which the astral lines of force hit the earth changed. Consequently, the orientation of these newly aggregating particles deviated from their original orientation. The result was the formation of a curved conducting filament. This curved conducting filament finally became a closed circuit provided with an insulating sheath. The sheath at the ends of the filament acted as a condenser. Then this circuit, endowed by its construction with capacity and self-inductance, began to vibrate under the influence of electromagnetic radiations and penetrating rays. Thus it was that the cellular circuit was formed. The further aggregation of molecules added the other parts of the cell, and these other parts were guided in activity by the cellular circuit.

Also Lakhovsky endeavored to substantiate this theory by an appeal to the facts of radiation therapy.[1] Certain bacteria would cause oscillatory disequilibrium in the human for these bacteria vibrate at a different frequency than the human. In other words, the cells of the human would be forced to vibrate at an abnormal frequency. Disease could be conceived as anomalous vibration. In order to restore health, the living thing must be treated by radiation of appropriate frequency which would reinstate the original equilibrium. Indeed, he even pioneered in the successful treatment of var-

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[1] Ibid., p. 79.

ious organic diseases, including cancer, by means of an oscillator of multiple wavelengths in the field of which every cell, every organ, and every tissue could find its own frequency and thus be restored to normal oscillation.[1]

Besides his pioneer work in radiation therapy, Lakhovsky performed other experiments to validate his theory. Aware of the fact that the frequency of oscillation of any circuit is modified by contact with a metallic substance, he postulated that a bacterium would die when exposed to a metal because the oscillation of the nucleus would be modified due to contact with the metal. He believed his postulation to be verified when cultures of Bacillus coli and Bacillus typhosus were sterilized upon contact with silver and platonix circuits.[2]

He gathered further evidence in favor of his hypothesis that living cells were oscillators by placing a mixture of B. coli and B. typhosus in an electrical field. In other words, the bacteria were introduced into a liquid of slight electrical conductivity which contained two electrodes connected respectively with the positive and negative poles of an electric battery. It was observed that the typhoid bacilli were attracted to one pole and the coli bacilli were attracted to the other pole. This phenomenon he interpreted as supporting his cellular circuit theory inasmuch as the

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[1] Ibid., p. 177.

[2] Ibid., pp. 99-100.

bacteria clearly exhibit electrical properties.[1]

Thus it was that Lakhovsky answered the question, What is life?, in the following words:

> It is the dynamic equilibrium of all cells, the harmony of multiple radiations which react upon one another.[2]

## F. S. Northrop's "Electro-dynamicism"

Other changes occurred in physical theories of the nature of life as further changes occurred in physical concepts. Field physics allowed a new approach to the organization which is characteristic of a living thing. F. S. Northrop (1893- ), American philosopher and professor at Yale who is noted for his contributions in the philosophy of science, utilizes such an approach. By applying the concepts of field physics to a living thing he feels he has solved the problem of the nature of life because he thinks he can now explain its organization.

Northrop arrives at his materialistic theory of life by a consideration of the adequacy of the chemical and thermodynamical theories of the nature of life. The chemical theory of the nature of life is inadequate. The isolation of units, chemical reactions, enables us to explain the constituents of life but not its organization. Northrop asserts that the chemical theory is limited for it cannot

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[1] Ibid., p. 82. [2] Ibid., p. 3.

tell us of the flux of the chemical constituents within the living thing. Yet, as Northrop points out, we know that such a state of flux exists through our investigations of protein molecules within the living thing. Atoms of the protein molecules have been tagged by incorporating isotopes, such as heavy carbon atoms, in the protein molecules. Their behavior has been noted and the dynamic interchange of chemical constituents has been found to be the rule.

The thermo-dynamical theory of the nature of life is also inadequate. It is true that this theory accounts for the energy necessary for the dynamic interchange of chemical constituents. It explains the transfer of energy from the environment to the chemical constituents which make up the living thing. But Northrop contends that thermo-dynamics does not solve the difficulty of the peculiar relatedness into which energy organizes the moving chemical constituents. Relatedness implies a state of mean compensated entropy; that is, a state of organization. The second law of thermo-dynamics allows only gradual progress toward a state of maximum entropy; that is, a decay into a disorganized state. The living thing seems to defy the second law of thermo-dynamics and to concentrate upon itself a stream of negative entropy to compensate the entropy increase occurring by the act of living. Mean compensated entropy or permanence or relatedness or organization results. Northrop states that "what seems to be called for in addition to the concepts...of

chemistry and thermo-dynamics, is a...theory of physics which will prescribe an irreducible relatedness between moving physico-chemical entities."[1]

The theory of physics which provides an explanation of relatedness is Maxwell's field physics. Because of the existence of light and other electro-magnetic propagations, a field could not be defined by compounding its particles. In particle physics such compounding is the method. Particles related by forces are compounded into the field. Maxwell's approach, however, was to begin with the field and its relatedness and to derive from it the location of the charged particles in the electric current. According to Northrop, if this notion of field physics is extended to life, its organization can be explained. We must begin with the living thing and its relatedness and derive from it the location of the chemical constituents in their dynamic interchange. To this notion Northrop gives the name, "electrodynamic theory of life".

As experimental verification of the fact that a field occurs in a living thing that is similar to a physical field, Northrop cites the experiments of H. S. Burr. Burr took a fertilized egg of ambystoma in a stage of embryonic development when no differentiation was visible and found a definite organized pattern of electrical potential differ-

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[1]F. S. Northrop, The Logic of the Sciences and the Humanities (New York: The Macmillan Company, 1947), p. 163.

ences. Using dyes he marked that pattern on the egg, and as the organism grew, found that differentiations appeared at precisely the locations marked by the dyes.

Since a field similar to a physical field occurs in a living thing, we must approach it as Maxwell does a physical field; that is, we must interpret life in electrodynamic terms. In the words of Northrop:

> Chemical theory provides the postulated entities at the basis of the material constituents of living organisms; thermo-dynamics provides an understanding of their dependence on energy factors from without; and the electro-dynamic theory provides the irreducible relatedness necessary for an understanding of the organization of the constituents as worked upon by the energy.[1]

## Erwin Schrödinger's "Order From Order"

The advent of the quantum theory was to have an impact upon physical theories of the nature of life. This impact is seen in Schrödinger's theory which utilizes physical concepts as they are modified by the quantum theory. Erwin Schrödinger (1887- ) is a German physicist who is known for his work on the wave theory of matter and on the quantum theory.

In order to understand his theory of the nature of life, we must first compare the orderly behavior of the physical and the living worlds. Most of the order we observe in the physical world is a statistical effect. The idiosyn-

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[1] Ibid., p. 167.

crasies of the individual electrons, atoms, and molecules cancel out, as it were. Order is derived from disorder. An example from Schrödinger's exposition[1] will elucidate this assertion. Imagine a beaker filled with water containing a few crystals of potassium permanganate. If you leave the beaker alone a very slow process of diffusion occurs. The permanganate spreads from the places of higher concentration to the places of lower concentration until it is equally distributed. But this orderly behavior of diffusion is only a statistical effect. If we focus on the individual molecules, we see them moving in unpredictable directions as they are knocked about by the impacts of the water molecules. They move sometimes towards the higher concentrations and sometimes towards the lower concentrations. Why then should these unpredictable movements of the permanganate molecules produce a predictable flow? This is explained by visualizing a plane separating an area of lower concentration from an area of higher concentration. It is true that in both areas the molecules will with equal probability be carried to an area of lower or higher concentration, but the plane will be crossed by more molecules coming from the higher concentration than those from the lower because more molecules are present in the higher concentration. This will continue until a uniform distribution occurs. Hence, because of the enormous

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[1]Erwin Schrödinger, What is Life? (Cambridge: Cambridge University Press, 1945), pp. 12-15.

numbers of molecules that cooperate in the phenomenon, order emerges from disorder.

Life, too, is an orderly event, but we cannot account for its orderliness on statistical grounds. The supposition that life involves such enormous numbers of single atoms and single atom processes that laws of physics and physical chemistry can be applied is erroneous. A gene, the basic unit structure of life, contains only a comparatively small number of atoms, not more than a million or a few million atoms.[1] This number is much too small to effect orderly behavior according to statistical physics as can be seen by the $\sqrt{n}$ law.[2] If there were only 1,000,000 molecules--that is, $n = 1{,}000{,}000$--the probable relative error would be $1/\sqrt{1{,}000{,}000}$ or 1/10% which is too large for reliable predictions.

Therefore, the order apparent in life is different in kind from physical order. The physical order is a statistical result derived from disorder. All physical things obey the tendency to go over into disorder; that is, the second law of thermodynamics holds for physical systems. This means that in physical systems the disordering tendency of heat motion will be eventually realized in maximum entropy. On the other hand, in living systems the order is

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[1] Ibid., p. 30.

[2] The accuracy of any law is determined by the $\sqrt{n}$ law.

based on the maintenance of existing order. Stated differently, the living thing remains at a fairly low entropy level. Even though every activity in the living thing effects an increase of entropy, the organism somehow compensates for these increases.

This comparison between the orderly behavior of physical and living systems indicates why life cannot be interpreted by the statistical laws of physics. In the words of Schrödinger:

> It appears that there are two different 'mechanisms' by which orderly events can be produced: the 'statiscal mechanism' which produces 'order from disorder' and the new one, producing 'order from order'...we cannot expect that the 'laws of physics' derived from [the 'order-from-disorder' principle will] suffice straightaway to explain the behaviour of living matter, whose most striking features are visibly based to a large extent on the 'order-from-order' principle. You would not expect two entirely different mechanisms to bring about the same type of law--you would not expect your latch-key to open your neighbour's door as well.[1]

However, there is another latch-key which will open the door of life. It, too, is a physical principle. "For the new principle that is involved is a genuinely physical one: it is, in my opinion, nothing else than the principle of quantum theory over again."[2]

How does the quantum theory explain life? According to Schrödinger, the only explanation of life that could account for its orderliness is one based upon the view that the material unit structure of life, the gene, is a "well-

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[1] Ibid., p. 80. [2] Ibid., p. 81.

ordered association of atoms, endowed with sufficient resistivity to keep its order permanently."[1] And it is the quantum theory which embodies the physical concepts to explain this resistivity. According to the quantum theory, a system or association of atoms is capable of discontinuous change from one so-called "energy level" or state to a number of other levels. This change or "quantum jump" may involve loss of energy if state A is at a higher level than state B, or uptake of energy if A is below B. The gene, then, is such a system--a huge molecule capable only of discontinuous change. But the gene typically resists such change, and its resistivity would be due to the fact that the energy threshold separating one arrangement of the atoms, state A, from another arrangement of the atoms, state B, is high enough to make rearrangement a rare event. Empirically this is verified by the fact that mutations, changes in the gene, are rare. Yet the gene, granted an adequate energy supply, is capable of a variety of possible isomeric rearrangements that are sufficient to account for the elaborate developmental pattern of an organism.

Thus, Schrödinger contends that physical concepts alone are adequate for the explanation of life. But we must not make the mistake of employing the concepts of statistical physics. Rather we must utilize the concepts of quantum physics. For these concepts alone, according to

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[1] Ibid., p. 61.

Schrödinger, can explain the unity or orderliness and the complexity which are the unique characteristics of life.

## Summary of the Chapter

This chapter has presented certain theories of the nature of a living thing. All of the theories contain either implicitly or explicitly the same metaphysical theory as to the nature of reality. The metaphysical theory is materialism which asserts that only matter, defined as "the object of physical science", is real or operative. Living things are of the same nature as non-living things. Both are matter or objects of physical science. Since living things are objects of physical science, only physical concepts need be utilized in the explanation of living things. Thus, a certain biological method is inherent in a materialistic theory as to the nature of life. Consequently, all of the theories agree in embracing the method of physical science as the biological method.

