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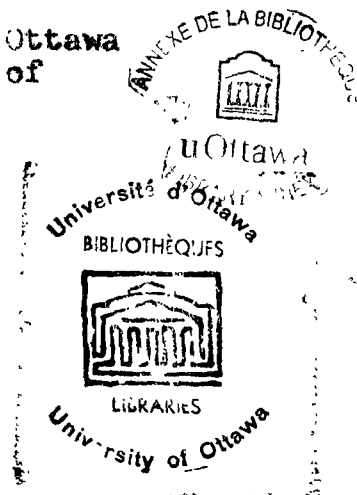
THE NATURE OF LIFE
IN
SAINT THOMAS AQUINAS
AND
SOME MODERN BIOLOGISTS

By

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PREFACE

Although the problem of the nature of the distinction existing between the world of the animate and that of the inanimate is no new one, there is no period in history when the question has been debated with more vigor than at the present. It is only during the last fifty years that a series of seemingly critical experiments has been devised to solve the problem biologically; it is only during that same period that the answers thus achieved have formed the basis and central theme of many biological and philosophical systems. The question of the assessment of these systems in terms of Thomistic philosophy, therefore, seems particularly opportune today.

I should like particularly to acknowledge my gratitude to Rev. Jacques Croteau, O.M.I., for his indispensable help as the director of this dissertation. His suggestions have been always fruitful, his criticisms invariably penetrating and enlightening. To my wife and to many kind friends I owe also a great debt for their sympathy, encouragement, and aid in the research, typing, and correction connected with this work. I am happy to acknowledge my indebtedness to their assistance.

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SECTION I
SIC ET NON

SECTION I

CHAPTER I

THE HISTORY OF THE PROBLEM

How long ago man began to wonder about the remarkable difference between living and non-living, who it was that first tried to find an explanation for the difference and called this cause a soul--these are problems that can never be solved, problems whose answers have been lost in the long, dim corridors of human memories.

Certain it is, however, that when the philosophy of nature drew its first speculative breath in ancient Greece, the problem of the soul was among the first to catch its infant fancy. For Thales, wise man of the early Greeks and founder of theoretical philosophy, is reported to have declared "that the magnet has a soul in it because it moves the iron."¹

Childish as such a statement may seem, it would be something less than clearsighted of us to overlook the fact that Thales' statement shows an incisive understanding of the relationship between motion and soul. It was this one problem of the peculiarities of motion as exhibited by living things together with an attempt at explaining the remarkable fact of

1. Aristotle, "De Anima" in The Basic Works of Aristotle, ed. by Richard McKeon, trans. by J.A. Smith, (New York: Random House, 1941) I, ch. 2, 405a21-22.

conscious knowledge that led to the answers Greek thinkers gave to the riddle of life.² Indeed the problems concerning the nature of life today are the same two.

Being reasonable men, these early nature philosophers agreed in demanding that some explanation for the unique phenomena of life be given, and this explanation they further agreed in calling by the name 'soul.' It must not be thought, however, that they were all what we would call animists or vitalists today, for they display a great variety of solutions to the problem of the nature of the soul.

Some were outright materialists and declared the soul to be one of the elements--fire for Democritus,⁴ air for Diogenes,⁵ and in Hippo the soul is water.⁶ "Each of the elements," Aristotle remarks ironically, "has thus found its partisans except earth."⁷ And even earth finds a part to play as co-principle of the soul in Empedocles, where the harmony of the four elements is considered to be the cause of life.⁸

2. Ibid., I, ch. 2, 403b25-27

3. e.g. in the arguments of Driesch. cf following chapter.

4. Because fire atoms are round, extremely fine, and hence most mobile. cf. Aristotle, op.cit., I, ch. 2, 405a8-13.

5. Because Diogenes thinks air is "finest in grain." Ibid., I, ch. 2, 405a21-24.

6. Since the seed of animals is fluid, Ibid., I, ch. 2, 405b1-2.

7. Ibid., I, ch. 2, 405b8

8. St. Thomas Aquinas, Quaestio Una de Anima, (Turin, Marietti, 1949), art. 1, c.

The outstanding exception to this general materialism among the pre-Socratic thinkers is found in Anaxagoras. His opinion recognizes a connection or perhaps even an identity of soul and mind--his analysis is somewhat vague at this point--and mind for him had nothing in common with anything else.⁹

In spite of such great diversities of opinions, however, as Aristotle points out there are a few points of view common to almost all of the pre-Socratic philosophers. These are the following: first, that the soul is a self-moving mover--the concept of an unmoved mover seemed to them less comprehensible than that of self-motion. Secondly, almost all those who considered the soul as the origin of sensation, impelled as it were by the realization that the likeness of the thing known must be in the knower, and interpreting this as a pre-existing likeness, concluded that the soul must somehow or another be made up of the elements of all other reality. The sole exception to this general rule was, as we have seen, Anaxagoras. Finally they all recognized a certain incorporeality and imperceptibility about the soul itself, and though few of them recognized that the soul was not matter, all agreed on making it a comparatively subtle kind of matter.¹⁰

With these views of the pre-Socratics, the conception of soul in the Platonic dialogues has much in common. For Plato, like many of his predecessors, started his analysis of soul

9. Aristotle, op.cit., I, ch. 2, 405b20-22

10. Ibid., I, ch. 2, 405b12

from the fact of knowledge, and like the others he considered that there must be a natural similarity between the knower and the known. Hence, in the Timaeus, Plato derived the nature of the soul from a composition of the elements of the Same (the indivisible and unchangeable), the Other (the divisible and mutable) and the Essence (a compound of the primary two)¹¹ after he had first derived the nature of the universe from the same elements.¹² Moreover, he explicitly attributed the fact of knowledge to the identity of principle in both soul and universe.¹³

Now as distinguished from the rest of the universe, the corporeal world was represented for Plato by the element "the Other" alone. Hence it is mutable whereas those things made from "the Same" are indestructible, and among these is the soul.¹⁴ Hence the soul not only is different in kind from the corporeal universe, but it is immortal as well. As a matter of fact, the soul differs so radically from the body that Plato considered it perfectly possible for the same soul to inhabit many different bodies.¹⁵ The relationship between them is merely that between an agent and his tools or between a weaver and his coat.¹⁶

11. Plato, "Timaeus," in The Dialogues of Plato, trans. by Jowett, (N.Y.: Random House, 1937) 41b.

12. Ibid., 35a

13. Ibid., 37a

14. Ibid., 41b, cf also Phaedo, 70a-90a.

15. Timaeus, 42a-b, Phaedo, 70a

16. Phaedo, 87b

Hence Plato, while affirming the need for a soul and the difference between that soul and matter, was so impressed by that distinction that he created an almost impassable gulf between soul and body. For him, in St. Thomas' words, "the human soul not only subsisted in itself, but also had the complete nature of a species."¹⁷

To some of these doctrines of Plato, Aristotle gives his full support. For the Stagyrte too there is an essential difference between the living and the non-living;¹⁸ for him as for his master the cause behind this difference is the soul. Moreover at least one kind of soul, the human, is independent of matter in some of its actions--those of the intellectual faculty¹⁹--and hence may be presumed to have in some sense that independence in being attributed to it by Plato.²⁰

Of Plato's division of the living thing into two complete substances, however, Aristotle will have no part. No soul, regardless of whether or not it is capable of action independent of the body, is merely related to its body as a rider to its horse or a pilot to his vessel; neither is it simply an extrinsic cause, efficient or final, of the body.²¹ On the

17. St. Thomas Aquinas, op.cit., art. 1, c.

18. cf. for example his explanation of the difference between the actions of the elements and those of the plants. Aristotle, op.cit., II, ch. 4, 416a3-17, and II, ch. 2, 413a23-25.

19. Ibid., III, ch. 4, 429a19-26

20. Ibid., III, ch. 5, 430a24

21. Ibid., II, ch. 4, 415b8-11. The soul is the efficient and final cause of the body, but it is the formal cause as well.

contrary the soul is the act of the body itself, indeed it is the first act, the form, or the 'entelechy' of the body.²² Hence soul and body together form one single substance; it makes as little sense to ask whether soul and body are one as to ask ask whether a wax seal and its shape are one.²³

For Aristotle then the soul is the (in a way) unmoved source of the unique type of motion exhibited by living things; it is the source, as well, of sensation and of intellectual knowledge. Because these activities differ from those of matter, every soul has a certain immateriality that differs from one genus of soul to another and that rises to a state of independence from matter in the case of the mind. Nevertheless, even this independent principle is related to matter in an essential union, for the soul is the form of the body. To these concepts and, particularly, to the reasons for their enunciation we shall return when we analyze the notion of life in St. Thomas Aquinas.

After the time of Aristotle, as is well known, the predominant interest of Greek and Roman philosophy was ethical. It was only as a by-product or substantiation of some system of moral philosophy that any speculations on natural philosophy were produced at all. One of these systems, however, has had a profound influence on modern philosophical and scientific thought, and for that reason it must be mentioned here.

This development was a revival of the atomism of Democritus by the school of Epicurus, and by the best known of the

22. Ibid., II, ch. 1, 412b6

23. Ibid., II, ch. 1, 412b6

Roman Epicureans, Titus Lucretius Carus, commonly known as Lucretius. According to this doctrine, there exists nothing but atoms and the void. Between one atom and another there is no specific difference but only in their individuality and at most in their size and shape. It is the differing arrangements of these atoms that constitute the body and create the obvious differences between one body and another.

The soul, then, like any other reality, is only a body and is easily corruptible. Its peculiar activities, however, suggest that it must be made of extremely fine, highly motile atoms, identified by Democritus as fire atoms and later by Lucretius as the atoms of warmth, air, and aura (an extremely rarified air.)²⁴

From the time of the overthrow of the Roman empire, of course, until the Scholastic revival there was little active speculation about the nature of life. It is true that among the Arabian philosophers there continued to be discussions of various problems connected with the Aristotelian analysis of the human soul--for example concerning the individual or universal nature of the agent intellect²⁵--and this discussion was continued by Moses Maimonides.²⁶ These questions, however, have only a remote connection with philosophical considerations of the nature of life itself; nevertheless the connection is present, and a

24. cf. Eric Nordenskiöld, The History of Biology, trans. by Eyre, (N.Y.: Tudor, 1928), pp. 46-49

25. St. Thomas, De Anima, art. 5, c.

26. Ibid., art. 3, 6th objection.

great deal of medieval thought about the necessity and the nature of the soul was prompted by discussion of these problems.

The philosophers of the Scholastic period were almost universally animistic in their conception of life. The source of this agreement, of course, is largely found in the Christian faith of these philosophers, and in the overwhelming influence exerted by the Platonic and later by the Aristotelian philosophical traditions and writings. As the opinions of St. Thomas are typical of the period, and as his insight into the reasons for such an opinion is far deeper than that of most of the Scholastics, it will be preferable to allow a more comprehensive resume of medieval opinions on the subject to wait for explanation until the detailed study of the Angelic Doctor's teaching in the second part of this book.

The decadence into which Scholastic philosophy fell shortly after the time of St. Thomas, and the reintroduction into the culture of western Europe of the writings of more and more authors of the Greco-Roman world began to turn the eyes of Renaissance philosophers in new directions in search of answers for the ultimate problems of nature. The first radical sign of this exploration of new theoretical lands in philosophy is found in Giordano Bruno. The half-mystical and wholly materialistic pantheism of Bruno is based largely upon the atomism of Lucretius. Although he did not treat of the nature of life specifically, it is obvious that Bruno in his pantheism has laid a metaphysical foundation for a denial of specific differences between living and non-living; whereas his atomism established

a basis in the philosophy of nature for explaining the operations of living things.²⁷

Contemporaneous with the swing away from the philosophical principles of Scholasticism, and indeed closely connected with this reaction, is the rise of the modern empiriological sciences. The idea of Lord Bacon, who is ordinarily credited with being the earliest theorist of the empirical sciences, is to establish the connection of subject and predicate in philosophical propositions by means of an exhaustive enumeration of instances. His aim was to found a new philosophy of nature.²⁸ And in believing that this new and more accurate method would lead to new philosophical knowledge of the world, Bacon was joined by Galileo²⁹ and Newton.³⁰

Moreover, it is interesting to note that the method and principles presupposed by the latter two scientists lead inevitably to atomism. The experimental method, seeking as it does principles of corporeal being that can exist and be observed by themselves, implicitly attributes to those principles the common characteristic of extension. The principle of inertia too, regarding the action of any being as simply the vector

27. cf. Harold Hoffding, History of Modern Philosophy, trans. by Meyer, (N.Y.: Humanities Press, 1950) I, 134.

28. Lord Francis Bacon, Novum Organum, ed. by Fowler, (London: Oxford Press, 1889). cf. his Praefatio to this work, pp. 185-189.

29. Galileo Galilei, Dialogues concerning Two New Sciences, trans. by Crew and de Salvis, (N.Y.: Macmillan, 1914)

30. Sir Isaac Newton, Principia Mathematica Philosophiae Naturalis, trans. by Motte, ed. by Cajori, (Berkeley: U. of California Press, 1947) p. xvii.

sum of outside forces, denies the presence of any intrinsic form or source of motion, and thus reduces every corporeal being to a machine.³¹

Thus revived and sponsored by the new sciences, atomism was applied without delay to the biological sciences. Here the groundwork was installed once again by a philosopher, Descartes.

It is an error to classify Descartes, as is usually done, among the opponents of vitalism, for with regard to the human being, at least, Descartes admitted the existence of a soul. Not every action regarded as a vital phenomena, however, must be attributed, according to Descartes, to a soul; on the contrary the phenomena observable in plants and animals are explicable solely upon mechanistic grounds. As a matter of fact, the human body itself is in its own proper nature a machine, which in turn is under the direction of the soul. For atomism as such, no argument was advanced by Descartes; his theory, nevertheless, resembles atomism insofar as matter has no characteristic besides extension, and hence is able to change in regard to place alone.³²

It was immediately following the time of Descartes that the first great groundswell of mechanism appeared in the history of biology. Indeed, like all the other experimental sciences,

31. A more extended discussion of this point will be found in Section II, ch. I of this book. cf also Vincent Smith, Philosophical Physics, (N.Y.: Harper & Bros., 1950) pp. 25-31.