The theories, however, differ in regard to the physical concepts that they utilize. Huxley employed the Newtonian concepts. He attempted to explain various phenomena of life in terms of matter, motion, and the mechanical laws governing such motion. Loeb explained life in terms of chemical reactions. He viewed the living thing as a static system. Units, chemical reactions, were isolated

and then compounded into a whole. The unity or organization of the living thing was neglected to a large extent. But Child feels that this unity can be analyzed if we view the living thing as a dynamic rather than a static system. Unity is explicable in terms of dynamic interrelationships that are physico-chemical in nature. As new physical concepts were introduced, they were employed in the explanation of life: the concept of electricity by Lakhovsky, the concepts of field physics by Northrop, and those of the quantum theory by Schrödinger.

Because not all the above theorists utilize Newtonian concepts, "mechanism" is not an adequate term to describe their methodological approach. It would be misleading to designate as "mechanistic" a methodological approach which utilized the concepts of the quantum theory. Therefore, I propose to use the term "physicalism" to designate a method of explaining life which utilizes physical concepts and <u>only</u> physical concepts. "Mechanism" would be a type of "physicalism". Other types of "physicalism" could then be designated by other terms as they reached the stage of definition that has been reached by the "mechanistic" approach.

# CHAPTER II

## DUALISTIC THEORIES

### Origins of the Dualistic Theories

The origins of non-materialistic theories of the nature of life can be traced to the metaphysics of Aristotle, a Greek philosopher of the fourth century B.C. It was Aristotle who introduced the concept of telos or purpose.

He arrived at this notion through a consideration of causality or the principles from which a being derives its existence:

> ...we have to acquire knowledge of the original causes (for we say we know each thing only when we think we recognize its first cause), and causes are spoken of in four senses. In one of these we mean the substance, i. e. the essence (for the 'why' is reducible finally to the formula, and the ultimate why is a cause and principle); in another the matter or substratum, in a third the source of the change, and in a fourth the cause opposed to this, the purpose and the good (for this is the end of all generation and change).[1]

Thus, there are four causes or principles of being: formal, material, efficient, and final.

The material cause or principle is that out of which a thing becomes; that is, matter or capacity for becoming.

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[1]Aristotle, The Works of Aristotle, trans. Smith and Ross (Oxford: Clarendon Press, 1908), Vol. VIII, Metaphysica, Book 1, Chapter 3, $983^a$ 25-33.

Purposive order is not present but is still to come. The formal cause or principle is that which determines what a thing will become; that is, form. The form is related to matter, the principle of potentiality, as that which determines it, the principle of actuality. Purposive order is now present. The efficient cause is conceived of as a source of motion or change. For example, the efficient cause of a house is the builder of that house. Since the builder received the impulse to build from the form of the house he beheld in his mind's eye, the efficient cause can be said to coincide with the formal cause. This is the case especially in living organisms, because that which impels the plant to grow is its form--its entelechy. The final cause is that at which the movement is aimed. The final cause may be seen to coincide with the formal and efficient causes, for the builder aims at nothing more than imposing form. Therefore, the four original principles reduce themselves to two, the material and the formal.

It is important to notice that Aristotelian metaphysics commits us merely to a non-materialistic theory of the nature of a living thing. It is not the basis of a dualistic theory, inasmuch as matter and form are inseparable except for the one pure form of all forms which is God. Furthermore, Aristotle thought of "matter" not as the object of physical science but rather as "potentiality".

Descartes, the French rationalist, gave to the modern world the sharp opposition between material substance and mental substance. Matter[1] is precisely what mind is not, extension versus thought. He separated the self, the "I think" of which he was certain, from the physical world. Mental substance is that which thinks, res cogitans; physical substance is res extensa. This Cartesian dualism which was applicable to the living thing, man, had but to be extended to all living things for the emergence of a dualistic theory of the nature of a living thing.

## Hans Driesch's "Entelechies"

Hans Driesch (1867-1941), a German biologist and philosopher noted as a vigorous proponent of a dualistic theory of life, asked the following question:

> Is organic individual wholeness produced on the basis of a machine, i.e. by processes which, though arranged in a special given manner, are in themselves inorganic processes, as known from physics and chemistry, or are there in the organism whole-making processes sui generis, i.e. processes not reducible to the forms of inorganic becoming?[2]

He answered this question by embracing "Vitalism" "if by 'Vitalism' we mean the possibility merely negative at first, that there may be processes in the organism which are not

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[1]Matter is no longer mere "potentiality" but is the object of physical science.

[2]Hans Driesch, The Problem of Individuality (London: Macmillan and Co., Limited, St. Martin's Street, 1914), pp. 4-5.

of the machine-like or 'mechanistic' type, and which may be said to be 'teleological' or purposeful in more than a merely formal sense."[1] What led Driesch to answer the question in this way or to embrace a dualistic theory of the nature of life?

First, there was embryological evidence. If the machine theory were true, when one removes a part of the machine in its early stages of development the consequent development should be affected. Complete final organization necessitates the presence of all parts of the machine. Partial organization or fragments of organization should result if parts are removed. Yet fragmented organization does not occur if the embryo of a sea urchin is fragmented. On the contrary, experiments carried out with early embryonic stages do not result in the production of fragments of organization but complete organization results. Ontogenetic systems are "harmoniously equipotential"[2]; that is, any portion produces completeness of final organization. "Every cell of the original system can play <u>every</u> single role in morphogenesis; which role it will play is merely a function of its position."[3] Therefore, Driesch concluded that a living thing cannot be matter alone. A non-physical agent that is responsible for the realization of form or complete organization

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[1] <u>Ibid</u>., p. 5.

[2] <u>Ibid</u>., p. 17.

[3] <u>Ibid</u>., p. 18.

must be postulated.

The fact of inheritance also led Driesch to embrace a dualistic theory. How can one account for the eggs, produced by the ovary, containing all the elements necessary to form the same complex totality from itself as the organism that produced them? The ovary was produced from a single cell after thousands of divisions, but can a machine be divided and remain the same? The egg, certainly, cannot contain the same machine as the organism that produced it. If one holds that the cell which produced the ovary was not a machine, where did the machine in the egg originate? How explain the "complex-equipotential system?"[1] "Some agent that arranges is required, and this arranging agent in inheritance cannot be of a machine-like, physico-chemical character."[2]

The final evidence Driesch cited is the characteristics of human action:

> He is the sovereign of the results of his personal history; his history affords him only means of future acting and nothing more. When he acts, these means are used according to the principle of correspondence among totalities; it is not that one part of the stimulus causes one part of the effect according to a fixed order. In action nothing is fixed in the sense of what fixation means in anything like a "machine".[3]

What Driesch maintained in this quotation is that stimuli

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[1] Ibid., p. 21.

[2] Ibid., p. 23.

[3] Ibid., p. 30.

and responses are unities but not related with one another part by part. They have a meaning. The past is not reproduced, but used in action. Purpose is operative in human action. Therefore, purpose must be recognized and dealt with in a theory of the nature of life.

The name that Driesch gave to the purposive agent in living processes is the Aristotelian term, "entelechy". "Entelechy is something that is non-physico-chemical; and the only positive character we are entitled to attribute to it, so far, is that it is an actual elementary agent or factor of Nature."[1] But entelechy has certain negative characteristics. It does not depend upon spatial substance. Spatial substance possesses quantity, but how can quantity be applied to entelechy which has only to do with arrangement? Also, entelechy is not dependent upon energy, for energy is only a measurement of causality in space. Finally, entelechy cannot create energy for this introduces the Cartesian difficulty of a non-mechanical thing acting upon a mechanical thing even if it only be a change in the direction of motion. Also, if the entelechy could create energy how does one account for the limited character of all regulations?

The relationship between entelechy and the material factor of a living thing is that the entelechy depends upon material conditions for its effect, the wholeness or unity

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[1] Ibid., p. 33.

of the living thing, but not for its existence. The entelechy controls the material systems by relaxing its suspensory powers and allowing events to take place.

## Eugenio Rignano's "Memories"

Driesch's "entelechy" can be objected to as an empty word incapable of definition. The only positive character it has is that it is a factor of nature. Rignano (1870-1930), an Italian noted for his contributions in the philosophy of biology, attempted to answer this objection. The "entelechy" is a group of memories or a group of traces of the previous activity of the living thing in the form of a peculiar type of energy unique to life:

> But what these mechanical and physico-chemical analogies are unable to explain even in outline is the power of anticipation by which an organism prepares to accommodate itself to conditions not yet realised.
>
> We must, therefore, assume the existence of a new property quite peculiar to vital energy. This property would consist in the circumstance that every state of physiological equilibrium as it gives place to a new one always leaves a trace of itself behind. This trace would consist of an accumulation of a corresponding specific variety of vital energy in each of the points of the organism which have been the seat of this physiological process now replaced by a new one.[1]

This conception of life as including not only a material system but a peculiar form of energy endowed in contradistinction to all other forms of energy with the pro-

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[1]Eugenio Rignano, Biological Memory (London: Kegan Paul, Trench, Trubner and Co., Ltd., 1926), p. 138.

perty of mnemonic accumulation allows us, according to Rignano, to explain organization. The agent that arranges or produces organization is a group of memories.

How then do memories produce organization? The fertilized egg embodies in its nucleus all the memories, traces of activities, acquired during the past history of the race. These memories are passed on to the daughter nuclei when mitosis occurs. Each nucleus resulting from mitosis has the power of discharging these memories, mnemonic units or specific potentials, in the form of nervous currents. At the site of discharge, memories corresponding to those carried in the nervous currents are deposited. However, if all of the nuclei could equally discharge their memories, no specialization and integration could occur. But organization is dependent upon specialization and integration. Therefore, certain nuclei must become dominant and their discharges or memories must be responsible for unity or organization.

Dominance is explained in the following manner. Some nuclei in development come to be excluded from the central zone. Radiations of impulses from the nuclei in the central zone cause the specialization of cells lying outside of this zone. The radiations add to these cells new somatic potential elements in virtue of the power that a radiation has of depositing a corresponding accumulation of itself. These somatic potential elements, increasing in number, finally displace completely the original potencies of these cells.

Hence, the radiation of impulses from the central zone suppresses the powers of the nuclei outside this zone and reduces them to a specialized condition. The paths along which these influences radiate are at first intracellular bridges which connect the cells together. As the animal grows and increases in complication of structure some of these intracellular bridges become nervous fibers. In animals that have a highly developed nervous system, the central zone is a part of this system.

Has Rignano given any meaning to "entelechy"? It is true that he has translated the concept of purpose or "entelechy" into an unknown form of energy. In his words:

> We admit that in postulating the properties with which we have endowed nervous energy we have introduced a form of energy which at present we cannot reduce to any of the other forms of physico-chemical energy so far known. In a word, we have imagined such a form of energy, which...would nevertheless differ by the possession of certain well-defined fundamental qualities from all the other forms of energy in the same way as these differ from one another.[1]

However, has he simply stated that the concept of purpose is some unknown physical concept? If so, he embraces an <u>eventual</u> explanation of the nature of life in terms of physical concepts and only physical concepts. Meanwhile, he embraces a physico-teleological explanation of the nature of life for he accepts the concept of purpose as well as physical concepts and is not able to reduce the concept of purpose to a physical concept.

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[1]<u>Ibid</u>., p. 108.

## J. Von Uexküll's "Impulses"

Uexküll (1864- ), German biologist and comparative psychologist, also accepts a dualistic theory of the nature of life. He maintains that a non-mechanical (non-physical) factor is operative in the living thing. Moreover, he attempts to show how such a factor is operative.

This biologist begins his exposition by pointing out the absurdity of the mechanist's position:

> It is a remarkable fact that, while the assertion that a machine may be regarded as living organism excites general contradiction, the opposite assertion, i.e. that we may compare living beings with machines, finds many supporters. The contradiction in this becomes less obvious if we express the two statements in another way. From the statement 'machines have the properties of the living' we shall at once dissent; on the other hand, the statement 'living have mechanical properties' is certain to meet with general agreement.
>
> It sounds positively ridiculous to maintain that a locomotive with an optical apparatus is a kind of a horse; but to compare a horse with a locomotive is very tempting.[1]

Thus he concludes that one must admit the presence of a super-mechanical activity in a living thing which makes it unlike a machine. This super-mechanical activity includes the activities exercised on machines by human beings. Human beings make machines according to a plan, run the machines and finally, repair the machines when they are faulty. However, the living thing makes a machine of itself according to its own plan, runs the machine itself and undertakes all

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[1] J. Von Uexküll, Theoretical Biology (London: Kegan Paul, Trench, Trubner and Co., Ltd., 1926), p. 120.

its own repairs.

The existence of this super-mechanical activity appears to be bound up with protoplasm, which machines do not possess. Every living thing proceeds from protoplasm and traces of protoplasm remain in every cell where it forms that part of the cell which does not pass over into the mechanical framework of the whole. The protoplasm as a whole is kept in continuity by means of fine connecting strands. The super-mechanical factor is located in the protoplasm, more particularly in the genes, and is called "impulse".

Impulses, then, are the non-material factors which make the machine according to a plan, run it and repair it. Impulses, as it were, seize, in a given sequence, upon the physico-chemical elements and an ordered framework emerges. The mechanical is controlled by the non-mechanical or super-mechanical. The non-mechanical factors, impulses, bring the building sequence to the mechanical factors, the materials.

Impulses presuppose a subject. Therefore, Uexküll states, "So far as we can judge at present, to be alive and to be a subject mean the same thing. To be a subject means... the continuous control of a framework by an autonomous rule."[1] The living thing is thus a subject for it consists of a biological framework which is controlled by impulses.

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[1] Ibid., p. 223.

## William McDougall's "Purposes"

William McDougall (1871-1938), British psychologist and philosopher, has also set forth a dualistic theory of the nature of life. Physical concepts alone are inadequate when one deals with the phenomena of life. Physical science cannot explain life for it "has deliberately for its own purpose abstracted from, or refused to consider and take account of, the facts of Life and Mind."[1] In other words, the laws expressed in the events of the physical realm are inadequate to explain vital events, for the laws as formulated do not incorporate the distinctive property of such vital events.

What, then, is the distinctive property of vital events?

> ...just as the actions of the living organism cannot be explained, nor even intelligibly described in purely mechanistic terms, so also its organization cannot be completely described in terms of material structure. The facts of both orders combine in pointing to non-spatial organization that expresses itself with a causal efficacy that is teleological.[2]

The actions of the living organism cannot be explained in mechanistic terms because they exhibit two peculiarities which distinguish them from the movements of inorganic things. According to McDougall, these two peculiarities are:

> (1) the 'total' or unitary nature of reaction, i.e. the reaction of the organism as a whole with co-ordination

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[1]William McDougall, Modern Materialism and Emergent Evolution (London: Methuen and Co., Ltd., 1929), p. 11.

[2]Ibid., p. 107.

> of the movement of its parts in response to a stimulus directly affecting one small part only; and (2) the persistence of the effect of the stimulus, a persistence closely analogous to the persistence of varied movement which in ourselves and our fellows we recognize as the expression of a persistent effort after a desired end.[1]

For example, the behavior of Paramecium, a ciliate, when it collides with a hard body cannot be explained in terms of a tropism; that is, a direct local reaction to a physical stimulus. The reason is that Paramecium on colliding suddenly reverses the movement of all its cilia and backs off; the nature of the turning movement is independent of the point of incidence of the stimulus, the hard body.[2] Furthermore, an amoeba shows the persistence of the effect of a stimulus. If an obstruction is placed in the path of an amoeba to check its pursuit of an end such as food, it will vary the direction of its movements again and again until it hits upon a movement that meets with no obstruction. "...it seems to work towards the biological end by the method of persistent 'trial and error'."[3]

Also the organization of a living thing cannot be described in terms of material structure. For example:

> The embryo seems to be resolved to acquire a certain form and structure, and to be capable of overcoming very great obstacles placed in its path. There is here something analogous to the persistence of the efforts of any creature to achieve its ends or purposes and the satisfaction of its needs under the driving power of instinc-

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[1]William McDougall, Body and Mind (London: Methuen and Co., Ltd., 1928), pp. 260-1.

[2]Ibid., p. 259.

[3]Ibid., p. 260.

> tive impulse or craving. In both cases, mechanical obstacles turn aside the course of events from their normal or direct path; but, in whatever direction or in whatever manner the turning aside is caused, the organism adjusts itself to the changed conditions, and, in virtue of some obscure directive power, sets itself once more upon the road to its goal; which, under the altered conditions, it achieves only by means of steps that are different, sometimes extremely different, from the normal.[1]

Consider also the organization of a living thing in the light of energy transformation. "Organisms seem to be capable of overcoming the tendency of energy to be degraded [from energy of higher potential to forms of lower potential]; the metabolic processes are in large part synthetic, and they result in the raising of energy to higher levels of potential in the form of substances peculiarly rich in energy..."[2] Therefore, organization cannot be explained in terms of material structure, since in the inorganic realm all transformations of energy involve dissipation of energy. Does not the living thing exhibit purpose in raising energy to higher levels of potential in defiance of the second law of thermodynamics?

The purposive nature of vital events is clearest in mental events:

> Memory, then, though it is determined by the past, works toward the future <u>as one aspect of an essentially teleological or goal-seeking activity</u>. And, in thus working to mould the future as we conceive and desire it, and to guide our forward striving action, it becomes imagination, the function in which Mind manifests most clearly its

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[1] <u>Ibid</u>., p. 243.

[2] <u>Ibid</u>., p. 245.

creative power.[1]

The dualistic theory of McDougall can be summarized by means of the following quotations:

> The position, then, is that we recognize a realm of teleological mental events, and a realm of physical events that seem to be purely mechanistic; and in between these two realms in an uncertain status are all the organic processes that are not obviously mental. Shall these be assimilated to the mechanistic physical realm or to the teleological mental realm? It seems to me that the grounds for assimilating them to the mental or teleological realm are over-whelmingly strong.[2]

> It may, therefore, be said to-day with even more confidence and force than in the time of Democritus or of Lucretius, of Hobbes or of Huxley, that the mechanical view of the organic world remains nothing more than a hope, a faith, a postulate, or a prejudice, in the minds of those who hold it.[3]

McDougall, however, realized the difficulties involved in accepting teleology in the realm of living things. "And the difficult problems involved in the acceptance of teleological causation in the organic realm have hitherto hardly been formulated, chiefly by reason of the continued influence of a defunct dogma, that of Atomic Materialism."[4]

## Summary of the Chapter

This chapter has presented a group of theories which

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[1]McDougall, Modern Materialism and Emergent Evolution, p. 80.

[2]Ibid., p. 160.

[3]McDougall, Body and Mind, p. 253.

[4]McDougall, Modern Materialism and Emergent Evolution, p. 158.

agree in rejecting materialism and in embracing a dualistic metaphysical explanation of life; that is, all the theories postulate the coexistence of the physical and the psychical[1] in the living thing. Furthermore, the theories distinguish between living and non-living things. Reality consists of non-living things which are physical and living things which are both physical and psychical.

The theories differ in respect of their description of the psychical factor. Driesch does not describe the psychical factor in positive terms. He merely substitutes the term "entelechy" for the terms "psychical factor". Rignano and Uexküll attempt to describe the psychical factor in positive terms. According to Rignano, the psychical factor is a group of memories in the form of an unknown kind of energy, while, according to Uexküll, the psychical factor is a group of impulses. McDougall does not attempt a description of the psychical factor. He merely affirms its necessary presence because purpose is operative in living things.

All of the theories agree in rejecting physicalism. Since living things are physical as well as psychical, physical concepts alone are not adequate. The concept of purpose is necessary also. This methodological approach can be designated as "physico-teleologism". This term is used

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[1]"Psychical" here means not so much "mental" as "principle of life" or "vital force".

rather than "vitalism" since there is confusion as to the use of the latter term. "Vitalism" is used at times in a sense that is equivalent to "physico-teleologism", that is, it designates a methodological approach. "...Vitalism is a theory in biology which holds that living processes cannot be explained by physico-chemical laws."[1] At other times, or perhaps even at the same time, "vitalism" is used to designate the dualistic metaphysical theory of the nature of a living thing. "[Vitalists] assert that in addition to the organisms as studied by their rivals there is another entity of a totally different nature the existence of which is revealed by the peculiarities of the organism."[2]

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[1]Arthur Berndtson, "Vitalism", A History of Philosophical Systems, ed. V. Ferm (New York: The Philosophical Library, 1950), p. 375.

[2]J. H. Woodger, Biological Principles (London: Kegan Paul, Trench, Trubner and Co., Ltd., 1929), p. 230.

# CHAPTER III

## EMERGENT THEORIES

### Origins of the Emergent Theories

The origins of emergent theories of the nature of life can be traced to the evolutionary hypothesis of Charles Darwin (1809-1882). In The Origin of Species he advanced the hypothesis that living matter can change. It is not cast once and for all into fixed forms or species. New species evolve from old ones; new kinds of plants and animals are the changed descendants of old ones. The changes of living matter usually result in greater complexity:

> Although much remains obscure, and will long remain obscure, I can entertain no doubt, after the most deliberate study and dispassionate judgment of which I am capable, that the view which most naturalists until recently entertained and which I formerly entertained--namely, that each species has been independently created--is erroneous. I am fully convinced that species are not immutable; but that those belonging to what are called the same genera are lineal descendants of some other and generally extinct species, in the same manner as the acknowledged varieties of any one species are the descendants of that species.[1]

The emergent evolutionist extended the concept of evolution to all of reality. Reality is a process of emergent evolution in which different levels of being are super-

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[1]Charles Darwin, The Origin of Species (New York: D. Appleton and Company, 1896), p. 6.

imposed upon one another. Each level is a novel, irreducible development. The higher level depends upon the lower level for its emergence, but contains something more than the lower level and therefore cannot be reduced to the lower level. Life depends upon the lower physical level for its emergence, but it cannot be reduced to physical things for it contains something more than what is contained in physical things. Life is a stage of material complexity that has produced a novel emergent property. Even though we have complete knowledge of the constituents of the material complexity known as life we could never predict that in a certain combination they would manifest the properties of life.

## C. L. Morgan's "Relatedness"

C. L. Morgan (1852-1936), an English zoologist and psychologist who is sometimes credited with the founding of comparative psychology, set forth a theory of emergent evolution which embodies a theory as to the nature of life:

> Under what I here call emergent evolution stress is laid on this incoming of the new. Salient examples are afforded in the advent of life, in the advent of mind, and in the advent of reflective thought. But in the physical world emergence is no less exemplified in the advent of each new kind of atom, and of each new kind of molecule. It is beyond the wit of man to number the instances of emergence. But if nothing new emerge--if there be only regrouping of pre-existing events and nothing more--then there is no emergent evolution.[1]

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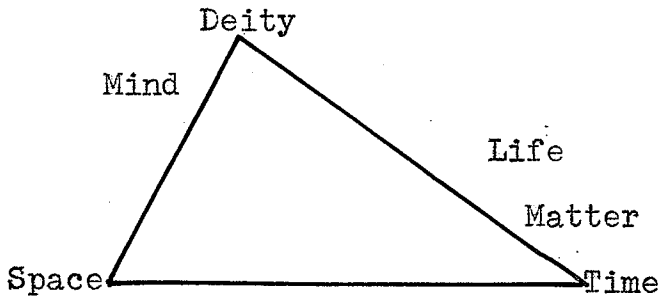
[1]C. L. Morgan, Emergent Evolution (London: Williams and Norgate, 1923), p. 2.