32. cf. R.E. Brennan, Thomistic Psychology, (N.Y.: Macmillan, 1941) pp. 76 f. Also J. Van der veldt, "The Evolution and Classification of Philosophical Life Theories," in Franciscan Studies, vol. III (June, 1943) p. 119

biology had just recently made an appearance as an independent science, and even at the period of which we are talking, the study was being carried on for the most part by physicians anxiously in search of fresh anatomical knowledge by means of the new methods.³³

The first of the great mechanists in this stripling age of biology was Giovanni Alfonso Borelli. A pupil of Galileo's, Borelli applied the principles of his master to the task of describing the actions of muscles on limbs. Encouraged by the remarkable success of this attempt, Borelli boldly held out the hope in his work that the whole range of life phenomena would eventually be explained on mechanistic, or at least chemico-mechanistic grounds.³⁴

Similar to Borelli in both his theory and his work was Claude Perrault, an amateur biologist who held to the classic theory of atomism as proposed by Epicurus and Lucretius, a theory that he apparently inherited by way of Gassendi.³⁵

Following Borelli and Perrault is a long line of mechanists including Nicolaus Steno who is as notorious to certain scandalized modern scientists for his conversion to Catholicism as he is well known for his work in geology, paleontology, and biology,³⁶ Friederick Hoffman, a disciple of that colorful

33. Nordenskiöld, op.cit., pp. 98-107. There were exceptions of course, as, for example, Leonardo da Vinci, who undertook his anatomical studies for artistic purposes.

34. Ibid., pp. 151-3; cf. also Van der Veldt, op.cit., III, 120-121.

35. Nordenskiöld, op.cit., pp. 153-155.

36. Ibid., pp. 155-158

mountebank, Paracelsus,³⁷ Hermann Boerhaave, a celebrated Dutch physiologist whose life theory closely approximates that of Descartes,³⁸ Stephen Hales, a devoted follower of Newton and a spare-time biologist who performed some highly ingenious and enlightening quantitative experiments with nutrition,³⁹ and even, oddly enough, that self-styled mystic, Emanuel Swedenborg.⁴⁰

The climax and almost simultaneously the end of this first great period of mechanism in the history of biology came during the time of La Mettrie. Whereas the biologists mentioned above almost universally admitted the existence of spiritual as well as material substances, La Mettrie remorselessly drove the theories back to the materialism in which they were conceived. The soul, at most, is a function of the body; the brain secretes thought as the liver secretes bile; and the body, finally, is no more than a machine.⁴¹ Whether such radical theories warned biologists away from the mechanistic view, or whether they were rather deterred by the comico-tragic death of La Mettrie,⁴² it is a fact, nevertheless, that his death in 1751 brings to an

37. Ibid., pp. 176-178; Van der Veldt, op.cit., III, 121.

38. Nordenskiold, op.cit., pp. 183-186; Van der Veldt, op.cit., III, 121.

39. Nordenskiold, op.cit., pp. 252 f.

40. Ibid., pp. 186-189

41. Van der Veldt, op.cit., p. 121.

42. He seems to have died of food poisoning incurred while satisfying an excessive taste for truffle pastry. This end, which, in view of his epicurean views and life, is one of the purest recorded cases of poetic justice and provided endless preachers with a gold-mine of sermon material. cf. Nordenskiold, op.cit., p. 239

end the first great period of mechanism, and the theory was not to reappear in any force for almost a hundred years.

Even a superficial perusal of this period makes it obvious that the mechanism professed by a majority of the scientists mentioned was not of the complete, anti-vitalistic sort professed by La Mettrie and by the later Darwinistic school. They are almost universally still influenced by the Christian traditions and admitted (even Boerhaave, who seems to have been more of a disciple of Spinoza than a Christian) the existence of a human soul differing substantially from the body. Moreover, they generally followed Descartes in positing some sort of spiritus animales to explain the existence of certain vital phenomena, such as sensation and locomotion;⁴³ and concerning the nature of those animal spirits there is room for a good deal of misunderstanding. How they differ, for example, from the "vital spirits" of Harvey it is often difficult to perceive. It is illuminating in this connection that the historians of the mechanistic controversy frequently disagree on which side some particular thinker belongs.⁴⁴

Although during the period just discussed, the mechanists were the most strongly represented group, it must not be thought that the vitalistic theory was lacking in champions.⁴⁵ as a

43. Re Descartes' theory, cf. Nordenskiöld, op.cit., p. 124. Borelli postulated a "vital spirit" (Ibid., p. 153), Perrault a "substance spiriteuse" (Ibid., p. 155) and so on.

44. e.g. Perrault who is classed as a mechanist by Nordenskiöld, but as a vitalist by Van der Veldt, op.cit., III, 135.

45. "Vitalism" is used here simply to describe any theory postulating an essential difference between the living and the non-living.

matter of fact, one of the great vitalistic proponents, Harvey, was a contemporary of Descartes, and the other outstanding vitalistic figure of the period, Stahl, was a close friend of the Friederich Hoffmann mentioned above.

Harvey, of course, is best known for his mathematical demonstration of the circulation of the blood; but he is also the author of a work (Exercitationes de generatione animalium) concerning the development of embryos, and it is here that he most clearly presents his theory of vitalism.⁴⁶ Here he expressly attributes to the embryo a soul distinct from that of the parents and developed from a "primordium vegetale" in the egg by the agency of a rather vague "opifex."⁴⁷ His theory is sometimes referred to as being "faithful to Aristotle,"⁴⁸ but his conception of the unity of the living organism seems to be of an accidental unity of many substantially distinct parts.⁴⁹

A more adequate Aristotelianism was proposed by Georg Ernest Stahl. While his mode of expression is often obscure, Stahl agrees with Aristotle that the phenomena of life, the organic processes, and particularly the obvious finality of living things demand a unique principle, a principle that together with

46. The "spiritus vitalis" mentioned in Harvey's work Exercitatio de motu cordis et sanguinis in animalibus is also considered a vital force, but its nature is somewhat ambiguous. cf. Van der Veldt, op. cit., III, 135.

47. Hans Driesch, History and Theory of Vitalism, trans. by G. K. Ogden, (London: Macmillan, 1914) pp. 26-30

48. Nordenskiöld, op. cit., p. 118

49. Van der Veldt, op. cit., III, 296-297.

the body forms a substantial unity. Hence, the organism is neither simply a machine, nor is it a machine inhabited and directed by a soul. The body is at once formed by the soul, controlled and guided by the soul, and finds in the soul its end.⁵⁰

There were many lesser vitalists during the same period, including J. B. van Helmont, who postulated a "smith" (Archaeus) as cause and director of the body's vital activities,⁵¹ Caspar Friederich Wolff, a scientist of great repute who seems to base his theory of life solely on his inability to imagine an external mechanical force sufficient to supply plants with the water they need for life, and reduces this "vis essentialis" to a status similar to and co-ordinate with the physico-chemical forces found in the organism.⁵²

During the period immediately following the life of La Mettrie, the theory of vitalism gained in strength. Just as the great successes of the mechanistic theory in explaining certain of the life phenomena--e.g. of bodily motions in terms of levers applied by the muscles--had led to the hope that these principles might someday be able to explain life itself, so later the failure of the methods to realize these hopes resulted in a reversion to earlier beliefs in the unique nature of phenomena of life and in the need for an explanation of these phenomena differing from those given in mechanics. As a matter of fact,

50. Driesch, op.cit., pp. 31-44. cf also Nordenskiold, op.cit., pp. 181-183, and Van der Veldt, op.cit. III, (Sept. 1943), pp 296-297.

51. Driesch, op. cit., pp. 24-26.

52. Ibid., pp. 44-49

so evident did this seem to most biologists at this time that few of them saw the least necessity for proof of this assumption.⁵³

One important difference, however, separates the vitalists of the following period, at least in general, from the earlier thinkers already mentioned, the fact, namely, that most of the later scientists united in disclaiming any knowledge of the nature of this vital cause. Such an attitude, of course, had appeared in science as early as Newton's "Hypotheses non fingo,"⁵⁴ and it had been repeatedly reinforced by the opinions of succeeding scientists as well as by such philosophers as Locke and Hume. Furthermore, this attitude received its greatest philosophical justification in the works of Kant, works which were written during the years under discussion.⁵⁵

Thus we find Albrecht van Haller (1707-1777) listing the qualities of irritability and sensibility as being characteristic of life as opposed to non-living things, but refusing to draw any conclusions whatsoever as to the nature of the cause.⁵⁶ In this same category may be mentioned Blumenbach who adds to Haller's list of vital operations a "formative impulse" (nisus formativus) to account for the evolution of the embryo out of an apparently

53. Ibid., p. 100.

54. Newton, op. cit., p. 547.

55. This outlook was no mere historical accident, but was the logical outcome of the methodological and philosophical presuppositions of empiriological science. cf. Jacques Maritain, Philosophy of Nature, (N.Y.: Philosophical Library, 1951), pp. 46f.

56. Van der Veldt, op. cit., §II, 135. However Haller recognized the mind as an indivisible principle of human life, cf. Nordenskiöld, op. cit., p. 236.

undifferentiated mass. This "nisus" is, however, merely a power among powers, and moreover its very nature is unknown.⁵⁷

Another representative of this same tendency is Georges Cuvier, the celebrated French anatomist. In his Leçons sur l'anatomie comparée, Cuvier affirms the radical difference in operation of living things, inasmuch as the ordinary physical and chemical forces are opposed and overcome by the tendencies of life. But the word "life" itself represents only "a summary of the phenomena that have given rise to its formation."⁵⁸ The nature of life in itself is unknowable.

Among the other proponents of this view that we recognize different powers in living and non-living beings without an adequate knowledge of either the nature or the cause of this difference may be mentioned Barthey (1734-1806), a French scientist, and Bichat, (1771-1802), founder of the tissue theory.⁵⁹

Others during this period of reaction to the surge of mechanism postulated a somewhat more explicit theory, which, however, was no more adequate in the long run than were those of the relative agnostics above. This was a theory espoused by George Louis Leclerc de Buffon that there are simply two kinds of matter, living and non-living. It is true he represents the living particles as being united in one body by a "moule intérieur", a sort of vital force, but what the relation is between this force and the life of the particles is not entirely clear.⁶⁰

57. Driesch, op. cit., pp. 57-65.

58. Quoted by Nordenskiöld, op. cit., p. 334

59. Van der Veldt, op. cit., III, 130.

60. Driesch, op. cit., pp. 4-42.

Similar to this idea was that of Johann Christian Weill (1759-1813), who derived his theory from a variation of Kantian epistemology. For him, all that existed was either matter or idea, and since plants and animals seem to antedate ideas, their characteristics can only come from matter.⁶¹ Hence he postulates not one but three kinds of living matter.⁶²

Going farther than these contemporaries is a third group of the same period that postulates a definite cause or force responsible for life, a theory that appears in various combinations with those of agnosticism and of living matter.

One of the earliest and most controversial of these figures was Charles Bonnet, a Swiss scientist and philosopher. He is variously classed as an Aristotelian animist⁶³ and as an anti-vitalistic mechanist.⁶⁴ It seems clear, however, that Bonnet attributed a unified, indivisible soul to all animals,⁶⁵ but criticizes Stahl and his school for neglecting research in favor of too easy explanations by means of the soul.⁶⁶

61. Driesch, op. cit., pp. 98-100

62. Nordenskiöld, op. cit., p. 313.

63. By Van der Veldt, op. cit., III, 297

64. By Driesch, op. cit., p. 50. Driesch's chief ground seems to be that Bonnet upheld the pre-formation theory; and since the pre-formation theory denies what is in Driesch's opinion the most obvious proof of vitalism, he classes all pre-formationists as mechanists.

65. Hence he is hard pressed for an explanation of regeneration in an earthworm, but solves the problem by assuming the diffusion throughout the body of germ cells capable of becoming the besouled organism. cf. Nordenskiöld, op.cit., p. 245.

66. Ibid., p. 247.

Quite as controversial a figure as Bonnet is Alexander von Humboldt (1769-1859), who in his youth published a mythological story, Die Lebenskraft oder der rhodische Genius, upholding the existence of a soul, but later held this same work up to his students as an example of romantic, juvenile foolishness, an example to be avoided.⁶⁷

Also included under this category of vitalists who have explicitly attributed a unique cause to life phenomena is the group called by Driesch the Dogmatic school. This comprised a group of German scientists from Treviranus to Müller who agreed in assuming the existence of a life force without proof and who attempted to explain this life force in terms of the romantic German nature-philosophy of the time.

In the writings of Treviranus himself (1774-1864) the idea of a vital force is combined with that of a kind of matter peculiar to life, i.e. Reil's concept of living matter; and in this combination of elements he is followed by F. Tiedemann and, more remotely, by Oken.⁶⁸ Treviranus attributed to the "vis vitalis" the function of maintaining the uniformity of bodily phenomena in spite of environmental changes. Neither matter, nor a property of matter, this force is nonetheless conceived of as quantitative.⁶⁹

To this function of the soul, Tiedemann adds that of producing the more complex chemical compounds found in organisms.

67. Ibid., pp. 314f.

68. Driesch, op. cit., pp 105 f.

69. Ibid., pp.103f.; Van der Veldt, op.cit., III, 130.

He also points out the state of rest to which inanimate compounds tend and the continuous activity of animate things, as well as the difference in growth between crystals and organisms.⁷⁰

Oken, on the other hand, seems to have produced some rather wild theories of life; he claimed, for example, that all generations of life took place spontaneously from decaying organic matter. However, he did assert the irreducibility of organic to inanimate phenomena.⁷¹

The mixture of the assertion of a vital force and a refusal to investigate its nature is best illustrated by K. F. Burdach, a member of this same dogmatic school. He insists that there must be a cause peculiar to the phenomena of life, but goes no further in its study. In a burst of philosophic confidence, he finally does declare that the vital force is the "primordial thought realizing itself within certain limits."⁷²

Of all the Dogmatists, the clearest and most thorough analyst is Johannes Müller (1801-1859). In his Manual of Human Physiology, (1840), Müller proposed several functions for the soul: to organize the activities of organisms, to explain the obvious finality of living things, to produce the organic compounds, and so on. To explain these, he posited an "organic creative force," which he identifies with the soul of Stahl.⁷³

70. Ibid., p. 108.

71. Nordenskiöld, op. cit., p. 288

72. Quoted by Driesch, op. cit., p. 111.

73. With the difference that he disagrees with Stahl concerning the consciousness of the life-force. Ibid., p. 116.

Thus , through his adoption of Stahl, Müller returns to the long-avoided stream of the Aristotelian solution.⁷⁴

The forces which were to produce a second surge of mechanism, however, were already forming during Müller's life; and the Darwinian controversy, which was to strike a temporarily decisive blow against vitalism, broke in the very year of Müller's death. But two other events took place at about the same time that had an influence on the question: Wohler's synthesis of urea, and Helmholtz's enunciation of the law of the conservation of energy.