This "incoming of the new" has produced a series of events in progressively ascending grades. From space-time has emerged matter; that is, physical and chemical events in progressively ascending grades. Later in the evolutionary sequence, life--"a new 'quality' of certain material or physico-chemical systems with supervenient vital relations hitherto not in being"[1]--has emerged. Here also we find progressively ascending grades. Then the higher quality of consciousness or mind arises within a part of space-time already qualified by life. Again progressively ascending grades can be distinguished. Finally, the quality of deity has emerged in some men and is the latest product of evolution up to date.[2] Morgan has given this diagrammatic expression to the notion of emergence:[3]




The pyramidal form is used to indicate that the range of events decreases in extensiveness from space-time to deity:

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[1]Ibid., pp. 9-10.

[2]Morgan states that his account follows S. Alexander's philosophic interpretation of nature.

[3]Ibid., p. 11.

> Such a diagram...is a...composite graph of a vast multitude of individual pyramids--atom-pyramids near the base, molecules a little higher up, yet higher, "things" (e.g. crystals), higher still, plants (in which mind is not yet emergent), then animals (with consciousness), and near the top, our human selves. Classify how you will; but let every individual entity have its appropriate place in the synoptic pyramid.[1]

What is it that emerges? "If it be asked: What is it that you claim to be emergent?--the brief reply is: Some new kind of relation."[2] "On our view liquidity, solidity, life, and mind are, one and all, names that we give to the specific kind of relatedness that obtains in this or that entity under consideration."[3] "Relatedness" means that all the parts play their part, each in respect to the other. The parts are integrated into a whole. There is a determinate plan or a "matter of go". "Relatedness in this sense gives the stuff and substance of the integral whole..."[4]

But why does Morgan insist that the relations are new? "The reply is that their specific nature could not be predicted before they appear in the evidence, or prior to their occurrence."[5] The meaning of this statement can be clarified by citing an example given by Morgan:

> ...Picture a state of matters in which, say at high temperature, there is a vapour condition; this system gradually cools; a stage is reached when liquid drops are formed; there is further cooling; and a stage is reached

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[1] Loc. cit.

[2] Ibid., p. 64.

[3] Ibid., p. 66.

[4] Ibid., p. 69.

[5] Ibid., p. 65.

> when solids appear. Conceive the molecules in the vapour-system to have reflective experience. It would be that of the kind of relatedness which therein obtains. Could such a molecule foretell the relations which will obtain in liquids or in solids? We think not. And why? Because there are as yet no instances of these kinds of relatedness of which to have experience; and they are quite different from those in the vapour.[1]

Nevertheless, it is important to note that the new relation which emerges also contains old relations:

> Space-time-event relatedness...is always within any given system under consideration; sundry chemical transactions are within a more highly evolved system; that kind of relatedness which the quality of life expresses is no less within the organism; emergent mind is within the personal system and no where else.[2]

Life, therefore, is a relatedness that has emerged from physico-chemical relatedness. It has its own determinate plan or "gotogetherness" or wholeness. The behavior of the parts of the living thing, mechanisms, are subservient to the determinate plan because the plan guides the interrelation of the parts:

> Our theme is determinate natural plans with subservient mechanism. We urge that in organism there is such a determinate plan. We urge that this plan is predicable of the organism as a whole, that is, subject to the concept of discrete items of stuff which go together in the substantial unity of organization. We urge--fully realising that there are those who dissent--that, in the organism, there is a manner of go in the current events which is special to, and distinctive of, the living being as such. That is what I mean by emergence of life.

As a consequence of the emergence of a determinate

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[1] Loc. cit. [2] Ibid., pp. 191-2.

[3] C. L. Morgan, Life, Mind, and Spirit (London: Williams and Norgate, Ltd., 1926), pp. 78-9.

plan that characterizes life, both materialism and dualism must be rejected. Materialism must be rejected because physical things are different from living things. "...there are different natural systems to be reckoned with--mind-life-matter systems; life-matter systems; and matter systems."[1] Dualism must be rejected. "Entelechy" is not invoked from some disparate order of being. "...any insertion into physico-chemical evolution of an alien influence which must be invoked to explain the phenomena of life...is explicitly rejected under the concept of emergent evolution."[2] Life does not possess a vital principle. It is merely a specific kind of relatedness. "We should [not] hypostatise [life] or give to...[it] the status of an entity separable from...the organism."[3]

Furthermore, the method of mechanism is inadequate. "The essential feature of...a mechanistic interpretation is that it is in terms of resultant effects only, calculable by algebraical summation."[4] This method is inadequate because "it ignores the something more which must be accepted as emergent."[5] "Resultants there are; but there is emergence also."[6]

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[1]Morgan, Emergent Evolution, p. 22.

[2]Ibid., p. 12.

[3]Ibid., p. 66.

[4]Ibid., p. 8.

[5]Loc. cit.

[6]Loc. cit.

What method, then, must the biologist utilize? The biologist must approach life holistically. He must ask this question: "Given something that happens; what exactly is the nature of the relational 'field' within which it thus happens? or, given such and such a relational field; what is it precisely that happens here or there within the field?"[1] In other words, the behavior of the parts, mechanisms, must be considered in relation to the whole, the determinate plan.

Let us consider an example given by Morgan in order to illustrate this method.[2] The determinate plan of life is embodied in heredity:

> I think it may be said that in modern biology heredity is singled out for special emphasis as the characteristic feature of life in respect to an observable and inferable relatedness between precedent and consequent life entities in accordance with a determinate plan along some given line of filiation.[3]

We can discover this determinate plan through Mendelian analysis. Suppose a man is tall, brown-eyed, curly-haired, narrow-browed, etc. These characteristics may be considered as "stuff" which go to make up his determinate plan or his substantial unity. Because he stands on a line of filial descent, that is, his determinate plan is related to the determinate plans of his ancestors, we can discern the former

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[1]C. L. Morgan, The Emergence of Novelty (London: Williams and Norgate, Ltd., 1933), p. 21

[2]Morgan, Life, Mind, and Spirit, p. 83.

[3]Ibid., p. 81.

through comparison with the latter by means of Mendelian laws with the aid of the statistical method. On the other hand, the mechanism of heredity is mitosis. It is through mitosis that the characteristics are transmitted, for during mitosis the chromosomes composed of genes--the determiners of heredity--are formed. This mechanism, mitosis, is subservient to the determinate plan, heredity. Therefore, mitosis must be correlated with heredity. In other words, mitosis must be interpreted as a statement of what happens here and there in the relational field which is heredity. If instead the biologist attempts to correlate mitosis with phases of action and reaction--correlates one mechanism with yet another mechanism, then he is forced to call upon a vital principle to direct action and reaction according to a plan. He has failed to relate the happenings of the parts to a whole because he has ignored the whole which exists. Therefore, he must introduce an ordering principle.

## Roy Sellars' "Organic Momentum"

Roy Sellars (1880- ), Professor Emeritus of Philosophy at the University of Michigan, is noted as an exponent of the "new naturalism". Sellars writes:

> In controversial literature, naturalism has been so completely identified with the reduction of the higher to the lower that it will be hard to rescue the term from opprobrium. But intellectual honesty demands that the battle be made. Man will understand himself and his life

> only after he sees himself as a child of nature. Romantic dreams are in the long run a source of weakness rather than of strength. They cast a veil of obscurity over the situation and undermine the intellectual virility of which man stands so much in need.
>
> But while man is a child of nature he possesses powers and abilities not elsewhere come to fruition. The stream can rise higher than its source. Man is of nature and yet above her. It is clear that pluralism with its permission of heterogeneity comes to the rescue of new or evolutionary naturalism and frees it from what might otherwise be a paradox. It is the specificity of the part which justifies the statement that man is of nature and yet above her. The older naturalism tended toward cosmical equalitarianism; the newer naturalism recognizes levels and differences. It is both humanistic and naturalistic.[1]

What, then, is the general plan of nature which presents itself to us when we embrace the new naturalist's outlook; that is, when we take "the common world, in which we find ourselves immersed, as the real and only world?"[2] Sellars likens the general plan of nature, that is presented to us, to a pyramid of tier-like construction. "A process of creative organization led at each stage to the advent of gradients or levels above. Each new level depended upon the energies and conditions of the lower level and was adjusted to its wide-spreading foundation." Evolution occurred. Matter was evolved. Then the earth appeared with its water, salts, and earth. Little by little came life which reached ever upward to more complex forms until mind appeared. The

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[1]R. W. Sellars, Evolutionary Naturalism (Chicago: The Open Court Publishing Company, 1922), p. 341.

[2]R. W. Sellars, The Philosophy of Physical Realism (New York: The Macmillan Company, 1932), p. 12.

[3]R. W. Sellars, The Principles and Problems of Philosophy (New York: The Macmillan Co., 1926), p. 363.

human mind was the latest and highest to appear:

> The old persists while the new develops with effort within it. In this regard, evolution offers us the spectacle of the differentiation of nature through its temporal dimensions. And this temporal differentiation is spread out in space in the variety of co-existing kinds of realities.[1]

If, then, we admit of levels in nature expressive of organization or "creative synthesis", materialism or "old naturalism" is untenable. It reduces the higher to the lower. A metaphysical monism cannot satisfy the requirements of a pluralistic universe. Materialism "thought of the physical world in terms of atoms and motion and tried to bully mind and consciousness into the framework thus set [and] it did not take growth and organization seriously because it was essentially a pre-evolutionary system."[2]

Dualism is also incompatible with evolutionary naturalism. The psychical factor is not something apart from and distinct from the physical factor. The psychical factor has emerged from the physical factor and contains all that the physical factor contains.

> [The psychical] is so evanescent, so much a process of change which varies with the state of the organism, so dependent upon external stimuli and upon emotional tensions, that it seems more an organized complex of events than a self-sufficient substance able to stand over against the physical world as autonomous and sovereign.[3]

According to the perspective of the new naturalist,

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[1] Ibid., p. 364.

[2] Ibid., p. 190.

[3] Ibid., pp. 207-8.

"living bodies contain the materials of lifeless bodies but possess a constitution and exhibit processes of a more complex type. It is as though a line of development opened up and was followed from level to level, the result in the end being the achievement of bodies with quite novel properties."[1] The novel property of a living thing is its "organic momentum":

> ...An organism is a thickened system with definite trends. Its organic structure points it toward a future. It has needs and ways of doing things. It has what might be called an organic momentum which uses and bends to itself those factors in the environment which are significant for it. Such a trait seems to me inseparable from an organic system.[2]

Stated otherwise, a living thing is characterized by "immanent, or internally developed, teleology or directedness":[3]

> The mistake which we must be on guard against is to reify these trends and make them external, attractive ends which exercise a spell over the organism. To do so would be merely to project a vicious analysis of human purpose into organic systems.[4]

Since a living thing is characterized by "organic momentum", what method must the biologist use in studying living things? Sellars rejects physicalism in these words:

> How could the physicist expect to do justice to chemical processes? Or the chemist to biological phenomena? Or the biologist to social institutions? Yet the specialist on his philosophical adventures is only too prone to postulate not only the truth of his categories but their sole sufficiency for all the problems confronting the mind. As against such an assumption, we shall argue that all the sciences contribute to the solution of ultimate problems. To attempt to solve the basic queries as to

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[1] Ibid., p. 278.

[2] Ibid., p. 376.

[3] Loc. cit.

[4] Loc. cit.

> the nature of life in the light of physics alone is to challenge failure or a resort to sophistry.[1]

"Creative synthesis implies the relative autonomy of the sciences and their logical discontinuity."[2] Thus, chemical laws cannot be deduced from physical laws nor can biological laws be deduced from chemical laws. "...the laws of nature form a hierarchy in which the different levels are discontinuous."[3]

> The organism is a physical system. It is a system in which there is division of labor and interdependence. All that can be learned about it by all the sciences is true of it... And, yet, so far as each science has a specific point of view and technique, it cannot exhaust the reality of the organism. Valuable as each physical science is, it is too analytic and disintegrative to deal truly with such a highly evolved unity as an organism. Organization is objectively significant.[4]

Biology, consequently, has need also of the "teleological categories".[5] "Organisms have designed themselves because design is natural to the physical world."[6] Thus it is that Sellars affirms "physico-teleologism" as the rule of procedure for the biologist.

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[1]Sellars, Evolutionary Naturalism, p. 6.

[2]Ibid., p. 333.

[3]Sellars, The Principles and Problems of Philosophy, p. 364.

[4]Sellars, Evolutionary Naturalism, p. 335.

[5]Sellars, The Principles and Problems of Philosophy, p. 377.

[6]Loc. cit.

## Ludwig Von Bertalanffy's "System-theory"

Bertalanffy (1901- ) is an outstanding theoretical biologist who was formerly professor at the University of Vienna but is now professor of biology at the University of Ottawa. He maintains that life is an unique quality that has emerged. It is a whole or Gestalt[1] that is different from any other whole or Gestalt:

> The series of Gestalten passes continuously from electrons through the atom and molecule to cells and cellular organisms. But biology, would, on the other hand, represent a turning-point of the curve, since a level of complication and individuality is reached here which can no longer be dealt with under physical law...[2]

He thus rejects physico-chemical explanations of life because of life's uniqueness exemplified by its organization. Vital processes cannot be fully described physico-chemically for what is essential in the organism is that the particular physico-chemical processes are organized in it in an unique manner:

> Whether we consider nutrition, voluntary and instinctive behaviour, development, the harmonious functioning of

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[1]Wolfgang Köhler is credited as one of the founders of the Gestalt-theorie which Bertalanffy utilizes in his approach. The most general concept of Gestalt-theorie is that the nature of any process cannot be determined by a consideration of local factors but must be determined by the actual situation in the whole field, that is, the whole is greater than its parts. "Quite apart from psychology the same will be true of ontogenetic development, and other biological events..." Wolfgang Köhler, Gestalt Psychology (New York: Liveright Publishing Co., 1929), pp. 193-4.

[2]Ludwig Von Bertalanffy, Modern Theories of Development, trans. and adapted J. H. Woodger (London: Humphrey Milford, 1933), p. 62.

> the organism under normal conditions, or its regulative functioning in cases of disturbances of the normal, we find that practically all vital processes are so organized that they are directed to the maintenance, production, or restoration of the wholeness of the organism.[1]

Physico-chemical explanations of life, according to Bertalanffy, depend upon analysis of the whole into partial processes and for this reason are doomed to failure. It is impossible to comprehend life by means of chemical formulae or physical explanations given for the partial processes into which life is analyzed. "It is the property of 'regulation' which is opposed to such an attempt."[2] The reactions that occur in a given part of a living thing depend not only upon what is going on in that part but also on the state of the whole organism or what is going on in every other part of the organism. In other words, "the organism [is,]...within wide limits, a unitary system, and not merely...an aggregate of individual machines."[3]

It is for these reasons that Bertalanffy distinguishes biophysics and biochemistry from theoretical biology. Biophysics and biochemistry are sciences that investigate the ingredient materials and processes in the organism. But the ingredients do not make up the whole. Therefore, the results of biochemical and biophysical investigations cannot constitute a theory of life. A theory of life must explain the organization of such materials and processes at the biological level.

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[1] Ibid., p. 8.

[2] Loc. cit.

[2] Ibid., p. 49.

Dualism is also inadequate as a theory of the nature of life. It has had historical merit in its recognition of the wholeness of life which is suppressed in the physico-chemical attempts at a theory of the nature of life. But this is its only merit, for it postulates a factor of wholeness which is beyond investigation:

> The fundamental objection to it [Vitalism] is that it bars the way to an investigation of these basic features of organisms by means of natural science, because it bases organic wholeness on transcendent factors which in the last resort are analogous to the psyche.[1]

Bertalanffy's view, as opposed to physico-chemical explanations of life, takes into account organic individuality and wholeness and in contrast to dualism treats of organic individuality and wholeness in a manner which admits of scientific investigation. "This view, considered as a method of investigation, we shall call 'organismic biology', and, as an attempt at explanation, 'the system-theory of the organism'."[2]

The scientific investigation of wholeness or the non-additive character admits of greater difficulty. But Bertalanffy points to field physics. It was impossible to determine the charge first in this place and then in that, because the charge at any given place depended upon that at all the others. However, physics solved the problem, which had to be solved by one stroke as a whole, by means of the theory of

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[1] Ibid., p. 45. [2] Ibid., p. 46.

integral equations. Biology must do likewise:

> [We must] define the total event in the organism with one stroke by means of an integral law (this, in our opinion, is the essential biological problem). But we should then have to renounce the physico-chemical determination of the partial processes, because the integral law would become endlessly complicated if we attempted to fill it in in detail with physico-chemical constants.[1]

Bertalanffy sees in the approaches of modern embryologists verification for his assertion that life must be approached holistically:

> All the more recent theories of development, however much they may differ in detail, show this same common tendency. Goldschmidt's theory of genetics is strictly mechanistic, but is not a machine theory; it is one which regards the germ as a whole as a polyphasic chemical system. From the more vitalistic side we find the view which emphasizes the wholeness of the organism in the demand of Heidenhain for the rejection of the view of development which regards it as a sum of separate processes, and its replacement by one which sets the whole of the organic germ with its in-dwelling 'syntony' in the forefront. Gurwitsch has endeavoured, in his Field Theory, to make the factor of the whole, which Driesch regards as ultimate, amenable to geometrical analysis. Speman's definitive conclusion is that we must keep the germ as a whole in view, if we are to solve the problem of determination, and that a theory which treats development as a process involving preformed separate parts which are independent of one another is untenable. The final result to which we come, as the general tendency of modern movements in embryology, is therefore as follows: we must view the germ as a whole, as a unitary system, which accomplishes the developmental process on the basis of the conditions which are present in it and depend on the organization of its material parts.[2]

## R. S. Lillie's "Emergent Dualism"

According to Lillie (1875- ), Professor Emeritus of physiology, University of Chicago, "in life we have a com-

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[1] Ibid., p. 62. [2] Ibid., p. 178.

bination of the regularly acting physical with the directive or integrating psychical."[1] The living thing is dualistic in nature.

Many phenomena of life are explicable in terms of physical concepts. Therefore, the living thing is physical. This is verified by predictions which approach physical exactitude in cellular and large-scale physiology. This exactitude is shown in cellular physiology for osmotic pressures which depend on diffusion and thermodynamics, for the regulation of acidity and alkalinity which depends upon mass-action, and for electrical properties as impedance, potential and capacity which depend upon general electrical conditions. Exactitude is also shown in large-scale physiology for the mechanics of blood-flow, muscular leverage, and the dioptrics of the eye.[2]

However, physical analysis is inadequate when we consider the processes that are most characteristically vital. "The biological systems are, however, peculiar among natural systems in certain very definite respects,--in their physico-chemical complexity, their automatic integration of structure and activity, their self-preservative property, their maintenance through continual interchange with their

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[1]R. S. Lillie, "Living Systems and Non-living Systems", Philosophy of Science, IX (1942), 318.

[2]R. S. Lillie, "Some Aspects of Theoretical Biology", Philosophy of Science, XV (1948), 123.

surroundings."[1] "The main feature is synthesis. In all living organisms there is an orderly transformation of relatively simple materials taken from the environment, where they are distributed at random, into the complexly organized and active living being."[2] Organization, then, is the distinctive vital feature. Organization demands a psychical or directive factor:

> Unless counteracted by directive action the causal or random element in nature tends to increase. If things are left to chance, not only does organization of any high degree of complexity fail to develop, but what organization there is tends to lapse or disappear. Hence in those cases, such as living organisms, where the existence and activity of the system depend on a special and complex organization, it appears necessary to assume the continued operation of a stable directive influence or factor which pervades the whole system and excludes or compensates casual factors as far as possible. The presence of this factor is what makes possible the development and maintenance of the organization required for vital activity.[3]

Therefore, the living thing is psychical as well as physical.

His theory is, however, also an emergent theory for he states that "the property of vitality, as we find it in nature, has its own special emergent level which is different from that of purely physical nature, although superimposed on it."[4]

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[1]R. S. Lillie, "Types of Physical Determination and the Activities of Living Organisms", Journal of Philosophy, XXVIII (1931), 561.

[2]R. S. Lillie, "Living Systems and Non-living Systems", Philosophy of Science, IX (1942), 307.

[3]R. S. Lillie, "Vital Organization and the Psychic Factor", Philosophy of Science, XI (1944), 161.

[4]R. S. Lillie, "Some Aspects of Theoretical Biology", Philosophy of Science, XV (1948), 119.

## Summary of the Chapter

This chapter has presented a group of theories which agree in rejecting materialism and in thus admitting a difference between living and non-living things. This difference is due to emergence. Living things are different because they have emerged from non-living things. Life has emerged from matter.

Furthermore, all the theories, with the exception of Lillie's, reject dualism. The living thing does not consist of two coexistent factors, the psychical and the physical. Rather the psychical, because it has emerged from the physical, embodies all that the physical contains.

What then has emerged in a living thing? Morgan and Bertalanffy maintain that a new relation or unique organization has emerged. Sellars maintains that the organization is characterized by internal purpose. But all three theorists agree that organization cannot be ascribed to a factor distinct from the physical.

Since emergentism is incompatible with materialism, physicalism cannot be the methodological approach of the biologist. Physical concepts alone are inadequate to explain life. Recognition of unique organization implies that the living thing must be approached holistically, that is, biological laws must be discovered through a consideration of the whole living thing, inasmuch as physical laws apply only

to the parts of the living thing. Sellars and Lillie assert that a holistic approach implies the use of teleological categories as well as physical categories. Therefore, the biological rule of procedure inherent in the emergent theory is physico-teleologism.

# CHAPTER IV

# PAN-PSYCHISTIC THEORIES

## Origins of the Pan-psychistic Theories

Pan-psychistic theories of the nature of life preserve the continuity of nature by maintaining that purpose is found throughout nature. Living things are of the same nature as physical things because physical things as well as living things are pervaded by purpose.

The forerunner of modern pan-psychistic theories of the nature of life was Leibniz's theory of spiritual atomism. The universe being complex and many-sided, Leibniz reasoned that it must, therefore, ultimately be composed of simple elements. By "simple elements" are meant "parts which are themselves incapable of any further division or analysis." These simple elements he called "monads". Furthermore, the monads or atoms cannot be material. A material thing must be an extended thing. If the monad were considered material it would have to be extended, but an extended thing could be further subdivided. Therefore, a monad in order to be a monad or a simple element must be immaterial or spiritual.

A monad, being immaterial, is really a set of activities which Leibniz terms "perceptions". In the monad we

find nothing else but perceptions and their changes. Perception is a shifting state that represents the multiplicity of the monad, that is, represents its relations to all other monads and represents thereby the universe. Appetition or desire is the internal principle of the monad which causes the passage from one perception to another. All monads are, therefore, souls because they are all characterized by perceptions and desires.