One of the favorite arguments of the eighteenth century vitalists was exploded by the production of urea in a laboratory by Wohler (1800-1882).⁷⁵ We have already seen how frequently a soul was invoked as an explanation of the highly complicated chemical compounds found in organisms. When the superficiality of this argument had been exposed, therefore, by the production of even such a simple organic compound as urea out of cyan-ammonium, many scientists were led to believe that a fundamental fallacy had been discovered in the vitalist position.⁷⁶

This belief in the impending downfall of vitalism was strengthened by Helmholtz's enunciation of the law of the

74. Van der Veldt, op. cit., III, 298.

75. Wohler, however, was himself a vitalist and correctly perceived that the artificial synthesis of organic products had no bearing whatsoever upon the question of the existence of a vital principle. cf. J. S. Haldane, Philosophy of a Biologist, (Oxford: Oxford U. Press, 1935) p. 41.

76. cf. Nordenskiöld, op. cit., pp. 407-410

conservation of energy in 1847.⁷⁷ One of the basic arguments for a life force from the time of Aristotle had been that the soul was an originative principle of motion. Whether rightly or wrongly, this was interpreted to mean an absolute origin, so that the soul was credited with bringing into existence physical energy that had not before existed. Hence it seemed clear to many scientists that Helmholtz's principle had indeed removed the heart of the vitalist position.⁷⁸

When added to the above two factors, the influence of the theory of evolution, particularly in its Darwinian form, was nearly fatal to vitalism among biologists until the turn of the century. For the Darwinian theory, far from explaining the origin of mutations, had to attribute them, for lack of a competent agent, to chance alone. It was obvious, therefore, that since chance cannot explain a difference in natures, there is no such difference between one living thing and another, nor, indeed, between living and non-living.⁷⁹

With the advances in the physical sciences mentioned above, a co-cause of the resurrection of mechanism as a theory

77. The same law was enunciated in a purely speculative fashion two years earlier by Julius R. Mayer (1814-1878), but Helmholtz did the experimental work in confirmation of the principle. cf. Nordenskiöld, op. cit., pp. 407-410.

78. Ibid., p. 407.

79. The flagrant petitio principii involved in reasoning of this sort seems to have been overlooked. As Chesterton once pointed out, the Darwinian theory appeals to the common human failing of regarding the impossible as quite conceivable if it only happens slowly enough. For the Darwinian theory's basis in chance, Ibid., p. 467

of life was the rise in the nineteenth century of a materialistic philosophy opposed to the romantic identity-philosophy descended from Kant.⁸⁰ The principle representatives of this movement were Büchner (1824-1899),⁸¹ Moleschott (1822-1893),⁸² and Vogt (1817-1895).⁸³

The combination of these elements led to the violent anti-vitalist reaction during the last half of the nineteenth century. The signs, however, of this revolution had long been apparent, and many eminent biologists had turned again to mechanical explanations as the ultimates in the phenomena of life. Most famous of these, perhaps, is Jean Lamarck, (1744-1829), who seems to have admitted the autonomy of life processes, but for fear of introducing "supernatural" factors into scientific explanation, posited mechanical movement alone as the cause of vital phenomena.⁸⁴ Also numbered among the rejectors of vitalism because of its "unscientific" character were the eminent Swedish chemist, J. J. Berzelius (1779-1848),⁸⁵ and Francois Magendie (1785-1855), a French physician and physiologist of note.⁸⁶

80. Driesch, op. cit., p. 137.

81. Nordenskiöld, op. cit., p. 452.

82. Van der Veldt, op. cit., III, 323-324.

83. Nordenskiöld, op. cit., p. 451. Vogt seems almost universally remembered for just one sentence: that the brain "produces ideas as the liver produces bile and the kidneys urine." Quoted by Nordenskiöld, p. 451.

84. Driesch, op. cit., p. 95, footnote.

85. Van der Veldt, op. cit., III, 122.

86. Ibid., III, 122.

A sort of midway position between vitalism and mechanism was adopted about this time by the physiologist and philosopher, Claude Bernard. Pointing out that the supposed life force performed no activities independent of purely physical forces, and that it complicated explanations by introducing into the picture extra-physical and non-material forces, Bernard rejected vitalism, only to postulate in turn that vital phenomena were not explicable in terms of the physical laws as they operated in the inanimate world. From these conflicting facts, Bernard evolved a theory that postulated life as being bound by the same laws as the rest of the world--but that the laws in this case are especially determined to suit the kind of thing in which they are applied. This solution Bernard called "Determinism."⁸⁷

Among the scientists influenced against the life force theory by its apparent contradiction of the principle of the conservation of energy were the two scientists responsible for the enunciation of the principle, Mayer and Helmholtz,⁸⁸ and in addition the German scientists, Carl Ludwig (1816-1895),⁸⁹ and Emil du Bois-Reymond(1818-1896).⁹⁰

The culmination of these waves of revolt was reached in the attitude of the followers of Darwin. The treatise, On the

87. Driesch, op. cit., pp134-136.

88. cf. supra, pp 22-23

89. Nordenskiold, op. cit., pp. 413-414.

90. Ibid., pp. 411-413. Du Bois-Reymond points out the fact that "force" is a product and quality of matter, and not something autonomous. He was willing to admit the inexplicability of vital phenomena, but simply adopted an agnostic attitude about possible causes of such behavior.

Origin of Species was published in 1859 and it was immediately adopted by the mechanists as the key to the remaining difficulties in their position. The finality apparently present in living things no longer needed a cause--the organs were merely chance variations preserved by natural selection. No more was there a necessity of a supra-sensible explanation of, for example, embryonic development, for this process was simply a recapitulation of the history of the race. Indeed the study of the organs in a dynamic relation to their activities--a study that implies an assumption of finality in some form,--lay almost entirely neglected for forty years while the static science of comparative morphology "celebrated a perfect witches' orgy" in the construction of hypothetical phylogenetic trees and the framing of ill-based laws.⁹¹

To give him credit, Darwin himself spent little effort trying to draw out philosophical results of his investigations, though he seems to have gravitated towards a rather placid agnosticism towards the end of his life.⁹² However, some of his followers, for example Huxley and Spencer, became quite militant in their agnosticism,⁹³ while others such as Haeckel found in Darwinism the basis of a thoroughgoing mechanism.⁹⁴

91. Driesch, op. cit., p. 10.

92. Nordenskiöld, op. cit., p. 476.

93. Ibid., pp. 49 and 476.

94. Ibid., p. 513.

Once again, however, after the high water of mechanism had been reached in the last years of the nineteenth century, the tide began to flow in the other direction with ever-increasing strength. It would be too much to say even today that the majority of biologists were vitalists; indeed most of them make an at least implicit working assumption of mechanism, which they regard as the only profitable basis of biological inquiry.⁹⁵ Nevertheless, many factors conspired to bring about a shift in the philosophical presuppositions of some of the most eminent biologists. Let us see what some of these factors were.

First may be mentioned the failure of mechanism once again to live up to its great promises. Great strides had been made during the preceding decades in explaining some of the more mechanical aspects of organic activities particularly by the use of the newly improved microscope;⁹⁶ nevertheless, at the end of this process the actual differences between living activities and those of inanimate ones were as far from being explained as they had been in the beginning.⁹⁷ As the earlier mechanistic movement had died out because of this failure, a

95. cf. for example, the statement of Horatio Hackett Newman, "The Nature and Origin of Life," in The Nature of the World and of Man, ed. by H. H. Newman, (Chicago: U. of Chicago Press, 1933) p. 165. "When used as a working hypothesis the mechanistic principle has simply justified itself--so long as a hypothesis is fruitful in unlocking the secrets of nature it is doing all that could be asked of it. No wonder, then, that modern biology is so frankly mechanistic and so inhospitable to vitalism!"

96. Driesch, op. cit., p. 139.

97. cf. J.S. Haldane, op. cit., pp 38-39.

similar reaction set in towards the end of the nineteenth century.

Other factors too had their part in the movement. One of these was a revival of interest in the branch of biology known as physiology, the study of organic processes in living things. As we have already seen, this branch of research had largely been neglected during the Darwinian period in favor of the more static analysis of anatomical or morphological likenesses. The more dynamic study, therefore, when interest in it was revived by W. Roux,⁹⁸ contributed largely to the revival of vitalism, for these very activities are our principle source of evidence for the comparative study of living and non-living.

Intimately associated with this revival of physiology and parallel to it was a direction of attention away from the largely futile pre-occupation with constructing evolutionary family trees towards a study of the development of the individual. Called Ontogeny, this discipline studies the embryonic evolution, not as a textbook of pre-historic reminiscences, but from the point of view of explaining the part played in the development of the individual by each stage in the foetal growth. Thus Ontogeny, given its greatest impetus by Wilhelm His and Alexander Goette⁹⁹ tried to replace the purely historical explanations of the phylogenists with more scientific causal (and, as it happened, at least implicitly teleological) explanations.

98. Roux himself was a mechanist, but many of his followers defected to the vitalist camp. cf. Driesch, op.cit., p.171.

99. Ibid., p. 150.

In the meantime, help was coming to the vitalistic cause from a somewhat unexpected source. It will be recalled that in addition to reducing all motion to locomotion (the point on which it is especially attacked by vitalists), mechanism embraces the atomistic viewpoint that everything is made up of actually distinct and divided particles. This presupposition was now attacked by a scientifico-philosophical movement known as "holism." This theory denied that many of the facts of experience can be understood as simply the sum of its material parts--atoms, chemical compounds, and organisms, for example, are wholes which are not simply a combination of their parts in the sense that a rock pile is the sum of the rocks. This opinion has reached the height of its popularity in the Gestalt Psychology of W. Kohler,¹⁰⁰ but the movement had been vigorous long before the time of Kohler in the works of A. Mayer,¹⁰¹ Jan Christian Smuts,¹⁰² and many others.

There was, of course, a reaction against Darwinism from the very first by men who still clung to the vitalism of an time. Karl Ernst von Baer (1792-1876), for example, opposed Darwin bitterly and advanced a life-theory in which life was described as a process controlling physico-chemical events and

100. Robert E. Brennan, Thomistic Psychology, (N.Y.: Macmillan, 1941) pp. 346-348.

101. Van der Veldt, op. cit., III, 286

102. It must not be concluded that every holist is a vitalist, although holism certainly undermined the opposed theory of mechanism and, carried to its logical conclusion, results in animism, as we shall see later. However, many holists are materialists, as for example are Kohler and Meyer. cf. Van der Veldt, op. cit., III, 279-281 and 287.

and not resulting from them.¹⁰³ Among the others opposing Darwin at the same time were the vitalists von Hanstein¹⁰⁴ and Wigand.¹⁰⁵

As the reaction to mechanism gained strength, a great profusion of vitalistic theories were expounded--a profusion so great, indeed, that it is difficult to give any concise summary of them. Owing to the extremely complex nature of most of the theories, to reduce them to a logical outline is to work an obvious injustice upon the thinkers responsible for them, inasmuch as the process of cramming the thoughts of these men into set categories is bound to sheer off some of the more important characteristics of their vitalism. If we follow this plan, therefore, it is only to get a quick overview of the most important aspects of modern life theories. A more adequate exposition of the solution of a characteristic member of this movement, Hans Driesch, will be presented in the next chapter.

It is worthy of note that the starting points in modern explanations of life are still those that puzzled the forerunners of Aristotle. Now as then the problems are to explain the facts of consciousness and of the peculiar sort of motion to which living things are subject.

One of the most conspicuous groups studying life primarily from the point of view of the existence of consciousness is called the psycho-vitalistic school. Impressed as all modern vitalists are by the striking finality of living beings, and

103. Driesch, op. cit., pp. 151-152.

104. Ibid., pp. 153-154.

105. Nordenskiöld, op. cit., p. 483.

relying upon a basically true but incomplete analysis of the relation between finality and consciousness, this school sees a necessity of attributing a conscious instinct in every living thing to account for its goalward tendencies. For some this instinct in every living thing is also an explanation of evolution.¹⁰⁶ One of the earliest members of this group was Gustav Bunge, whose vitalism was of a merely tentative sort, adopted until more accurate information should be available.¹⁰⁷ Another prominent defender of this position is Meumeister who consistently points out the irreducibility of psychic to material phenomena.¹⁰⁸ Generally classified as psycho-vitalists are A. Pauly, R. H. France, P. Jean, A. Wagner, and Schneider.¹⁰⁹

Closely associated with the theory that the life force is essentially the source of cognition is the hypothesis known as mnemonism, that finds in irritability the characteristic feature of life, and in nerve energy its proper cause. In the theory developed by Hering, Simon, and Rignano, this nerve energy is received by living things in small energy-packets called "nervions," and their reception is the physiological concomitant of irritability, sensation, and of conscious life in general. Similarly, the storage of such nerve energy-packets is taken to account for the physiological side of memory (hence the name of

106. Van der Veldt, op. cit., III, 138-139.

107. Driesch, op. cit., pp. 156-157.

108. Nordenskiold, op. cit., p. 608.

109. Van der Veldt, op. cit., III, 138-139; cf. also Driesch, op. cit., p. 181.

the school) and for the process of evolution as well.¹¹⁰ Somewhat similar but philosophically more sound is the theory of Bergson who also finds in memory the distinctive feature of living things.¹¹¹

Among those biologists who took the unique activities of living things in general (i.e. nutrition, growth, and in particular reproduction and regeneration) for the starting point of their theories, some continue, nevertheless, to accept the mechanistic assumption that the organism is simply a harmonious combination of parts, whereas others, impelled by the holistic tendencies mentioned above, incline towards the view of the organism as a substantial unity.

In the ranks of those who admit a substantial multiplicity in organisms can be found one of the pioneers of the neo-vitalistic movement, L. C. Virchow. Believing that the organism possessed special energies, Virchow, nevertheless, asserted the material nature of these. He is, thus, a transition figure, suspended midway between materialistic mechanism and the revival of vitalism.¹¹²

Closer to the vitalistic position but still wavering on the border line is Johannes Reinke, who was one of the foremost opponents of Haeckel in Germany, and whose work has had a profound influence on later theories. Reinke postulates forces

110. Van der Veldt, *op. cit.*, III, 139-141. Notice the similarity, even in nomenclature, to the quantum theory of physics.

111. *Ibid.*, III, 142.