The problem of dualism is eliminated, for physical things are of the same nature as living things whether the living thing be man or amoeba. They are all reducible to monads. The Cartesian error, Leibniz maintained, was due to the failure to distinguish between "perception" and "apperception". "Apperception" is the conscious knowledge of perceptions. Descartes, equating apperception to perception, considered only human souls as monads. According to Leibniz the distinction between human souls and other monads is of degree rather than of kind. All monads are percipient but not all monads are self-perceiving. This distinction enables Leibniz to account for our distinction of "the physical world" from "the world of men":

> The passing condition, which involves and represents a multiplicity in the unit or in the simple substance, is nothing but what is called Perception, which is to be distinguished from Apperception or Consciousness... In this matter the Cartesian view is extremely defective, for it treats as non-existent those perceptions of which we are not consciously aware. This has also led them to believe that spirits [human souls] alone are Monads,

and that there are no souls of animals nor other Entelechies.[1]

## Henri Bergson's "Élan Vital"

One of the foremost exponents of a teleological theory of the nature of life has been Henri Bergson (1859-1941), famous French philosopher and biologist. The basis of Bergson's explanation of life is his explanation of time. Science, and mechanistic philosophy based upon science, has given all its attention to space and has neglected time. It is true that a time is assumed during which events take place, but it is abstract time. It is merely a condition of events happening. "All our belief in objects, all our operations on the systems that science isolates, rest in fact on the idea that time does not bite into them."[2] Moreover, time is commonly conceived and expressed in terms of space. A clock indicates time by hands moving in space. A physicist compares times by lines of various lengths on paper. Our science is a science of space not of time, for scientific time is spatial; that is, it can be divided up into an infinite number of independent and identical moments. However, real time or concrete time is duration. "Duration

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[1]Leibniz, "The Monadology", The Monadology and Other Philosophical Writings, trans. R. Latta (London: Geoffrey Cumberlage, 1948), p. 224.

[2]Henri Bergson, Creative Evolution, trans. Arthur Mitchell, Ph.D. (London: Macmillan and Co., Limited, St. Martin's Street, 1912), p. 9.

is the continuous progress of the past which gnaws into the future and which swells as it advances."[1] Duration is thus not one instant replacing the other. It is not spatial time. If so, there would only be the present. There would be no advance. "The more we study the nature of time, the more we shall comprehend that duration means invention, the creation of forms, the continual elaboration of the absolutely new."[2] Time makes a difference. There is an incommensurability between what goes before and what follows. In short, there is duration.

Abstract time or spatial time is an adequate concept in dealing with material objects or matter. Matter is spatial and determined:

> Either it remains as it is, or else, if it changes under the influence of an external force, our idea of this change is that of a displacement of parts which themselves do not change.[3]

> ...any state of the group may be repeated as often as desired, and consequently the group does not grow old. It has no history. ...Thus nothing is created therein, neither form nor matter. And as there is nothing more in the form of the whole than the arrangement of its parts, the future forms of the system are theoretically visible in its present configuration.[4]

Therefore, science with its reliance on laws and consequent prediction is adequate in dealing with material objects.

But living things defy science. The concept of concrete time is necessary. The very nature of life is time:

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[1] Ibid., p. 5.

[2] Ibid., p. 11.

[3] Ibid., p. 8.

[4] Ibid., p. 9.

> Like the universe as a whole, like each conscious being taken separately, the organism which lives is a thing that endures. Its past, in its entirety, is prolonged into its present, and abides there, actual and acting. How otherwise could we understand that it passes through distinct and well-marked phases, that it changes its age--in short that it has a history? ...Wherever anything lives, there is, open somewhere, a register in which time is being inscribed.[1]

Therefore, the distinctive feature of an organized body or living thing is that it grows and changes without ceasing. Time makes a difference.

Furthermore, the living thing is an individual. It is a system closed off by Nature, herself, and is composed of unlike parts and diverse functions. Only living things can be said to be individuals, for non-living things, as a crystal, do not have this diversity of parts or functions.

The organism is distinguished from inorganic matter by its tendency to individuation. It is, therefore, not comparable with any inorganic cut-out portion of the universe:

> We must no longer speak of life in general as an abstraction, or as a mere heading under which all living beings are inscribed. At a certain moment, in certain points of space, a visible current has taken rise; this current of life, traversing the bodies it has organized one after another, passing from generation to generation, has become divided amongst species and distributed amongst individuals without losing anything of its force, rather intensifying in proportion to its advance.[2]
>
> ...life is like a current passing from germ to germ through the medium of a developed organism.[3]

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[1] Ibid., pp. 16-7.

[2] Ibid., p. 27.

[3] Ibid., p. 28.

Life, then, is an impulse (élan vital) that is divided into many forms, "for life is tendency and the essence of a tendency is to develop in the form of a sheaf, creating by its very growth, divergent directions among which its impetus is divided."[1] But this tendency is never fully realized for it meets with the resistance of matter:

> When a shell bursts, the particular way it breaks is explained both by the explosive force of the powder it contains and by the resistance of the metal. So of the way life breaks into individuals and species. It depends, we think, on two series of causes: the resistance life meets from inert matter, and the explosive force--due to an unstable balance of tendencies--which life bears within itself.[2]

Since each moment adds something new as the stream of life produces living things, the future could not, even with infinite knowledge, be prophesied, as alleged by the mechanistic hypothesis of science. Physics and chemistry will never give the key to life. Chemical synthesis has never yet succeeded in reconstructing anything but the waste products of vital activity:

> ...those who are concerned only with the functional activity of the living being are inclined to believe that physics and chemistry will give us the key to biological processes. They have chiefly to do, as a fact, with phenomena that are repeated continually in the living being, as in a chemical retort. This explains, in some measure, the mechanistic tendencies of physiology. On the contrary, those whose attention is concentrated on the minute structure of living tissues, on either genesis and evolution, histologists and embryogenists on the one hand, naturalists on the other, are interested in the retort itself, not merely in its con-

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[1] Ibid., p. 104. [2] Ibid., p. 103.

> tents. They find that this retort creates its own form through a unique series of acts that really constitute a history. Thus, histologists, embryogenists, and naturalists believe far less readily than physiologists in the physico-chemical character of vital actions.[1]

The mechanist's thesis is refuted by a consideration of that real time which constitutes the nature of life. The mechanist's thesis deprives time of its efficacy. It does nothing and is nothing. Therefore, since time is nothing, life is nothing:

> Radical mechanism implies a metaphysic in which the totality of the real is postulated complete in eternity, and in which the apparent duration of things expresses merely the infirmity of a mind that cannot know everything at once. But duration is something very different from this for our consciousness, that is to say, for that which is most indisputable in our experience. We perceive duration as a stream against which we cannot go. It is the foundation of our being, and, as we feel, the very substance of the world in which we live. It is of no use to hold up before our eyes the dazzling prospect of a universal mathematic; we cannot sacrifice experience to the requirements of a system. That is why we reject radical mechanism.[2]

Bergson also rejected what he termed "radical finalism". "Radical finalism" can be condemned on the same basis as radical mechanism. "Radical finalism" supposes all is given because it implies that all beings merely realize a programme previously arranged. Can time, then, make a difference? For time to make a difference, the plan must be behind us rather than before us. "Harmony, therefore, does not exist in fact; it exists rather in principle; I mean that the original impetus is a common impetus, and the higher we

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[1] Ibid., p. 38.

[2] Ibid., p. 41.

ascend the stream of life the more do diverse tendencies appear complementary to each other..."[1] Also, finality must, be external, common to all life, rather than internal, specific to each individual living thing:

> The organized elements composing the individual have themselves a certain individuality, and each will claim its vital principle if the individual pretends to have its own. But, on the other hand, the individual itself is not sufficiently cut off from other things, for us to allow it a 'vital principle' of its own. ...If there is finality in the world of life, it includes the whole of life in a single indivisible embrace.[2]

Not only is life different from matter because it is of the nature of duration, but reality itself is of the nature of life or of the nature of duration. "Reality is mobility. Not <u>things</u> made, but things in the making, not self-maintaining states, but only changing states exist."[3] Life is things in the making for "life is movement".[4] Therefore, life is reality. Matter, on the other hand, is a "movement which is the inverse of [life's movement]."[5,6] Hence, Science that tells us

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[1] <u>Ibid</u>., pp. 53-4. [2] Ibid., pp. 45-6.

[3] Henri Bergson, <u>An Introduction to Metaphysics</u>, trans. T. E. Hulme (New York: The Liberal Arts Press, 1949), p. 49.

[4] Henri Bergson, <u>Creative Evolution</u>, p. 263.

[5] <u>Loc. cit</u>.

[6] Bergson's conception of matter and its relation to life is very puzzling. Even though matter is the "extension" of the "unmaking" of the"making" which is life, why is it that life should "unmake" itself and why should the "unmaking" be extended? Stated differently, Bergson's fundamentally pan-psychistic position seems to resolve itself into a dualistic position for a reason that is not apparent. We seem to be left with the same distinction between a living and a non-living thing that a dualist would make.

of matter cannot tell us of reality any more than it can tell us of life, for life is reality.

Since Science is inadequate, is there a method for dealing with life or reality? There is such a method: intuition. "Life, that is to say consciousness launched into matter, fixed its attention either on its own movement or on the matter it was passing through; and it has thus been turned either in the direction of intuition, or in that of intellect."[1] The intellect is "fascinated by the contemplation of inert matter,"[2] and has thus evolved the scientific method. But the scientific method can deal only with matter. If it deals with life, it treats it as if it were dead and therefore fails. "The intellect is characterised by a natural inability to comprehend life."[3] However, intuition allows us to comprehend life. "It is to the very inwardness of life that intuition leads us,--by intuition I mean instinct that has become disinterested, self-conscious, capable of reflecting upon its object and of enlarging it indefinitely."[4]

> What, then, is this faculty of intuition? There is nothing mysterious in this faculty. Everyone of us has had occasion to exercise it to a certain extent. Anyone of us, for instance, who has attempted literary composition, knows that when the subject has been studied at length, the materials all collected and the notes all made, something more is needed in order to set about the work of composition itself, and that is an often very painful effort to place ourselves directly at the heart of the subject, and to seek as deeply as possible an impulse,

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[1] Ibid., pp. 191-2.

[2] Ibid., p. 170.

[3] Ibid., p. 174.

[4] Ibid., p. 186.

> after which we need only let ourselves go. This impulse, once received, starts the mind on a path where it rediscovers all the information it had collected, and a thousand other details besides; it develops and analyzes itself into terms which could be enumerated indefinitely. The farther we go, the more terms we discover; we shall never say all that could be said, and yet, if we turn back suddenly upon the impulse that we feel behind us, and try to seize it, it is gone; for it was mot a thing, but the direction of a movement, and though indefinitely extensible, it is infinitely simple. Metaphysical intuition seems to be something of the same kind.[1]

In the above quotation, Bergson attempted to set forth the approach of the intuitionist. It is by this approach alone, he maintained, that we can come to know the true nature of life which is duration.

## A. N. Whitehead's "Organisms"

Other philosophers have seen in pan-psychism a significant approach to the problem of the nature of life. A. N. Whitehead (1861-1947), English mathematician, logician and thinker of great prominence, was such a philosopher. He maintained that the concept of organism must be fundamental to all of nature. Evolution demands that we no longer consider living things alone as organisms. Reality must be of the nature of organism, for matter cannot evolve into organism. Only organism can produce more complex organisms:

> ...a thoroughgoing evolutionary philosophy is inconsistent with materialism. The aboriginal stuff, or material, from which a materialistic philosophy starts is incapable of evolution. This material is in itself the ultimate

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[1]Bergson, An Introduction to Metaphysics, pp. 59-60.