112. *Ibid.*, III, 137.

of two different kinds--physical and directive. It is in the latter, directive forces that living things differ from non-living. In inanimate things these directive forces are called "system-forces" and are mechanical in nature; in living organisms these forces are named "Dominants" and are presumably--but not certainly--of a non-mechanical nature.¹¹³

More definitely vitalistic but still maintaining the substantial multiplicity of organisms is Gustav Wolff. This scientist thought to prove the finality of nature by means of a series of experiments concerning regeneration, e.g. that of the lens in a water-newt's eye when damaged or even totally removed. On account of this experimentally proved teleology, Wolff found a specific difference between living and inanimate things; hence he postulates a vital force to account for this difference.¹¹⁴

Best known of all the proponents of vitalism is Hans Driesch, whose solution of the problem of life we shall study in more detail in the next chapter.

In partial opposition to the above school we find another whose vitalism is again based on an analysis of motion, but whose views return more closely to the Aristotelian conception of the living organism as a substantial unity.

Not all of the scientists who profess this theory, however, are perfectly consistent in their exposition of it. Von

113. Driesch, op. cit., pp. 180-181.

114. Ibid., pp. 175-176.

Uexküll, for example, though he begins by finding the principal difference between living and non-living in the wholeness of the organism, ends in attributing autonomy to the cells, and makes of the organism an accidental unity.¹¹⁵

Similarly, MacDougall, finding an intrinsic finality in living things not found in machines, at once affirms the unity of the organism and the existence of a teleological factor of a non-mechanical sort. He admits, however, with Plato and Descartes, the purely accidental unity of body and soul.¹¹⁶

Others, perhaps more consistent in their theories, insist strictly on the wholeness and uniqueness of the organism. The gestalt theory, for example, is adapted to a vitalistic form by von Bertalanffy¹¹⁷ and Putter,¹¹⁸ both of whom find the difference characteristic of animate gestalts in the autonomy and intrinsic finality of vital actions. The vitalism of von Bertalanffy, however, is of a somewhat tentative nature, inasmuch as he admits their biological laws may someday be reduced to those of physics.

Also prominent among the vitalistic theorists holding to a substantial view of the organism can be numbered J. S. Haldane, an avowed anti-mechanist, who, nevertheless, attacks the vitalism that makes of its principle an entirely independent and

115. Van der Veldt, op. cit., III, 180-181.

116. Ibid., III, 294-295.

117. Ibid., III, 298-300.

118. Ibid., III, p. 301.

autonomous subject without substantial ties to the body,¹¹⁹ von Manakov, who calls his vital principle "horme,"¹²⁰ and Sapper, a biologist whose theory of vitalism approaches quite closely the Aristotelian ideal.¹²¹

Not all vitalistic biologists, of course, argue to the existence of a vital principle from an analysis of knowledge alone or from a study of motion only; some use arguments of both sorts. Such, for example, are the arguments of Edmund Montgomery, an American philosopher who must be classed among the vitalistic holists,¹²² Eduard von Hartmann, propounder of the recently popular "Metaphysics of the Unconscious,"¹²³ and R. Wolterek, who proposed a life principle known as the "reaction-norm," a regulative principle that determines the adjustment of the organism to the external factors.¹²⁴ The latter two thinkers tend rather to dualism than to holism in their analysis.

In all these various opinions on the nature of living things and of the life principle, there are certain common emphases that may be noted. One is the revival of the ancient debate about the substantial unity or diversity of the organism, a question that had been regarded for hundreds of years as having received its final philosophical solution in Descartes,

119. J. S. Haldane, op. cit., pp 38-41

120. Van der Veldt, op. cit., III, 293.

121. Ibid., III, 301-305.

122. Driesch, op. cit., pp. 103-105.

123. Ibid., pp. 158-160

124. Van der Veldt, op. cit., III, 290-292.

its ultimate scientific answer in the mechanism of Galileo and Newton. That this question should be reconsidered at this particular time has added greatly to the philosophical profundity of modern discussions. The renewal of the discussion was due, in no small part, to the revival of interest in psychology during the 19th century and a consequently greater realization of the difficulties involved in psycho-physical parallelism and body-soul interactionism as explanations for the relation existing between the material and psychic aspects of human life.¹²⁵

Of equal importance was the assumption made by the biologists of this period that the problem of the nature of life is soluble upon strictly experimental grounds; hence, we find the modern arguments for a vital principle based, for example, on the ontogenetical studies of Roux and Driesch and the regenerative experiments of Wolff. The problems connected with the sources of evidence in this controversy raise many difficulties and considerable attention must be given to their solution.¹²⁶

Obviously the issues involved in all these positions are complex and varied. Nevertheless, I think that two questions stand out clearly as being of primary importance, all the others being simply subordinate to those two and frequently dictated merely by the approach taken to the solution of these crucial problems. The really critical difficulties that must be met by the proposers of theories of life are, first of all, the question

125. Brennan, op. cit., pp. 76-78

126. This problem will be investigated in the chapter on the relations of philosophy and science, Section II, Chapter I.

of whether the organism constitutes a single substance or a variety of substances as it does in the strictly atomistic explanation of life, and secondly, whether there is a difference in kind--a specific difference--between the realm of living organisms and the world of the inanimate.

It is ordinarily on the basis of these two problems, as Van der Veldt perspicaciously notes, that we make our distinctions between the various theories of life.¹²⁷ Both vitalists and animists are firm proponents of the view that there is undoubtedly a specific difference between the living organism and the kingdom of inert matter, and that there must be a life principle that accounts rationally for this difference. These theories, however, are distinguished from each other by their divergences concerning the unity of the substance of the organism. The so-called animists, following Aristotle, insist upon the union of organism and life principle in such a way that one substance only results; a vitalist, on the other hand, will insist at least upon a duality of substances, as in the horse and rider metaphor of Plato, and sometimes upon a great plurality of substances, one a principle of life and all the rest constitutive of the machine through which the life-source manifests itself, as, for instance, in the speculations of Hans Driesch.

Those who deny the essential difference between living and non-living are usually known simply as mechanists, but this classification is obviously inadequate since it fails to take

127. Van der Veldt, op. cit., III, 113-114

into account the basic differences among the anti-vitalists on the question of the unity of the organism. As we have already noticed, a mechanist in the classical sense not only denies the essential difference between living and inanimate, but holds firmly to the atomistic concept of matter and posits an at least numerical multiplicity of substances within the organism. Side-by-side with this mechanism, however, there exists a school of anti-vitalistic thought that seeks to overcome the shortcomings of mechanism by affirming the unity of the organic substance; these, for lack of a more traditional name, we have called anti-vitalistic holists.¹²⁸

Our discussion of these two basic problems will be approached from the aspect of investigating the validity of the philosophical assumptions necessarily made by anyone giving a view on the subject. In connection with the specific difference, therefore, between the animate and the inanimate, it seems that the first pre-requisite is to make some sort of philosophic judgment on the nature of the genus to which both belong, i.e. the class of mobile being. In this connection, a discussion of the final cause of motion is particularly important, since among those things which have goals, it is this end itself that furnishes the principle of difference between one thing and another. Moreover, in connection with any answer to the question of whether or not the organism constitutes a substantial unity, it is certainly necessary to have some preliminary knowledge of

128. Ibid., III, 278

what constitutes a unity, of the kinds of unity, of what marks are characteristic of a substantial unity, and of what sort of composition, if any, that unity might allow.

Of course, in our treatment of the vitalistic opinion of Hans Driesch and the anti-vitalism of J. B. S. Haldane, it will not be possible to make analyses of these points where none exist. Nonetheless an awareness of these problems and of their importance will be useful even while studying these men, and later an explicit account of their assumptions concerning these problems will have to be made in order to give validity to any critical evaluation of their opinions.

SECTION I

CHAPTER II

THE VITALISM OF HANS DRIESCH

To many a modern biologist or thinker conversant with the problem of the nature of life, an examination of the neo-vitalist position is practically identified with the study of the views of Hans Driesch. Not that Driesch alone today defends the vitalistic fortifications, for those who uphold the autonomy of life are many and distinguished. Indeed, if some happy chance brings unanimous agreement some day on the true nature of life, it may well be seen that many of Driesch's contemporaries in the service of vitalism have had deeper insights and profounder explanations than his have been. Nonetheless, it is Driesch's name that first is mentioned in every modern summary of the problem, his views first discussed, his objections given first hearing.

Nor is the pre-eminence of Driesch in this field surprising. Quite literally he devoted his life to the study of the problem. As a biologist his most famous experiments have to do with the exhaustive study of those phenomena wherein the animate differs most remarkably from the inanimate; his later work as a philosopher was concerned with putting vitalism on sound theoretical legs, and with drawing out the consequences of his one

central doctrine in terms of a world-view. Moreover, a good part of Driesch's fame is based on the fact that he was a pioneer in the attempt to study the problem experimentally; hence, he is looked at by those afflicted by scientism as being a "scientific" vitalist, a position which they feel that they can respect, even if they cannot agree.¹

Born October 28, 1867 in Kreuznach, Hans Driesch was the son of a wealthy merchant family. During his studies at the universities of Hamburg, Freiburg, Munich, and Jena, he showed marked interest in and aptitude for the natural sciences, and especially for Biology, on which he concentrated his principal attention. Following his graduation, Driesch embarked on a tour of the Far East, and, upon his return in 1891, went to Naples to work for the zoological station there.

It was during the period of his stay in Naples that Driesch carried through most of the experiments on which his reputation rests. Influenced by certain experiments carried out by Gustav Wolff and William Roux, Driesch formulated a series of critical experiments to test the teleological orientation--static or dynamic--of various organisms. To some of the more important of these we shall later have occasion to refer.

1. Of course Driesch's later defection to the camp of philosophers disappointed and dismayed those who contend that true and certain knowledge can only come through the "scientific method." His metamorphosis, however, merely served to strengthen the conviction that the nature of life, like other natures, is inaccessible to "scientific" knowledge, and is only a matter for "abstract speculation," a mental crime to be shunned and despised by the true positivist. e.g. cf. Nordenskiöld, op. cit., pp. 609-610.

The results of these experiments and Driesch's analytical interpretation of them were published in a series of works published between 1893 and 1904.² Finally in the Gifford lectures for 1907 and 1908, Driesch presented his fully matured vitalistic theory and incorporated it within the body of a comprehensive logical and philosophical theory.³

This attempt at the interpretation of vitalism in terms of a wider world-view marked a change in the direction of Driesch's interest towards philosophy. In 1909 he became Privatdocent in Philosophy at Heidelberg, advancing to the rank of Professor of Philosophy in 1911. In 1920 he went to Cologne in the same capacity, and in 1921 he transferred to the University of Leipzig. There he remained until his death in 1941. Concerning the purely philosophical part of Driesch's thinking a short summary will be given after an explanation of his central point, the proof and analysis of the vital principle.⁴

2. Hans Driesch, Die Biologie als selbständige Grundwissenschaft, 1893, Analytische Theorie der Organischen Entwicklung, 1894. In these first two works Driesch enters into the analysis of certain basic notions involved in the controversy. Having decided in 1895 that vitalism alone could explain the actions of animate things, Driesch published his first proof for vitalism in Die Lokalisation Morphogenetischer Vorgänge. Ein Beweis vitalischen Geschehens, 1899, a second proof in Die Organischen Regulationen, 1901, and the third in Die 'Scele' als elementarer Naturfaktor, 1903. A summary of the work done thus far was published in 1904 under the title, Naturbegriff und Naturteile.

3. Driesch, The Science and Philosophy of the Organism, Gifford Lectures of 1907-1908 (London: A. & C. Black, 1908) 2 vols. A revised second edition in one volume was issued in 1929 by the same publisher, and is referred to uniformly throughout this chapter.

4. For life of Driesch, cf. his History and Theory of Vitalism, pp. 176-178.

There is, however, one part of Driesch's philosophic analysis upon which his vitalistic theory places its full weight, and this point, therefore, it is expedient that we search well to find if it will bear the burden we propose to rest upon it. This portion is his analysis of causality.

We are aware of certain fixed relations, according to Driesch, among the succession of objects in our thoughts. And among these fixed relations we find that of consequence or implication; I am aware for example, that I am thinking of this because it is implied in that. I may think of animal because I have been thinking of sheep and the concept of the first is implied in or contained in the idea of the second. The relationship of implication and consequence, therefore, is recognized by the mind as a possible type of relation between objects.

The question now arises, however, whether this concept can be "thrown outwards" upon the world of natural objects. Looking to nature, then, I find that this concept of "consequence" is indeed found in the extra-mental world in a form that may be called causality.⁵ Not to be confused with mere temporal sequence-- although it takes place in time--causality expresses a propter hoc in addition to the post hoc. Neither, therefore, must causality be confused with functional dependence, the fixed ratio of change of two variables which can take place without

5. Indeed it is by judgment of the rationality of the becoming in terms of causality that Driesch distinguishes the world of nature from that of dreams and imagination. cf. History and Theory of Vitalism, p. 193.

either's being dependent upon the other.⁶ Briefly the idea of causality includes three elements: the element of consequence, that of the application of this concept to the empirical world, and that of a temporal sequence.

From the assimilation of causality to the concept of consequence, certain practical results may, and indeed must, be drawn. Most important of these for our purpose here is an axiom that may be stated, "A system, in the course of becoming, is unable to increase its manifoldness by itself."⁷ This principle is derived from an analysis of the primordial idea of implication from which the concept of causality springs. For obviously a concept which is contained in another and is implied by it must not be richer or more complex than that from which it is derived. This truth, then, must express a universal property of consequence and it is applied to causality in the above formula.

Understanding then that in a given spatial system, the complexity at any time cannot exceed that of a preceding time without the intervention of an outside system, Driesch now proceeds to analyze the possible varieties of causal interaction and the sources from which they may proceed. This analysis will, it is true, give only the a priori possibilities in causality, but we shall then be able to consult nature to see which of these varieties of causal relations we find actually existing.⁸

6. Science and Philosophy of the Organism, 2nd ed., p. 317.

7. Ibid., p. 319

8. Ibid., p. 218.

Let us suppose, then, a frictionless billiard table having on it n balls all travelling parallel to the short sides at a uniform velocity. We should not be surprised nor would we find any need for explanation if some time later we discovered the same number of balls still travelling (for the table is frictionless) in the same paths and at the same velocity. If, however, we found that the number of balls had increased, that the speed of one or more of the balls had changed, or that the paths in which they were moving had been altered, we would then be required to suppose an outside cause--a demand not at all hard to supply if, let us say, there is a billiard player present who has put more balls on the table or struck them with a cue. In other words, in this case the change within a spatial system is explained by the intervention of another spatial system. This alternative Driesch calls "singular causality."⁹

But what if the number of balls were to increase to a total of $n+a$ without the intervention of any external spatial system? That is, what if a balls suddenly appeared on the table without being transported to it from some place outside of it? In this case, in order to make the event rational, we shall have to postulate the existence of a non-spatial cause which we will call a "matter creating causality."¹⁰

9. cf. Driesch, The Problem of Individuality, (London: Macmillan, 1914) pp. 49-50. cf. also Science and Philosophy of the Organism, p. 321, and History and Theory of Vitalism, p. 198.