> substance. Evolution, on the materialistic theory, is reduced to the role of being another word for the description of the change of external relations between the portions of matter. There is nothing to evolve, because one set of external relations is as good as any other set of external relations. There can merely be change, purposeless and unprogressive. But the whole point of the modern doctrine is the evolution of the complex organisms from antecedent states of less complex organisms. The doctrine thus cries aloud for a conception of organism as fundamental for nature.[1]

"Biology [then] is the study of the larger organisms; whereas physics is the study of the smaller organisms."[2] The organisms of biology are composed of the smaller organisms of physics, while the smallest organisms of physics must be the primary organisms. These primary organisms are, like the monads of Leibniz, incapable of further analysis. "It seems very unlikely that there should be any infinite regress in nature."[3] There must be unanalyzable primary organisms.

If we would know the nature of life, we must know the nature of the primary organism or primary entity; that is, the nature of reality. Since there is continuity in nature, all differences are differences of degree not of kind:

> The strength of materialistic mechanism has been the demand, that no arbitrary breaks be introduced into nature, to eke out the collapse of an explanation. I accept this principle. But if you start from the immediate facts of our psychological experience...you are at once led to the organic conception of nature...[4]

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[1]Alfred North Whitehead, Science and the Modern World, (New York: The Macmillan Company, 1926), p. 157.

[2]Ibid., p. 150.

[3]Ibid., p. 151.

[4]Ibid., p. 107.

What, then, is the character of these primary entities? "There can be only one answer... We must start with the event as the ultimate unit of natural occurrence."[1] The primary entities are events. Reality is process or activity. "Concrete fact is process."[2] Events are occurrences within the process. "Each event is an individual matter of fact issuing from an individualisation of the substrate activity."[3] Within activity or process, events are the realization of actuality.

Events have two main characteristics: extensiveness and aim. By "extensiveness" is meant that the event develops upon a stage of space and time. It is spread over space and goes through time. By "aim" is meant that the event is oriented toward a goal.

First let us consider extensiveness. "There is no such thing as nature at an instant."[4] "Every event extends over other events, and every event is extended over by other events."[5] The spatial factor has been dethroned from its position of dominance. Previously, as Whitehead tells us, "the ultimate fact embracing all nature is a distribution of material throughout all space at a durationless instant of

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[1] Ibid., p. 151. [2] Ibid., p. 103.

[3] Loc. cit.

[4] Alfred North Whitehead, The Concept of Nature (Cambridge: Cambridge University Press, 1930), p. 57.

[5] Ibid., p. 59.

time, and another such ultimate fact will be another distribution of the same material throughout space at another durationless instant of time."[1] In other words, spatiality imparted the reality to the event. The status of the temporal factor was negligible. Relativity has shown that the time factor must be included. To take an illustration from Whitehead's writings,[2] Cleopatra's Needle is an object of perceptual experience which resolves itself into a phase in the universal life of nature, "the ether of events",[3] characterized by extensity in all dimensions, the temporal included, and therefore into a system of happenings or events. Some of these are changes due to the London atmosphere. Its surface may enter into chemical combination with the acid of the London fog. Others are electrical events which provide situations for the scientific objects we call molecules, atoms, and electrons.[4] The point of chief importance is that, by the inclusion of the time factor, Cleopatra's Needle considered as a whole becomes a complex event completely integrated with other events. Nature or reality is thus a process, a whole, in which all the events, parts, are

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[1]Alfred North Whitehead, An Enquiry Concerning the Principles of Natural Knowledge (Cambridge: Cambridge University Press, 1925), p. 2.

[2]Whitehead, The Concept of Nature, p. 166.

[3]Whitehead substitutes "the ether of events" for "material ether" to express that something is going on everywhere and always. Ibid., p. 78.

[4]Ibid., pp. 170-1.

interlocked. In Whitehead's words, "If you abolish the whole, you abolish its parts; and if you abolish any part, then that whole is abolished."[1]

The second main characteristic of an event is aim. Whitehead explains process in terms of teleology. The A which is in process of becoming B is not merely changing at random but orienting its changes towards B as a goal:

> We have only to transfer to the very texture of realisation in itself that value which we recognize so readily in terms of human life... Realisation therefore is in itself the attainment of value... The definite finite entity is the selected mode which is the shaping of attainment; apart from such shaping into individual matter of fact there is no attainment.[2]

The values to be attained or the goals are the eternal objects. The "eternal objects [are] pure potentials for the specific determination of fact or [are] forms of definiteness."[3] The eternal objects are the forms of Aristotle and, as such, attract the process towards its realization in events. Eternal objects, in Whitehead's own phrase, are the "lures" for the process. The eternal objects through their ingression produce the definiteness of the actual entities or events; that is, the values of the events.

The event is complete within itself, but incomplete

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[1]Alfred North Whitehead, Process and Reality (New York: The Macmillan Company, 1929), p. 442.

[2]Whitehead, Science and the Modern World, pp. 136-7.

[3]Whitehead, Process and Reality, p. 32.

when considered in relation to the world process.[1] God is the infinite eternal object. He is not merely one lure eliciting one particular event but the infinite lure towards which all process directs itself:

> He is the lure for feeling, the eternal urge of desire. His particular relevance to each creative act, as it arises from its own conditioned standpoint in the world, constitutes him the initial object of desire establishing the initial phase of each subjective aim.[2]

God through his attraction produces the "creative advance into novelty".[3]

Living things are complex organisms and as such possess all the characteristics of the primary organism or event:

> There are also organisms of organisms. Suppose for the moment and for the sake of simplicity, we assume, without any evidence, that electrons and hydrogen nuclei are such basic organisms. Then the atoms, and the molecules, are organisms of a higher type, which also represent a compact definite organic unity. But when we come to the larger aggregations of matter, the organic unity fades into the background. It appears to be faint and elementary. It is there, but the pattern is vague and indecisive. It is a mere aggregation of effects. When we come to living beings, the definiteness of pattern is recovered, the organic character again rises into prominence.[4]

How does Whitehead describe the organic character of life? "...The characteristics of life are absolute self-

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[1] Ibid., pp. 327-8.

[2] Ibid., p. 487.

[3] Ibid., p. 529.

[4] Whitehead, Science and the Modern World, pp. 161-2.

enjoyment, creative activity, [and] aim."[1] However, these marks of life can be shown to be marks of all events.

First let us consider self-enjoyment. "Self-enjoyment" means "a certain immediate individuality, which is a complex process of appropriating into a unity of existence the many data presented as relevant by the physical processes of Nature."[2] Whitehead uses the term, "prehension", to indicate this self-enjoyment.[3] But prehension "was introduced to signify the essential unity of the event, namely, the event as one entity, and not as a mere assemblage of parts or of ingredients."[4] Thus, self-enjoyment can be seen to be a mark of all reality and not of life alone.

Let us next consider creative activity. Creative activity consists in the transformation of the potential, eternal objects, into the actual, events. In the words of Whitehead, "process for its intelligibility involves the notion of a creative activity belonging to the very essence of each occasion [event]."[5] Hence, creative activity is characteristic of life for it is an event. But it is also

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[1]Alfred North Whitehead, Nature and Life (Cambridge: Cambridge University Press, 1934), pp. 61-2.

[2]Ibid., p. 58.

[3]"Prehension" is used instead of "perception", since "perception" in common usage includes the notion of cognitive apprehension. Prehension may be cognitive (as in man) or non-cognitive (as in the remainder of reality). Whitehead, Science and the Modern World, p. 101.

[4]Ibid., p. 106.

[5]Whitehead, Nature and Life, p. 59.

characteristic of all events; that is, of all reality.

Finally, let us consider aim. "By this term 'aim' is meant the exclusion of the boundless wealth of alternative potentiality, and the inclusion of that definite factor of novelty which constitutes the selected way of entertaining those data in that process of unification."[1] A "way of enjoyment" or eternal object is selected from the wealth of alternatives. It is aimed at for actualization in the event which is life. But all events are also selections and are, therefore, characterized by aim. All reality is characterized by aim.

Since life is characterized by self-enjoyment, creative activity and aim, what method can be used in the study of life? Whitehead answers:

> Science can find no individual enjoyment in Nature; science can find no aim in Nature; science can find no creativity in Nature; it finds mere rules of succession. These negations are true of natural science. They are inherent in its methodology. The reason for this blindness of physical science lies in the fact that such science only deals with half the evidence provided by human experience. It divides the seamless coat--or, to change the metaphor into a happier form, it examines the coat, which is superficial, and neglects the body, which is fundamental.[2]

Since science is blind to the true nature of life and reality, the methodology of science is inadequate in the study of life and in the study of reality.

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[1] Ibid., p. 61.

[2] Ibid., p. 66.

## J. S. Haldane's "Life as Reality"

J. S. Haldane (1860-1936), an English scientist who is famous chiefly for the discovery that the regulation of breathing is normally determined by carbon dioxide tension in the respiratory center of the brain, was another modern exponent of the pan-psychistic theory of the nature of life. Living things are of the nature of physical things because physical things are of the nature of living things. There is continuity in nature because all of reality is of the nature of life. In the words of Haldane:

> The fact of the co-ordination, as clearly shown in the phenomena of life, is inconsistent with the fundamental assumption that bodies and actions exist in space independently of one another. Hence we cannot form a consistent physico-chemical conception of visible reality, and must regard it...as life, making the conception of life not only the basis of the science of biology, but also an ideal for a deeper understanding of the whole of visible reality.[1]

Haldane arrived at a pan-psychistic theory of the nature of life because he found both materialistic and dualistic theories inadequate. Materialism and dualism could not explain our observations of living things. "It is upon what we can actually observe that we must base our conception of life and our scientific treatment of it; and the co-ordination of the structure and activity which we observe in the life of an organism is evidently of its very essence."[2]

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[1] J. S. Haldane, The Sciences and Philosophy (London: Hodder and Stoughton Limited, 1928), p. 331.

[2] Ibid., p. 95.

Materialism could not explain the coordination of structure and activity which is characteristic of life. Materialistic theories in explaining the fact that organisms maintain their specific structure and behavior--that is, this coordination--must assume in them all kinds of specific structure. But that structure is reproduced from generation to generation. Of this reproduction the physical theory can give no account. Furthermore, that structure is also being reproduced constantly in ordinary metabolic activity, that is, the structure is maintained. Of this maintenance the physical theory also can give no account:

> ...and the more structure and chemical complication we actually discover or assume in an organism, the more hopeless does the problem of its reproduction and maintenance become from a mechanistic [physical] standpoint. Thus from its first beginnings the mechanistic [physical] theory of life was embarked on a hopeless task.[1]

Dualism is also an inadequate theory of the nature of life. It explains the coordination of structure and activity that is characteristic of life by a guiding interference in the form of a vital principle. The living thing is of the same nature as a physical thing because it consists of a material body. Nevertheless, this material body is subject to a guiding interference. This dualistic position is inadequate for it is "impossible to demonstrate [the] influence [of the vital principle] apart from that of physical and chemical influences."[2] "What still remains mysterious is the

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[1] Ibid., p. 58.

[2] Ibid., p. 71.

specific co-ordination of activity, and corresponding organization of structure."[1] The vital principle is as mysterious as the mystery it attempts to explain.