10. Science and Philosophy of the Organism, p. 321, History and Theory of Vitalism, p. 199, and Problem of Individuality, p. 50

In a similar manner, if we suppose our billiard balls initially at rest and then suddenly moving without being set in motion by an outside spatial system, we shall have to postulate the existence of a "motion creating causality."¹¹

Finally let us suppose that we find a difference from one time to another in the complexity of relationships of our billiard balls. For example if the balls in the first place were arranged in a fairly simple configuration, e.g. a square, and if at a later time the outline they form is the comparatively complex one of an animal, we shall be forced to postulate an exterior cause for the newly-produced complexity. Even in the absence of any new elements (billiard balls) or becomings (movements), we should be forced to admit the existence of such a cause, and this type of relation we may now call "individualising causality."¹²

But what do we find when we turn to material reality? Are all of these types of causality realized or some only?

Of course, it would be impossible to say that anything theoretically possible never happens. What we have to consider here, then, is the normal state of affairs considered by physical laws. And in this realm, the law of the conservation of matter eliminates the second type of causality from our ordinary consideration, while the law of the conservation of energy does

11. Science and Philosophy of the Organism, p. 320.
History and Theory of Vitalism, p. 199, Problem of Individuation, p. 50.

12. Science and Philosophy of the Organism, p. 321.
History and Theory of Vitalism, pp. 200-201. Problem of Individuation, p. 51.

a similar job in blocking out of our thinking the third type. This elimination process, then, leaves us with only the first and last types of causality as possibilities. Of these, the first type, singular causality, embodies the ordinary relations existing between inanimate material objects and studied by physics and chemistry. Concerning the existence of individualising causality we cannot at this stage be sure, but it at any rate offers a promising clue in our investigation of biological problems.¹³

It seems obvious to a superficial process of reasoning that the development of the organism from a single-celled unit to the full-grown adult represents (if we neglect the increase in the number of units) an example of just this increasing complexity of relationship explicable by individualising causality. Supposing this naive reasoning to be correct, there are two ways in which an outside cause could be conceived: as a special entity, in which case the organism might be conceived of as simply being a machine constructed by another machine, or as a non-spatial cause, in which case there exists the disputed vital principle. Closer attention to our original induction, however, reveals that we may have overlooked a third alternative--that the complexity of the result is already actually present in the single cell from which the organism evolved. Not that, of course, the zygote will contain the completely formed animal in miniature, including such standard accessories as teeth, limbs,

13. Science and Philosophy of the Organism, pp. 322-323.
History and Theory of Vitalism, p. 200. Problem of Individuation,
p. 52

eyes, hair, and so forth,¹⁴ but is it not at least possible that there be a corresponding complexity of, say, a chemical type, which forms the evolutionary basis for the later physical complexity?

How shall we decide between the three alternatives? It was at least partially to answer this question that a famous series of experiments was undertaken, beginning with the work of Roux on the embryological development in a frog. And among those who followed Roux in the investigation of this crucial question was Driesch; by his results the latter was led into the camp of vitalism.

Briefly Roux's experiment may be described as follows: with a heated needle he killed one of the two first cells of an embryo frog, keeping the other one alive. If one proceeds upon the assumption that the first cell contains within itself the organization of the entire adult, then it will be reasonable to suppose that half of this organization will pass to each of the first two blastomeres, so that out of each, half of an embryo will be formed. Now this is precisely what Roux found to be true. Out of his single surviving blastomere there developed half of a typical frog embryo--"an organism, indeed, which was as much a half as if a fully formed embryo of a certain stage had been cut in two by a razor."¹⁵

14. Such a possibility was, of course, widely and loudly upheld for over a hundred years as the "preformation" theory. The absurdity of countless unborn being contained fully formed in each germ cell, together with the negative testimony of the high-power microscope finally did the theory to death. History and Theory of Vitalism, pp. 38-40.

15. Science and Philosophy of the Organism, p. 38.

It was in checking the results of Roux's experiment that Driesch made the discovery that was to make him a vitalist. In Driesch's experiment, the general plan was identical, although the experimental subject was different--he used the eggs of the common sea-urchin (Echinus microtuberculatus)--and his experimental method was somewhat different, for instead of using a hot needle, Driesch shook the eggs of the Echinus at the two cell stage until one of the cells died or the two were separated.¹⁶ At first the results of this division seemed to bear out Roux's results, for there developed from the one separated blastomere a hemisphere instead of the usual sphere produced from a normal egg. By the time the embryo had reached the blastula stage, however, it had formed into the usual spherical shape and appeared to be in every way normal, except that it was only half the normal size. Furthermore, this apparent wholeness persisted and in the end gave rise to a small but complete pluteus-larva of the sea-urchin.¹⁷

Beyond this experiment, Driesch proceeded to show that the same result could be obtained from any of the cells at the four cell stage of the embryo, and that three of these four cells

16. A somewhat less violent method of accomplishing the same object was established later by the discovery of Herbst that cells of the Echinus, dividing in water lacking calcium, lose contact with each other. Hence, any number of divisions may be allowed under such circumstances, and the separate cells then transferred to a normal sea-water environment in which the cells will go on dividing and will cling together. The results as far as the first two divisions are concerned are the same as those obtained in the experiments mentioned in the text. cf. Science and Philosophy of the Organism, pp. 65-66.

17. Ibid., pp. 38-39.

also produced a normal larval stage.¹⁸ Indeed, one-fourth--any one-fourth--cut at random from the embryo at any time up to the blastula stage of the sea-urchin gives rise to a small but fully formed larval stage.¹⁹

There is only one conclusion that Driesch can draw from all this--and there is much confirmatory evidence besides--and that is that the potentialities of a given embryonic cell are not limited to its actual fate. This particular cell is destined to give rise to these organs having this location and no other--yet it has the power (and under varying circumstances it will realize this power) to give rise to other organs having other locations, other functions, and other histological characteristics. In short, the cells are equipotential, each one having the same possible goals in the developed animal as the others. Moreover, in each individual case, these potentialities develop harmoniously, each one actually developing precisely that potency that is most suitable for the organism as a whole. Hence Driesch calls the total of these cells a "harmonious-equipotential system."²⁰

What could be the influence that determines, then, which of the many equally present potentialities will be actually developed? We have already seen in our causal analysis that here we have to take three possibilities into account; the presence

18. Ibid., pp. 40 f.

19. History and Theory of Vitalism, p. 209.

20. Science and Philosophy of the Organism, p. 88

of some outside influences, the previous state of the system within itself, or finally that something non-spatial is the cause of this phenomena. Which of these will provide a satisfactory explanation of the facts?

Of these alternatives, the first need scarcely be considered. Most outside forces are completely equal in direction, acting upon one side no more strongly than on the other. Hence if the actual fate of cells in a harmonious-equipotential system varies without a corresponding variation in outside forces, the second is not causally connected to the first. Of course, there are some forces, e.g. light and gravity, that are one-sided, so to speak, but while these have some influence in the development of plants, they are well known to have no such influence in the case of animals.²¹ Neither directional nor non-directional external stimuli will, therefore, answer our problem.

Is it not possible, then, that there exists within the structure of the embryo an organization of either a physical or chemical type--i.e. a machine in the broad sense--that precontains the organization of the complete organism, so that no real new complexity of relations has been produced at all?

That such an explanation might bear the weight of accounting for normal embryological development Briesch will admit; but that it does so in view of the experimental facts seems to him fantastic. For the very nature of a machine consists in a varying arrangement of parts--that the parts should differ in

21. Problem of Individuality, p. 16. Science and Philosophy of the Organism, p. 88.

size, density, shape, or composition, and therefore in function, and that these parts should be arranged in a certain order so that the activities of each part may be properly co-ordinated. Hence, a machine simply cannot be divided at any point and remain what it is, for the order and the sequence that constitute the very essence of the machine would be thus destroyed. So to quarter a printing press would be not to get four printing presses but to get four piles of junk. The organism of the embryo, however, can be split into four pieces and will nonetheless remain what it is. The source of the final organization, therefore, cannot be precontained in the embryo as a machine. For even if we supposed the embryo to be made up of four machines, this would not explain how we could divide the system almost at will and still retain its wholeness and typical organization.²²

It is equally impossible that this differentiation of the parts of an organism be due to purely chemical means--to the disintegration, for example, of some chemical substance, the breakdown products of which would then migrate to different poles of the embryo to serve as means of specifying their rate of growth, morphological characteristics, activities, and so forth. Such a theory would involve as a consequence, first of all, that the organism would follow in its development the strictly geometrical distribution characteristic of chemicals in building forms, a distribution exemplified, for example, in a crystal; and this consequence is simply not realized in living

22. Science and Philosophy of the Organism, pp. 102-105. Problems of Individuality, pp. 17-18

things. Moreover, parts of the body having identical chemical compositions, e.g. the bones, differ widely in shape and structure from one part of the body to another; these differences, then, are obviously not accounted for by chemical means.²³

With the elimination of these two possibilities, then, we are left with only one alternative as an explanation of the wholeness and organization of a living thing--that it is dependent for its existence upon the causality of a non-spatial agent, an agent that, without adopting the Aristotelian treatment of the nature of the life principle, Driesch calls by the Stagirite's term, "entelechy."²⁴

For the existence of this entelechy Driesch advances two further proofs, one from the existence of so-called complex-equipotential systems within the organism, and the other from the historical basis of action in some organisms.

A complex-equipotential system may be described as a system in which "all the elements are equally able to form the same complex totality out of themselves."²⁵ The ovary of an animal, for example, is such a system, for each of the cells within the ovary, i.e. the eggs, are equally capable of giving rise under proper conditions to the complex whole of an adult organism.²⁶

23. Science and Philosophy of the Organism, pp. 102-105.

24. Ibid., pp. 98-101

25. Problem of Individuality, p. 21.

26. Thus such a system differs from a harmonious-equipotential system such as the blastula, wherein each member is

In the very fact that such a system exists there is nothing that is exclusive of a chemico-mechanical explanation of life, nor is there any such proof to be gleaned from following the developmental processes of a single member of such a system.²⁷ But if, taking the opposite course, we follow the tracks of such a system back to its origin, we shall find a different opportunity for profitable analysis awaiting us. For here we discover a startling fact: that all of the members of this system are descendants of a single cell, its Anlage in the technical German description.²⁸

If now we say that each cell of this complex-equipotential system contains a machine that is the source of the vaster machine we call an adult organism, we are faced with a rather embarrassing choice. For either we say that the Anlage itself was a machine, in which case we are maintaining the absurdity that a machine can divide almost countless times and still remain itself (an impossibility as we have already seen), or we are maintaining that the source of the machine is not the organization of the Anlage, and must, therefore, be a non-spatial cause not identical with the system itself.²⁹ Once again, therefore,

equally capable of giving rise to any of the relatively simple organic parts out of which the whole organism is made up. The division, however, does not seem too precise, and at best refers to a difference in degree rather than in kind.

27. That is, at least, nothing that we have not already considered in the first proof.

28. Problem of Individuality, p. 22.

29. Science and Philosophy of the Organism, pp. 147-150.

our argument is carried irresistably to the existence of an entelechy.

Thus the second argument is quite similar to the first, both being based ultimately upon the impossibility of conceiving any machine that periodically splits in half and yet remains identical through any number of such divisions. In our consideration of the third proof, however, we shall meet with an entirely new aspect of the difference between an organism and a machine, and particularly is this true of certain actions of animals and men. It is in this latter area, the field where the divergences are the greatest, that we shall find our proof.

There are two cautions which Driesch urges before beginning the examination of this proof. One is that the instinctive action of animals must be eliminated from consideration in this proof. For instinctive movements are specifically perfect the first time that they occur; and such a motion may be mechanically explained, though with considerable straining of credulity.³⁰ Moreover, since the approach to this problem is biological rather than psychological, the methods used in studying animal and even human behavior cannot include introspection; we must, in short, adopt the method of the Behaviorists.³¹

30. Problem of Individuality, pp. 24-25

31. Science and Philosophy of the Organism, p. 203. Driesch in this work seems to reject the whole of introspective psychology, calling this a "pseudo-psychology." cf. pp. 193 and 203. However he does not accept with the method of Behaviorism the a priori assumption of Watson concerning the non-causal nature of consciousness. He merely agrees that consciousness cannot be studied scientifically. cf. p. 203.

Let us then with Driesch concentrate our attention upon the phenomena of animal action, i.e. that phase of the behavior of animals that is learned. For just as some actions arise perfectly formed in kind upon the first adequate stimulus, (though they may be perfected in facility later), so there are other responses to stimuli which do not arise, at least immediately, in answer to the first appropriate stimulus, but do so after many repetitions of the stimulus. The behavior of a nursing child is an instance of the first sort of response, and these we shall call instinctive. The tying of shoelaces is an obvious case of the second sort, and these we shall agree to call actions.

The determining character of an action, therefore, is due not to the immediate stimulus alone; at least it must be posited that other stimuli during the life of the individual have also a determining effect upon the specific nature of this reaction. It is a behavior pattern with a history. If we had not excluded psychological description we could say that in action the behavior of the organism is modified by experience.³²

So far, however, our description of action could apply equally well to a machine as to an organism, for many machines are capable of producing actions determined by long-past stimuli. One of the most obvious cases of this kind is the phonograph, an instrument that is reproducing for us today the songs of a Caruso dead for a quarter of a century.

32. This smuggling of psychology in through the windows is Driesch's procedure, not mine. cf. Science and Philosophy of the Organism, p. 204.

Yet in the very exemplification of the machine that reacts on a historical basis, we intuitively recognize that this sort of behavior is vastly different from what we call action. And it is plain where this difference lies. For the machine simply reproduces the stimuli which have been impressed upon it, whereas the organism does nothing of the sort. While the organism has its action modified by its history, the action cannot be said to be wholly determined by its past stimuli--there must be other specifying causes to account for the kind of an action produced.

Can we analyze further the nature of these differences? Can we in particular identify them as being due to a non-mechanical causality operating in the organism? Let us look once more to the relation between the stimulus and the responses of action to see what answer we can get to these questions.

One principal difference between machine and organism seems to be that in the phonograph there is immediately set up a determined correspondence between one stimulus and one response. What is given out on subsequent playing back of the record is not only always the same, but it is the specific stimulus simply reproduced. In the case of an animal, however, what appears to happen is that, first of all, the response is by no means necessarily of the same kind as the stimulus, and moreover the various stimuli together with their previous effects seem to be broken down into elementary components and stored up to make a sort of reservoir of possible responses to situations.

That this is so may be seen even in such elementary types of action as the conditioned reflexes investigated by

Pawlow in dogs. If a bell is rung frequently enough upon occasions when saliva would normally be secreted, e.g. when food is brought to an animal, Pawlow showed that in a short time the same effect--secretion of saliva--may be produced by the ringing of the bell alone. Obviously, here a connection has been made between what is ordinarily a mismatched stimulus-response team.

Again let us say, an animal tries to escape from a painful situation by three unsuccessful methods before achieving freedom by the fourth. If the animal has the power of learning, on subsequent occasions it will make fewer unsuccessful attempts, and finally will produce the successful response immediately.³³

Now nothing of the sort is found in machines. At most changes of behavior in machines due to their history are quantitative changes due to some lingering effect in the machine, e.g. wear, magnetization, etc., and are analogous to the organic phenomenon of fatigue rather than to the characteristic of actions we have been studying.³⁴

Even more striking is the contrast between the responses of an organism and that of a machine with regard to the wholeness of a stimulus. For if a complex stimulus is impressed upon a machine, each of the various elements will produce its own individual response; the stimulus will be to the machine the sum of the simple stimuli contained therein, the effect will be simply the sum of individual effects.

33. Ibid., pp. 212-213.

34. Ibid., pp. 202-213.

In organisms, however, the case is often entirely different. The animal reacts--at least in certain cases--to a stimulus as a whole; hence a small change in the stimulus may result in a drastic change in behavior, while a drastic change in the stimulus may produce no change in response at all. The dog that, at the approach of its master, goes bounding down the street with joyous yelps may remain entirely unmoved or growling hostilely at the approach of anyone else. Even more remarkable is the behavior of a man in a conversation. Here the words, "Your brother is sick," referring to a long-absent and little missed member of the family may produce an entirely different reaction in kind and degree than will the statement, "Your mother is sick." Yet the only change in the stimulus is a change from the letters, "br" to the letter, "m," in one word of the sentence, a change out of all proportion to that of the reaction. On the other hand, if the hearer understands French, the sentence, "Votre mère est malade," though a totally differing entity in its physical parts, produces the same effect as the English equivalent. The only explanation is that each complex group of sounds makes up as a stimulus for the organism a whole that is different from and more than the sum of its parts. Once again, therefore, we find the organism acting in a way that is not only different from a machine, but would be impossible in one.³⁵

On the basis of these three proofs, working out as they do to a single conclusion, Briesch rests his case for the reality of the entelechy. We can, it is true, add other indications of

35. Ibid., p. 214.

the truth of vitalism: from the facts of regeneration and healing, for example, or from the little knowledge of instincts that we have been able to gain. Still these indicia are not to be considered final, whereas the proofs as given are thought to be inescapable demonstrations.³⁶

But when the existence of an "entelechy" has been affirmed, when it has been demonstrated as the non-spatial sufficient reason for the explanation of the characteristic properties of the organism, has everything been said about it that might be said? Or can we find out more about the nature of this mysterious agent in itself, and about the causal relationships linking it to the material components of the organism? Since we are engaged in an a posteriori proof, let us look at the causal link between body and entelechy first, and go on after the settlement of those questions to the study of the entelechy considered in itself.

A primary difficulty seems to arise from the fact that the body of a living thing seems to submit to two different kinds of law; it is at once governed by the physical law that binds inorganic nature and by another group of laws unique to the biological kingdom. The first step in clarifying the relations of body and entelechy must be to ask to what extent the entelechy voids the physical law and how this is accomplished.

What can possibly be meant by saying that the organism is subject to physical laws? The implication here is that the living being is in some respect a machine, for physical laws are

36. History and Theory of Vitalism, pp. 214-215.

machine laws. They are based precisely upon the assumption that everything is made up of extended matter moving in space.³⁷ Physical laws, then, have for their function the statement of the energetic relations between one body and another, or between a body and its motion.³⁸

Now because the body is obviously a material system whose parts, e.g. the cells, have a certain spatial relationship, it must be considered in itself as a machine, and whatever non-mechanical action it exhibits must be attributed to the entelechy. Thus the nature of the body itself explains its subjection to the mechanical laws, and its relation to the entelechy renders intelligible the appearance of new determinants. How far, however, does this modification go?

The fact is that we have already answered that question in large part. We have seen that matter-creating causality and energy-creating causality, while a priori possible in the world, are not actually realized even in the organic realm--that is to say that the principles of the conservation of energy and of matter hold true in living as in inorganic things.³⁹ Hence the one type of causality left to entelechy is the individualizing

37. For the purpose of our present analysis let us ignore the question of whether this matter is qualitatively the same or not. The ultimate hope of every mechanist is to reduce all matter to one common kind, e.g. the ether. Whether or not this is possible, however, makes little ultimate difference; the basic requirements of quantified matter and motion in space remain constant in all theories. cf. Science and Philosophy of the Organism, p. 269.

38. Ibid., pp. 269-270.

39. Ibid., pp. 255-256.

causality.⁴⁰ Hence, Driesch suggests, the entelechy must interfere with the normal course of the natural laws only by guiding and arranging them for its own purpose.

To describe the mode in which such a thing may come about, Driesch proposes three possible solutions. His own theory is that the entelechy might be supposed to suspend temporarily certain actions that would otherwise take place according to physical law. This would imply actually a double power within the organism, for in addition to being able to stop one action, and later, of course, to allow it to resume by lifting the suspension, the entelechy would be able also to exercise control over which of two possible actions will take place. Let us say, for example, that the chemical compound "a" is able to react with either of the elements "b" or "c." Let us further say that if the three chemicals were mixed under inanimate conditions, "a" would react with "b" rather than "c". Now the entelechy may suspend both of these possible reactions so that no change at all takes place. Moreover, by suspending the reaction of "a" with one of the substances, it may cause it to react with the other--even with "c" despite the greater natural affinity of "a" for "b".⁴¹

In addition to explaining how entelechy does modify the laws of nature, this theory has the advantage of accounting for many things that do not happen. For example, it explains why the organism cannot become independent of its environment.

40. cf. supra, pp. 45-46.

41. Science and Philosophy of the Organism, pp. 261-264.

Entelechy, as the suspension theory explains, does not create the difference that enables one substance to act upon the other--hence there will be no reactions between physical or chemical agents not already potentially reactive by nature. Neon, for instance, would not react any better in an organism than outside. Neither can the entelechy create a substance it needs from elements that would not naturally cause such a result--it could not, for example, force sulfuric acid out of a combination of sodium chloride and water. All it can do is to interrupt and cause to resume a series of events that can take place according to nature's laws.⁴²

A second possible way in which entelechy might interfere with the mechanical laws of inanimate nature is suggested by Descartes' analysis of the mind-body problem. The mind, according to Descartes, cannot change the total energy⁴³ in a dynamic system, but could be conceived of as changing the direction of that energy. Since such an action ordinarily implies an expenditure of mechanical energy, however, it seems that such a solution requires the entelechy to be an energy-creating cause, a possibility that has been rejected already. In a later study of this possibility, however, Eduard von Hartmann has suggested that the energy required to effect this "transportation" of energy from

42. Ibid., pp. 261-262.

43. Knowing nothing of the later distinction made between kinetic and potential energy, Descartes evolved this solution to account for changes in direction of kinetic energy alone. Hence such a solution as the suspension of energy--a process that involves transforming kinetic into potential energy--would be impossible for him. cf. Ibid., p. 273

one spatial axis to another might be drawn from the energy itself. Whether such a refinement is necessary is (to Driesch at least) questionable, since in any case the total amount of energy represented by a moving body remains the same, and the part of the principle of inertia dealing with the straight-line motion of moving particles is abrogated for organisms.⁴⁴

There is still a third imaginable solution to this problem. For the action of the entelechy might well be a purely negative one--a prohibition rather than a command. According to this account, the material particles would ordinarily follow their own courses except that they might be prevented from following their natural course in some respects, much as a beam of light is reflected from its natural course by a mirror. The role of entelechy would be something like a "Keep off the grass" sign in a park. This Driesch calls the "hypothesis of immaterial resistance."⁴⁵

To tell which of these theories is the one that corresponds to reality is, in the present state of knowledge, impossible. There are, however, certain indications that make possible some tentative judgments of their relative worth. For instance, the second explanation, since it seems to limit the powers of entelechy by nothing but the total of available energy, does not have the advantage presented by the others of being able to account for the things entelechy cannot do.⁴⁶ And since the third

44. Ibid., pp. 273-275.

45. Ibid., pp. 275-276.

46. Ibid., p. 273.

theory restricts the power of the non-spatial agent more than any of the others, it is perhaps to be preferred; it is easiest to explain, on this basis, the peculiarities of individual organisms due to their mechanical configuration as well as the universal features they exhibit because of their entelechy.⁴⁷

No multiplication of theories as to the manner in which its causation is carried out, however, can answer for us the deeper problem of the nature of this causality. The question might be put thus: Is the entelechy that causes these actions of the organism dependent itself on the material body, as being the result either of some special kind of living matter or of a particular configuration of chemicals that we call a living body? This question we must now proceed to answer. And first we shall have to deal with two preliminary points, the nature of a material substance, and the existence of a living material substance.

It seems that all material substances have this characteristic in common, that they consist of simple substances existing beside each other in extensity. This characteristic holds true whether it is assumed that the mechanical or the dynamic view of reality is held. For even in the latter view, supposing that matter is made up of forces emanating from indivisible, unextended centers, still the forces themselves are extended and the substantial complex exists in space in an extended way. And this is the only universal characteristic of

47. Ibid., p. 276.

matter. The other qualities of such a substance may change from one body to another, but the requirement that they all -like- must be extended does not vary.⁴⁸

In what sense, then, do we speak of a living material substance? A careful analysis of the scientific evidence on this point is scarcely helpful in our search for it. Thus, the scientists speak freely, for example, about assimilation, and this may be presumed to be the action of a living organism increasing its substance at the expense of the components of its environment. However, on a closer look such a definition is seen to be mere assumption with very little basis in reality. Who could say, for example, at what point this presumed assimilation takes place or what sort of mysterious process it might be?

Now the facts that are really presented to us by biochemistry inform us that the living organism is actually made up of a mixture of many different chemical substances, none of which, taken in itself, is alive or shows any of the characteristics of life.⁴⁹ Furthermore, not any one of the specific substances in the body by acting itself on food changes this into its own substance; this task is always performed by another element, viz. an enzyme. Hence the process of assimilation on its chemical showing turns out to be a pseudo assimilation, and, more

48. Ibid., p. 276.

49. Not that there are not chemical substances that are specific, in nature at least, to living things, although many of these substances can be synthesized outside living things, and probably there is no a priori impossibility concerned in synthesizing the others. In any case, however, the individual substances do not manifest to us any of the characteristics of organisms, e.g. nutrition, sensitivity, etc.,

important, there is here to be found no sign of the existence of a living substance.⁵⁰

As a matter of fact there are many indications, and to Driesch not merely indications but proofs, that there can be no such thing as a "living material substance." To say that there exists such a thing as a material, chemical, living substance that "bears" entelechy would be to attribute extensity to the entelechy, for we have seen that the one characteristic of material substance is their extension. Now that entelechy is extended is impossible, otherwise the divisions performed in the embryo of the sea-urchin would have given very different results than they did. The fact that a complete organism was evolved shows that the entelechy must itself have been left whole and undivided by the division.⁵¹

Another argument against the "living substance" theory can be found in the strange consequences that follow from such a notion. Theoretically, we should be able to buy in the market place, if the theory were true, "six pounds of lion substance, or a pound and a half of eagle substance, or three ounces of earthworm substance."⁵² Now of course it would be possible to purchase six pounds of lion meat, but this is merely a mixture of proteins, fats, sugars, and other inorganic elements--it is a collection of substances, not one "homogeneous chemical material which is supposed to represent the 'being-a-lion.'"⁵³

50. Science and Philosophy of the Organism, pp. 290-292.

51. Ibid., pp. 292-293.

52. Ibid., p. 293

53. Ibid., p. 293

But still a third difficulty prevents Driesch from considering entelechy as the result of a material substance. If such were the case, entelechy would, of course, be itself material and as being material it would be subject to changes by material energy. However, it has already been established⁵⁴ that the reaction of an entelechy to body is not effected by such a transfer of energy. Once again, therefore, the theory of a living matter as a cause for entelechy fails to account for the facts.⁵⁵

But if there is no one living substance that can be considered as the cause of entelechy, would it not be possible to assign the origin of entelechy to a combination of compounds arranged in a typical "constellation"? Once again our answer must be negative. For the human mind cannot rest content with the explanation of a new elementary factor out of simply nothing: the new factor must have pre-existed somehow, either as a potentiality of one of the substances in a constellation or as a substance itself that becomes active only under certain circumstances.⁵⁶ In either case, however, we are once again reducing entelechy to a material thing with the same contradictions seen above.⁵⁷

Summing up, therefore, we can say that for Driesch, the

54. cf. supra, pp. 60-61

55. Science and Philosophy of the Organism, p. 295

56. Thus the appearance of electricity produced by rubbing a glass rod must be explained by supposing either that the rod has an electric potential (E) to begin with, or that there exists a substance of electricity (electrons) that is broken loose in the act of rubbing.

57. Science and Philosophy of the Organism, p. 295.

entelechy, while dependent in its actions upon a material substance, is not dependent for its existence upon the body. "The activity of an architect depends on the existence of stones. But could you care to say that the architect's existence depends on-- stones? A heap of stones without an architect is a heap of stones, and the matter of an organism without entelechy is an amount of matter."⁵⁸

Obviously to say that entelechy is neither a material substance nor the effect of a material substance is not to deny that entelechy is in itself a substance.⁵⁹ As a matter of fact, the reasoning proves that entelechy must be considered as a substance, since the effects we attribute to it must be produced by some substances, and we have seen that the extended substances of the material world could not be the causes of such behavior.⁶⁰

But what sort of a substance can this be? What are its properties? Is it essentially a psychic or non-psychic thing? Is the same entelechy common to many bodies, or does its individuality correspond to that of the material organism? Is it

58. Ibid., p. 296. "The great similarity in this figure to Plato's "pilot and his ship" is striking. Indeed Driesch borrows a Platonic argument from Alcibiades I (128a-129b) to prove the independence of the entelechy, viz. the living substance is distinct from that which belongs to it; now the body is said to belong to the substance, for we say that a dog has (not is) paws, legs, teeth, and a body. Hence the dog is its entelechy. The body is not the dog but belongs to the dog. Ibid., pp. 312-313.