What, then, is the interpretation the biologist should give to life? The biologist must accept as provisional the physico-chemical interpretation of life. In describing the phenomena of life the biologist cannot help making use of physico-chemical description. "Underlying this provisional interpretation, however, is the postulate that biological interpretation must be ultimately possible."[2]

> If we compare the biological with the physical interpretation of experience we find that life, though it appears to us as a struggle against physico-chemical mechanism, is something inherent in the apparent mechanism itself. Any other conclusion involves us in the impossible assumption that life is mere physico-chemical, or the equally impossible vitalistic [dualistic] interpretation. Despite appearances, therefore, the mechanism must be more than mechanism. The apparent independence of one another of different units of matter and energy can thus be no more than a superficial appearance. In other words, physical science deals with reality in only its superficial appearance...[3]

## Summary of the Chapter

This chapter has presented three theories which agree with the materialistic contention that living things and non-living things are of the same nature.[4] However, they disagree

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[1] Ibid., p. 73. [2] Ibid., p. 186.

[3] Ibid., p. 184.

[4] Bergson's theory may be an exception. See page 78 of this study.

with materialism because they assert that non-living things share in the psychical. Non-living things are more than matter. Furthermore, these theorists disagree with dualism inasmuch as all things, not only living things, are psychical. But the nature of a living thing is the same for the pan-psychist as for the dualist. A living thing is both physical and psychical.

Since a living thing is both physical and psychical, physicalism is inadequate as a method. The method must be physico-teleologism. Bergson would add that the teleological part of the method is the method of intuition.

# CHAPTER V

# CONCLUSION

## Classification of Theories

In this study, various prominent theories of philosophers and biologists have been grouped on the basis of similarity in respect of explanation of the status of living things in the universe. Then a general theory has been abstracted from each group of similar theories. The following four metaphysical theories emerged:

(1) Materialism: Although a living thing appears to be different from a non-living thing, it is "really" the same as a non-living thing. Both life and non-life are material or physical, for only matter--defined as "the object of physical science"--is real or operative.

(2) Dualism: The living thing not only appears to be different from the non-living thing, but is "really" different. The living thing consists of two coexistent factors--a physical and a psychical ("psychical" here means not so much "mental" as "having an anima")--while the non-living thing consists only of one factor, a physical.

(3) Emergentism: The living thing not only appears

to be different from the non-living thing, but is "really" different. It is different because it has emerged from the non-living thing. Life has emerged from matter. Because a living thing has emerged, it contains a new organization or relatedness of matter that is not found in a non-living thing.

(4) Pan-psychism: Although the non-living thing appears to be different from the living thing, it is "really" the same as a living thing. Both non-life and life are psychical as well as physical, for the psychical factor is operative throughout reality.

## Classification of Methods

From the four metaphysical theories emerged two methodological approaches. If we schematize the four metaphysical theories in the following manner:

(1) Materialism: non-life ≡ physical
life ≡ physical

(2) Dualism: non-life ≡ physical
life ≡ physical + psychical

(3) Emergentism: non-life ≡ physical
life ≡ physical + psychical[1]

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[1]Most emergentists assert that an unobservable principle--the psychical--should not be called upon to account for the difference between living things and non-living things. But must this assertion not be set aside? Even though the emergentist maintains that life has emerged from non-life, that is, that the sufficient conditions of life are material in nature, he nevertheless contends also that knowledge of these sufficient conditions is not sufficient to account for or to predict the characteristics of life. Such a position seems hardly tenable.

(4) Pan-psychism: non-life ≡ physical + psychical
life ≡ physical + psychical,

we observe that there are only two possibilities as to the nature of a living thing. A living thing is either matter or both matter and psyche. According to the materialist, the living thing is only physical. According to the dualist, emergentist, and the pan-psychist, the living thing is both physical and psychical. Consequently, there are only two possible methods:

(1) Physicalism: Since a living thing is only physical, the concepts of physical science are adequate in explaining life.

(2) Physico-teleologism: Since a living thing is both physical and psychical, the physical concepts alone are inadequate. The concept of purpose is necessary also.[1]

There are sub-forms of physicalism depending upon the physical concepts utilized in explaining life. One sub-form that has been clearly defined is mechanism. The mechanistic approach employs the concepts of matter and motion, and the Newtonian laws of motion in explaining life. Other physical concepts, such as electricity, the concepts of field physics and the concepts of quantum physics, have been and are being employed in the explanation of biological

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[1]"Purpose" is taken very broadly here. It does not mean "the will or intention to achieve some end or goal" but rather "the end itself". See pages 98 and 99 of this study.

phenomena. When these non-mechanistic approaches have reached the stage of definition that has been reached by mechanism, they too can be designated by specific terms as sub-forms of physicalism.

On the other hand, there do not seem to be any sub-forms of physico-teleologism. There is apparently only the one view that physical concepts are not sufficient and that somehow the category of purpose as well as physical concepts must be utilized in explaining life.

## Inadequacy of Mechanistic-Vitalistic Classification

The terms, "mechanism" and "vitalism", were found inadequate as designators of the two methods which emerged from the metaphysical theories.

"Mechanism" is inadequate to designate the methodological approach to life that relies solely on physical concepts. Its inadequacy follows from its restrictive nature. "Mechanism" designates an explanation of life in terms of Newtonian concepts. But other physical concepts have been employed. Consequently, an all-inclusive term, "physicalism", must be put in the place of the restrictive term, "mechanism"; and the term "mechanism" must be relegated to the designation of a sub-form of physicalism.

"Vitalism" is inadequate as a term to designate the method which utilizes the concept of purpose as well as

physical concepts in explaining life. Its inadequacy results from confusion in its use. "Vitalism" has been used at times to designate the metaphysical theory of dualism and at other times to designate this methodological approach. Therefore, the term "physico-teleologism" was introduced instead of "vitalism" to designate this method.

## A Possible Solution

If physicalism and physico-teleologism are taken as metaphysical assertions they are incompatible. The physicalist who asserts that living things can be explained only in terms of the physical contradicts the physico-teleologist who asserts that the concept of purpose is also necessary in explaining life. This clash between beliefs or expressions of faith cannot be resolved on empirical grounds. If the physico-teleologist appeals to the characteristics of life--the automatic integration of structure and activity, the self-preservative property, and the maintenance through continual interchange with environment--that have thus far evaded physicalism, the physicalist need but reply: "We have but to proceed by the physical method and these characteristics will be eventually explained." The physico-teleologist, however, will continue to maintain that these characteristics are inexplicable without recourse to the concept of purpose. Hence, we are faced with two metaphysical

assertions, both of which cannot be true. Yet we have no means of deciding upon one or the other unless there be tests of the truth of metaphysical assertions. But what such tests would be is not at all clear. Consequently, we are asked to make a profession of faith either in physicalism or in physico-teleologism.

But must the matter rest here? Kant did not think so. Need we assert what living things "really" are? Instead of metaphysical assertions, let us rather consider, with Kant, how we, due to the particular constitution of our understanding, must deal with living things.

To begin with, events within a living thing do appear to us as succeeding one another. There is succession. Event B does replace event A. A differentiated stage in the embryo does replace an undifferentiated stage. Furthermore, we can apprehend B only as following upon A and not as preceding A. Since our apprehension of living things is of this nature, there must be an a priori rule of succession given by the understanding to make our apprehension what it is:

> ...we must derive the subjective succession of apprehension from the objective succession of appearances. Otherwise the order of apprehension is entirely undetermined, and does not distinguish one appearance from another... The objective succession will therefore consist in that order of the manifold of appearance according to which, in conformity with a rule, the apprehension of that which happens follows upon the apprehension of that which precedes. Thus only can I be justified in asserting, not merely of my apprehension,

> but of appearance itself, that a succession is to be met with in it. This is only another way of saying that I cannot arrange the apprehension otherwise than in this very succession...[1]

Because the principle of efficient causality is necessarily true--it is given by our understanding in response to our actual observation of sequences--living things can be conceived of in physical terms. Predictions can be made because efficient causality obtains.

Yet physical terms are inadequate to explain our conception of a living thing. In the realm of biological phenomena, it looks very much as if purpose were operative. The living process appears to be one in which the completed product, before it is completed, influences and directs the process of its own completion, or in which a whole, resulting from a combination of parts, nevertheless causes the parts to combine as they do:

> In a natural product, each part not only exists by means of the other parts, but is conceived as existing <u>for the sake of</u> the others and of the whole, that is, as an instrument or organ; and not only so, but its parts are all organs reciprocally producing one another... Only a product of this kind is called a natural end, and it receives this name just because it is an organized and self-organizing being.
>
> Organized beings are the only things in nature which in themselves and apart altogether from their relation to other things, can be conceived to exist only as ends.[2]

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[1]Kant, <u>Critique of Pure Reason</u>, trans. N. K. Smith (London: Macmillan Company, 1929), p. 196.

[2]Kant, "The Critique of Judgment", <u>The Philosophy of Kant</u>, selected and trans. J. Watson (Glasgow: James Maclehose and Sons, 1919), p. 328.

Since this interdependence of the natures and functions of the parts of an organism on each other, and their dependence on the character of the whole of which they are parts cannot be explained by us through the utilization of the principle of efficient causality, there must be yet another a priori principle. The principle is this: "An organized product of nature is one in which all the parts are reciprocally end and means."[1]

But at the same time this principle cannot be "constitutive" but only "regulative", for the notion of end is only an idea existing in the judging subject. "...it is merely a regulative principle, or a maxim, for judging of the internal purpose exhibited in organized beings."[2] Kant states the difference between these two kinds of principles in these words:

> There is a great difference between something being given to my reason as an object absolutely, or merely as an object in my idea. In the former case our concepts are employed to determine the object; in the latter case there is in fact only a schema for which no object...is directly given, and which only enables us to represent to ourselves other objects in an indirect manner, namely in their systematic unity, by means of their relation to this idea.[3]

Thus, the physical aspect of a living thing is given to my reason as an "object absolutely". I can apply efficient causality to determine the object. However, the teleological

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[1] Ibid., p. 329. [2] Loc. cit.

[3] Kant, Critique of Pure Reason, p. XXIV.

or purposive aspect is given to my reason as an "object in my idea". I now have a "schema" whereby I can apprehend the systematic unity which is characteristic of the living thing. I can view the living thing as if it received its plan from an intelligence. "The idea is thus really only a heuristic, not an ostensive concept. It does not show us how an object is constituted, but how, under its guidance, we should seek to determine the constitution and connection of the objects of experience."[1] We cannot say that purpose or "entelechy" actually exists in a living thing, and thus we avoid the fault of hypostatization. But it does show us how to seek to determine the constitution and connections of the phenomena within a living thing. The living thing must be approached holistically. The regulative concepts, therefore, do not form "constitutive principles for the extension of our knowledge to more objects than experience can give, but as regulative principles of the systematic unity of the manifold of empirical knowledge in general whereby this empirical knowledge is more adequately secured within its own limits and more effectively improved than would be possible, in the absence of such ideas, through the employment merely of the principles of understanding."[2]

> All that is implied is, that we ought in all cases reflectively to judge them [living things] by the principle of natural mechanism [the physical principle],

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[1] Loc. cit.

[2] Loc. cit.

and to make this principle the foundation of all our investigations, and apply it as far as we can, since without it there can, properly speaking, be no knowledge of nature at all. But this in no way prevents us, if occasion is given for it, from following the guiding-thread of the second principle in our reflection upon natural forms...the principle, namely, of final cause, which is quite distinct from that employed in the explanation of natural mechanism. The value of reflection of the [first] kind...is not in any way denied, but on the contrary we are told to follow it as far as we can. Nor is it said, that those forms are not possible at all on the principle of natural mechanism: all that is said is, that by following this path human reason will never be able to discover any ground of the specific character of natural ends, although it will certainly gain increased knowledge of natural laws. Thus it is left undetermined whether in the inner ground of nature, which to us is unknown, conjunction by physical mechanism and conjunction by ends may not themselves be connected together in the same thing by one principle. We must conclude, however, that our reason is not in a position to unite the two principles...[1]

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[1]Kant, "The Critique of Judgment", op. cit., pp. 333-4.

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