59. i.e. a substance "in the sense of something irreducible which remains the always unchangeable bearer of its changeable qualities." Ibid., p. 297.

60. Ibid., pp. 300 and 324.

immortal? If so, in what sense? To some of these questions there are easily available answers; to others, the answer is impossible or at least out of reach at present. Let us begin by seeing what can be known of the nature of the entelechy.

The only way we can know entelechy is by means of the effects produced by it on the body. This causality, as we have seen, is of the type Driesch calls "individualizing causality," a causality that consists of creating in a material system a complexity of relationship not belonging to this system of itself. Indeed, we see that all the effects of entelechy are always complex "manifolds" that are extended either in space--the organism itself--or in time--the actions of the organism. The entelechy itself, therefore, in order to explain the complexity that is caused by it in the organism, must in some fashion precontain that organized multiplicity; it must be a "manifold" itself.

The kind of manifoldness the entelechy possesses must differ from the extensive manifoldness characteristic of the material substance. The first and second proof both show that the entelechy must be a non-spatial cause; indeed, both are founded upon the impossibility of dividing an extended manifoldness without taking away any of its parts. The nature of the entelechy, therefore, could be described as an "intensive manifoldness."⁶¹

But such a definition of entelechy is merely a sketch of this non-spatial substance in a state of potentiality. For

61. Ibid., pp. 245-247.

just as an architect only achieves the actuality of what he is in the work of constructing, so entelechy reaches its actuality only in its operation on matter. "As far as it is entelechy actu it is causality of the individuating form."⁶²

The characteristic of inextensiveness, moreover, raises an interesting point in connection with the property of divisibility in the entelechy. For how can an unextended substance be divided? Yet apparently the entelechy is so divided, e.g. in the ovary.⁶³ Nevertheless the division of a non-spatial system is impossible; the idea of such a thing is a priori contradictory. It can only be the material organism, in which entelechy manifests itself, that is divided; the entelechy itself must be considered indivisible. Here is the first bit of evidence to solve the problem of individuality of the entelechy. There are not as many entelechies as there are individual organisms.⁶⁴ Driesch, as a matter of fact, cannot escape the conclusion of a sort of world-entelechy. But of this we shall see a little more later.

One more property of the entelechy must be mentioned in view of its non-spatial character--it cannot be confined to any one "place" in the body. Hence Descartes' localization of the soul in the pineal gland is unnecessary. True, there are some parts of an organism that seem to be acted upon by entelechy

62. Ibid., p. 324.

63. cf. second proof, supra, pp. 52-53.

64. Science and Philosophy of the Organism, pp. 298-299.

while others are not, but this does not justify calling any of these centers of activity the "seat" or the proper place of entelechy. This is simply a matter of points of relation.⁶⁵

Furthermore, there is no justification in anything that we have seen for indulging ourselves in the pseudo-psychological assumption that it is necessary for every entelechy to be conscious or psychic. The only thing of which we can affirm with certainty that it is conscious is our own self. Nevertheless, Driesch accepts provisionally the Aristotelian division of souls, the nutritive soul ($\psi\upsilon\chi\eta\ \sigma\upsilon\epsilon\tau\iota\kappa\eta$) being found in all living organisms, the sensitive soul ($\psi\upsilon\chi\eta\ \delta\iota\sigma\theta\epsilon\tau\iota\kappa\eta$) being found as the source of sensation and instinct in all animals, and finally the "psychoid" ($\psi\upsilon\chi\eta\ \nu\omicron\upsilon\sigma$) as the seat of reason and of "actions" being found in the higher animals and in man.⁶⁶

Here again we run headlong into the problem of the unity and multiplicity of the entelechy, a problem already met in connection with the division of organisms.⁶⁷ In this case we have postulated a plurality of entelechies for a single organism--and there are many other problems which are best

65. Ibid., p. 299.

66. Thus departing from Aristotle who attributes the rational soul to man alone. Driesch's argument is that the higher animals possess more than mere instinct inasmuch as they are able to learn by experience. The fact, however, that they must have a memory scarcely entitles them to the reputation of being intellectual besides. Ibid., p. 335.

67. cf. supra, pp. 70-71.

explained upon the same supposition,⁶⁸ whereas the unity of the organism, and particularly the unity of the ego seem to demand the oneness of entelechy. Besides, looking at the problem from the point of view of the many organisms produced by one, we are faced with the metaphysical absurdity of supposing that non-spatial entities can be divided or even fused.

To Driesch, the forced conclusion from these indications seems to be the existence of one super-personal entelechy, which, however, can exist in two different states, "in the one-modus and the many-modus." The apparent division of entelechies can then be regarded as merely a multiplication of the modes of the one entelechy; the facts of the unity of organic life can be accounted for by the one basic ens that is the entelechy.⁶⁹

There are, besides the ones mentioned, many indications of this basic oneness of entelechy and the multiplicity of its modes. The continuity and obvious unity of the species and even, if we accept the theory of descent, of all life find in this unity of entelechy their best explanation.⁷⁰ Even the whole of empirical reality exhibits the individual wholeness of order that we seek to explain in organisms by entelechy.⁷¹ Finally, such

68. For example, Driesch considers such "stupid" acts of entelechy as the development of one-half an embryo when there is no possibility that the other half will develop (in Roux's experiment) as being best explained by an organization of entelechies, each one performing its appointed task in relative isolation from the others. cf. Science and Philosophy of the Organism, p. 280.

69. Ibid., pp. 331-332.

70. Ibid., pp. 332-333.

71. Ibid., p. 324.

psychological phenomena as split personality are understandable only in terms of a single entelechy that has been modified in its modes.⁷²

So far we have not said much about the place of finality in Driesch's treatment of the problem of life, and yet it is apparently in the nature of finality that Driesch ultimately finds the clue to the basic differences between entelechy and a machine.⁷³ The reason for this omission Driesch himself makes clear: the notion of teleology has been suspect in the physical sciences from the time of Newton. Whether or not this skeptical attitude is justifiable, it can easily be understood, for only too often arguments from teleology have been based on a univocal extension of the conscious end-seeking of man.⁷⁴ However, if the word "end" is correctly understood in its analogical sense as that toward which an agent has a tendency, there is no necessary objection to its use in biology. A conscious agent has an "idea of the end in its imagination"; whereas the natural agent has of course no such idea, but it has a tendency to act in one way rather than another. Naturally the end, being non-existent, cannot work, but the agent having a tendency to an end can, and hence Driesch prefers the term causa finalis to the more anthropomorphic "purpose."⁷⁵

72. Ibid., p. 334.

73. History and Theory of Vitalism, pp. 1-7 and 176-177.

74. Science and Philosophy of the Organism, p. 243.

75. Ibid., p. 323.

The two outstanding examples of goalward tendencies in the non-human realm are to be found precisely in organisms and in machines. Ordinarily, we do not speak of purpose with regard to natural things below the level of the organism, since purpose refers principally to processes, and non-living things are inert. What then is the difference teleologically between a machine and an organism?

Now the actions of the parts of a machine are end-seeking only in virtue of two determining facts: that it is in terms of the whole alone that the part has any meaning, and that the purposiveness of the individual action is derived only from its position in the whole. Nevertheless, the action of each part goes on in its singularity and the action of the whole is analyzable into the sum of these individual actions.⁷⁶

On the other hand the end-seeking of the organism is unanalyzable--it cannot be broken down into the action of the parts, for parts can be removed and the end is reached anyway. Even less, then, can the action of the parts in relation to the end be reduced to a function of its position, for the same part in an equipotential system may fill any number of duties. This sort of teleology, Driesch calls dynamic, as opposed to the static teleology of the machine.⁷⁷

But the final problem remains unsolved. Is there anything in the end itself that would explain the differences in

76. History and Theory of Vitalism, p. 4.

77. Ibid., p. 5. cf. also, Science and Philosophy of the Organism, pp. 243-244.

the characteristic end-seeking processes of machines and organisms? Concerning this, I cannot find a definite answer in Driesch's works. But we may find at least a hint of our answer in Driesch's reason for selecting the word "entelechy" to designate his life principle:

"Let us then borrow our terminology from Aristotle and let that factor in life phenomena which we have shown to be a factor in true autonomy be called Entelechy, though without identifying our doctrine with what Aristotle meant by the word *ἑντελέχεια*. We shall use this word only as a sign of our admiration of his great genius; his word is a mold which we have filled and shall fill with new contents. The etymology of the word *ἑντελέχεια* allows us such liberties, for indeed we have shown that there is at work a something in life phenomena which bears the end in itself. ὁ ἔχει ἐν ἑαυτῷ τὸ τέλος. 78

78. Science and Philosophy of the Organism, p. 106.

SECTION I
CHAPTER III
THE MONISTIC LIFE THEORY OF
J.B.S. HALDANE

It is usual to refer to J.B.S. Haldane as a mechanist in his views on the nature of life. Such a characterization, however does less than justice to his philosophy as a whole and to his theory of life in particular. It is true that he denies any specific difference between living organisms and non-living matter, and if this be the criterion of Mechanism, then Haldane is a mechanist. If, however, the traditional view of the world and the organism as a machine be insisted upon, i.e. the classic dogma confining the properties of matter to extension and its change to locomotion, then certainly Haldane cannot be forced into that category. Nor can he be confined to the more involved Mechanism found for example in Jacques Loeb--that the organism can be analyzed strictly in terms of the processes studied in both chemistry and physics. Haldane's theory is a good deal more subtle than either of these. Whether or not it adequately accounts for the facts we shall have to discover.

John Burdon Sanderson Haldane is a member of a family which, like the Darwins and the Huxleys, has produced a whole series of talented and even brilliant workers in scientific and

allied intellectual fields. His father, John Scott Haldane, was noted as a fine experimental biologist, a philosopher, a writer, and as a public servant for his efforts in behalf of bettering conditions in mines in Great Britain. An uncle, the Viscount Haldane, became Lord Chancellor and found time to write and translate a respectable list of books on philosophical subjects.

Born into this famous Scottish family in 1892, John Burdon Sanderson Haldane was brought up in an atmosphere of devotion to the scientific spirit, and especially of "intellectual curiosity and freedom." As a result he finds it odd that anyone should ever have been surprized or shocked at Darwin, Einstein, or Freud. His education was acquired at Oxford Preparatory School, Eton, and New College at Oxford.

He had just received his A.A. at the outbreak of the first World War. The years between 1914 and 1919 he spent in the famous Black Watch, became a captain in 1915, and was twice wounded. Half facetiously, he attributes his survival to the fact that while on duty in the East, he acquired a fever and was not sent back into action.

After the war, Haldane served as a Fellow of New College until 1922 when he became a reader of biochemistry at Cambridge. Here he remained until 1932, although there seems to have been some agitation for his resignation after some unfortunate publicity in 1925. From 1930 to 1932, Haldane also held the Fullerian Professorship of Physiology. Since 1932, Haldane has been a

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1. 1. Sketch of Haldane's life based on:
Current Biography, v. I, no. 11, (Nov., 1940), pp. 33-34,
and's who, 1950, (London: A.&C. Black) p. 1180

professor at London University, holding first the chair in genetics, and, since 1937, the position of professor of Biometry.

In the meantime, Haldane has also made a reputation as a popularizer of science. His professional work deals largely with the chemistry of the human body, with the mathematical side of genetics--particularly with the occurrences of mutations--and with similar studies on the influence of natural selection. Like his father, however, Haldane has been most interested in science for the sake of its practical applications to bettering human existence. The impact of the scientific study of consequences on Ethics, the legislative importance of modern studies of heredity, the replacement of religion and philosophy by scientific knowledge as the controlling factor in human life--these are his extra-professional interests. He has, on several occasions, drawn bravos from his scientific readers by calling loudly for government by technician--an advocacy based largely on his feeling that the only worth-while kind of knowledge comes from the physical sciences.²

In pursuit of these practical applications of science to the problems of political and economic life, Haldane early became interested in the philosophy of dialectical materialism, a philosophy that claims to have applied the scientific method to human history and to the nature of science itself.³ In 1937, Haldane announced his official conversion to Communism, and he has since been active in publicizing the Marxist cause and its

2. cf. Haldane's article, "The Duty of Doubt," in *Possible Worlds and other Papers*, (N.Y.: Harpers, 1928) pp. 222-236.

3. J.B.S. Haldane, The Marxist Philosophy and the Sciences, (N.Y.: Random House, 1939) p. 5

utility as a working plan within the field of the physical and social sciences. Almost all of the books Haldane has written since that time have had the object either of explaining science to Communists in terms of Marxism, or of explaining dialectical materialism to non-Marxists in terms of popularized science.

It is important for us to keep in mind this shift in Haldane's political thought, because it accompanies what appears at first sight as a philosophical revolution in his mind. It is reasonable to assume, therefore, that his theory of the nature of life would undergo a similar change. As we shall see later on, neither the philosophic conversion nor the change in view on the organism was as deep-going as they might appear, but changes there undoubtedly are.

Let us glance briefly at the philosophical presuppositions lying behind Haldane's differing life theories. It is not to be expected that we can give an adequate account of any one phase of Haldane's thought. To describe dialectical materialism adequately would obviously require several volumes in itself. Nevertheless it is important for us to discover what Haldane finds to be the crucial issues in the philosophical systems that he has successively espoused.

Like many another ardent supporter of Darwin,⁴ Haldane's basic outlook on the universe is that of a monist. " I may as

4. And Haldane is decidedly an admirer of Darwin. cf. his ardent championship of Darwinian theory in "Natural Selection" in Nature, Sept. 21, 1929, v. 128, p. 444. He finds points to be criticized in Darwinian theory, to be sure, but considers the basic theory of the struggle for existence sound. cf. also article on "Darwin" in Adventures of a Biologist, 2nd ed., (N.Y.: Harpers, 1940) pp. 104-105.

well frankly state my philosophical prejudices, for perhaps they should be rated no higher than that. My main prejudice is in favor of monism."⁵

Perhaps the key to his attitude can be found in the expression "prejudice" with which he describes his philosophy. Actually, according to Haldane, philosophical proof is merely a convenient fiction to cover ignorance of the facts.⁶ It is easy to discover that this state of affairs is so, for every system of metaphysics clashes with established facts. And the reasons for this discrepancy are equally plain: most philosophers have had some religious or anti-religious ideal to defend, and fitted the philosophy to the purpose. Besides they were based on "grounds which were largely sentimental or economic."⁷

If Metaphysics is, as it claims to be, speculative, then it is useless, and this too, for Haldane, constitutes an obstacle. "For a scientific man a philosophy is a program rather than a creed."⁸ This point of view comes more strongly to the fore in Haldane's Marxist writings where a primacy of deed over thought is explicitly recognized. Here knowledge cannot be called knowledge unless it involves control as well. "In fact, the existence of a 'high all-seer' who does not act is self-contradictory."⁹

5. J.B.S. Haldane, The Causes of Evolution, (London: Longmans, Green, & Co., 1932) p. 155

6. J.B.S. Haldane, "When I Am Dead," in Possible Worlds, p. 217.

7. Causes of Evolution, p. 158.

8. Ibid., p. 155.

9. Marxist Philosophy and the Sciences, p. 85.

It is easy, then, to see what difficulties lie in the path of Haldane's accepting a pluralism that proclaims an irreducible distinction between mind and matter. One philosophy proclaims certain problems, e.g. the union of mind and matter, to be insoluble "merely because three thousand years of thought by a few members of a species which may have many thousand million years ahead of it have not yet solved them."¹⁰

Monism, on the other hand, has the advantage of being capable either of proof or disproof--because if wrong it will ultimately lead to self-contradiction--and in the meantime it has proposed a program of research that "is leading to results which at present can be interpreted either as the mind-like nature of certain objects which we generally call material systems, or as the mechanical character of conscious behavior."¹¹

The principal difference between Haldane's earlier and more recent philosophical views seems to be in the particular variety of monistic view to which he was attracted. He describes his early philosophical state as that of "a rather vague sort of idealist." His reason for holding to idealism seems to have been an inability to find a logical consistency in materialism rather than any more positive value found in idealistic philosophy.

10. Causes of Evolution, p. 155.

11. Ibid., p. 156. Some of these results here referred to seem to be the additions made by relativity and quantum physics to "the strange list of analogies between mind and matter," especially as interpreted by Jeans. cf. J.B.S. Haldane, "The New Deism," in The Inequality of Man, (London: Chatto & Windus, 1932) p. 264.

Of the difficulties Haldane found in accepting any sort of materialistic system, the greatest seems to have been that of explaining knowledge on this basis. "I am not myself a Materialist," he wrote before his Marxist days, "because if Materialism is true, it seems to me that we cannot know that it is true. If my opinions are the result of the chemical processes going on in my brain, they are determined by the laws of chemistry, not those of logic."¹²

Difficult as it is for the Haldane of this period to account for the fact that our knowledge is thought of, and indeed must be, a reflection of the outside world, it is no less difficult to account for the very existence of the phenomena of consciousness. There is simply no way to explain the properties of awareness in terms of the known chemical and physical characteristics of matter, and consciousness is a fact "a good deal more certain than the existence of cells and atoms."¹³ Besides the mind obviously has a unity of its own. "Somehow the most diverse elements, sensations, emotions, thought and will, are held together."¹⁴ Haldane, in his earlier days at least, found it extremely difficult to account for this unity on the basis of

12. J.B.S. Haldane, "Some Consequences of Materialism," in Inequality of Man, p. 112.

13. J.B.S. Haldane, "Science and Ethics," in Inequality of Man, p. 113.

14. J.B.S. Haldane, "What is Life," in Adventures of a Biologist, p. 53. This article was written after Haldane's conversion to Marxism, but this is the clearest statement of a recognition obvious in Haldane's writings of both periods.

any sort of materialism.¹⁵ To a lesser degree, of course, Haldane finds the same difficulty facing him in the case of the organism. "Nevertheless," said he, "the biologist must take cognizance of facts (such as the unity of the organism) which have not yet been fully explained on Materialistic lines, and perhaps never will be."¹⁶

Even at this stage of his thinking, however, Haldane was willing to concede that the fact of consciousness might be explained on materialistic grounds. "Materialism, of course, includes many forms far more subtle than the crude materialism of fifty years ago, and if you are willing to concede enough unexpected properties to so-called dead matter it becomes distinctly idealistic."¹⁷

That such was actually the case, Haldane became convinced through a study of the writings of the philosophers of Communism. "The books which solved my difficulties were Frederick Engels Feuerbach, and Anti-Dühring, and later on V. I. Lenin's Materialism and Empirio-Criticism."¹⁸

The reasons which led to Marxism for Haldane were primarily practical and only in a secondary sense do they have

15. cf. J.B.S. Haldane, "Why I am a Materialist," in Adventures of a Biologist, p. 227.

16. "Some Consequences of Materialism," in Inequality of Man, p. 161

17. Causes of Evolution, p. 155.

18. "Why I Am a Materialist," in Adventures of a Biologist, pp. 228-229. The full titles of Engel's works referred to are respectively Ludwig Feuerbach and the Outcome of Classical German Philosophy, and Herr Eugen Dühring's Revolution in Science.

anything to do with intellectual satisfaction. "Unless one accepts their (i.e. the Marxists) political and economic theory," Haldane declares, "one is not likely to agree with their views concerning nature and knowledge."¹⁹

Hence it was the fact, first of all, that the Marxist philosophy showed great insight into the underlying methodology of science that primarily attracted Haldane. This understanding and the valuable aid to research it provides seemed to shine forth for Haldane in the advanced interpretation of science found in Engels,²⁰ and in the fruitful results being reaped from the application of this method to the sciences in Soviet Russia.²¹

The real turning point in Haldane's conversion came, however, in his observation of the internal contradictions being developed in the economic policy and the words of political leaders in Britain. "At a time when national self-sufficiency in food might be of vital importance, farmers were fined for growing too many potatoes."²² And the increasing prevalence of political corruption showed the decline in those nineteenth century standards of honesty to which these same politicians still payed tribute.²³ Such contradictions, completely unintelligible from the point of view of liberalism, suddenly became flooded with a new light of understanding when observed from the Marxist

19. "Why I am a Materialist," in Adventures of a Biologist, p. 229.

20. J.B.S. Haldane, "The Marxist Philosophy," in Adventures of a Biologist, p. 255

21. Ibid., p. 254

22. Ibid., p. 255

23. Ibid., p. 256.

viewpoint. Many of them had even been predicted by Communist prophets.²⁴

Although not his primary concern, Haldane found in Marxism a system that was intellectually satisfying as well. In spite of his "vague idealism," Haldane had always realized that, as a man and as a scientist, he was most frequently a materialist in practice. When we want to go somewhere we get into a train or bus, confident that on the one hand we shall not be able to propel ourselves as rapidly through space by the mere exercise of our wills, nor on the other that the vehicle will find any more difficulty in moving us than if we were a sack of potatoes."²⁵ We apply the laws of chemistry and physics to our bodies with the full and justified faith that we can foresee the results. Only the difficulties mentioned above, especially those concerning knowledge, kept Haldane from being a complete materialist from the beginning.

But what if these objections were to lose their force? And in the dual light of dialectical materialism and modern scientific--especially physiological--research, Haldane reached the conclusion that they were no longer valid.

This dialectical materialism, to begin with, was a strange sort of materialism. It utterly rejected the old mechanistic sort of materialism that strips matter of its richness to reduce it to a lowest common denominator of quantity. Haldane quotes

24. Ibid., p. 257.

25. "Why I am a Materialist," in Adventures of a Biologist, p. 227.

Lenin as thinking such a system "absurd" and preferring "an electro-magnetic or some immeasurably more complicated" materialism. The one basic quality common to all matter, according to this same quotation, is "the property of being objective reality, of existing outside our cognition."²⁶ Between materialism and idealism lie the basic differences that materialism assigns a temporal priority to matter and believes that matter, as external reality causes ideas in the mind and not the other way about,²⁷ The second of these tenets is clearly a corollary of the first, for the idea could hardly be called the cause of that which preceded it in time,²⁸

This view of matter as the whole of objective reality involves the view that whatever qualities may be found in objective reality must be assigned to matter, however opposed to each other they might be. In matter there must be a union of opposites. "I do not think that there is any choice between denying the reality of matter and admitting the unity of opposites," says Maldane.²⁹ Such a view of reality is made understandable by adoption of the old Heraclitean view of reality as becoming. "Nature is in a state of perpetual flux--in fact it consists of

26. Ibid., p. 229

27. "The Marxist Philosophy," in Adventures of a Biologist, p. 261

28. Except, of course, in the sense of final cause.

29. "The Marxist Philosophy," in Adventures of a Biologist, p. 261.

processes, not things."³⁰ Whatever there seems to be of apparent changelessness in things is simply the result of a balance of opposites. "The more we study nature, the more we find that what is apparently stable turns out to be a battlefield of opposing tendencies."³¹

In accordance with this theory, there is no trouble in assigning to the material brain the seemingly paradoxical quality of conscious thought. "It is becoming daily more plausible that our minds are physical realities acted on by the rest of the world and reacting on it. Our minds are processes which occur in our brains."³² In answer to his own difficulty that such facts as consciousness and understanding are not explained by the physical and chemical properties of atoms, Haldane points out that even in purely chemical changes, combinations of atoms give rise to properties that cannot be located in any one of the constituent parts.³³

But if the existence of consciousness is so easily explained, how can we avoid the absurdity involved in supposing that mental processes are guided less by the laws of logic than by the laws of chemistry? Experimental work done on the physio-

30. "Why I am a Materialist," in Adventures of a Biologist, p. 230

31. Ibid., p. 230.

32. Ibid., p. 232.

33. This sounds very much like Holism. The odd thing about this sort of explanation is that during his days as an idealist, a philosophy within which Holism makes somewhat more sense, Haldane explicitly repudiated any such explanation as possibly true but impossibly unscientific. cf. Causes of Evolution, pp. 156-157. We will return to this problem later.

logy of hearing, declares Haldane, explain why the subjective and objective aspects of that particular sense are the same. An amplified current taken from electrodes placed on the cerebral cortex and another part of a cat's body will reproduce through a loud speaker exactly the sound that the cat is hearing.³⁴ Presumably the case with the other senses is the same. External reality, according to the latest scientific report, can be regarded as periodic disturbances capable of setting up in the brain corresponding, though much slower, rhythmic changes. These form the subjective basis of the correspondence between sensation and the external world.³⁵

There seems to be no objection to the materialistic position, then, and a great deal in its favor. In addition to the above fact that we live and think scientifically as materialists, there is the additional evidence of the fossil record. The truth of evolution testifies conclusively that matter existed before mind, since living things of sufficient complexity to think have not developed, according to the animal remains left in the rocks, until quite recently.³⁶

There are, besides these, many more practical reasons for holding to materialism. One of the most cogent of such reasons is the mess into which wishful and idealistic thinking about society has led our economic system. Proclamation of some

34. "Why I am a Materialist," in Adventures of a Biologist, p. 231.

35. Ibid., pp. 231-232.

36. "The Marxist Philosophy," in Adventures of a Biologist, p. 262.

ideal and eternal values as embodied in society is largely due to those within the society who have a comfortable life therein and no interest in altering the structure of the community. This would not be too regrettable if our society were working well. "But," says Haldane, "it is working very badly."³⁷ Our only hope is to revise our thinking about society--to make our study of it materialistic and scientific.

Very briefly, let us summarize the outstanding tenets of Marxism as understood by Haldane.

In the first place it must be realized that the Marxist outlook on philosophy is a practical one emphasizing the supremacy of deed over thought. "The philosophers," denounced Marx, "have only interpreted the world in various ways; the point is to change it."³⁸ Theory, in Marxism, is therefore confined to a secondary role and is interesting only insofar as it leads to action.

One of the results of this state of affairs is that theory is looked at as only a provisional and incomplete approach to the truth. If the idea is caused by reality, presumably it is not perfectly identical with reality but, as all reproductions, differs from it in some respect. The truth, therefore, can be approached ad infinitum, but never completely reached.³⁹ As a

37. "Why I am a Materialist," in Adventures of a Biologist, p. 235. This whole argument is drawn from the same passage.

38. Quoted by Haldane in Marxist Philosophy and the Sciences, p. 8.

39. Ibid., p. 40

matter of fact, the theoretical parts of Marxism should be regarded rather as a method of approaching truth than as truth itself.⁴⁰

The only way to determine the truth or falsity of a theory is to apply it as a tool for the prediction and control of events--e.g. as in the method of the physical sciences. Any problems unable to be treated in this fashion are either invalid questions or else they are as yet insoluble because of a lack of sufficient empirical evidence. An instance of the latter situation for Haldane is the mind-body problem.⁴¹

The second principle Haldane mentions in connection with Marxist philosophy is that of its materialism. According to this view, as we have already seen, matter, defined simply as extra-mental reality, is postulated as prior to the idea both in time and causality. Because we think of matter as continually posing difficulties and contradictions in our thought, we must attribute to matter therefore an undiscerned richness of qualities, and indeed even of contradictory qualities.

It is for this reason that the Marxist philosophy is called dialectical materialism. In Hegelian idealism, the mind works out the evolution of matter and the world through the clash and reconciliation of opposed ideas--a mental process Hegel called "dialectic" because of its similarity to the Platonic method of arriving at truth. Marx, at one time a student of

40. Ibid., p. 8.

41. "The Marxist Philosophy," in Adventures of a Biologist, p. 260.

Hegel's, retained the idea of the opposition and harmonization of contraries as the source of evolution, but in insisting upon the priority of matter, had to transfer the ultimate location of these contraries to the material world.

It is worth emphasizing, however, that in the Marxian dialectic as understood by Haldane this opposition is "something conditional and temporary." It can exist only in virtue of certain absolutes that contain no such contradictions. Hence the apparent contradictions found in any scientific theory can be overcome as our knowledge reaches toward the ultimate--but a new contradiction will always be waiting for human knowledge, since it can never attain to these uncomplicated elementals.⁴²

Another principle of the Hegelian dialectic retained in Marxist theory is the affirmation of the equal reality of quantity and quality and the passage of one into the other. An example of the change of quantity into quality would be the familiar change of water to ice.⁴³ The reverse of this sort of transformation is seen in the changing of a symphony into a set of wiggles on a sound track.⁴⁴

Characteristically Hegelian too is the principle that progress in surpassing a previous state of perfection can only be attained by a negation of the perfection, and, in turn, a negation of the negation. The innocence of the child, for example,

42. The Marxist Philosophy and the Sciences, p. 25.

43. "The Marxist Philosophy," in Adventures of a Biologist, p. 263.

44. The Marxist Philosophy and the Sciences, p. 28

can only become the independent virtue of the man by being subjected to negation in the form of temptation and even sin, negations which in their turn are overcome by resistance to temptation and punishment of guilt.⁴⁵ Progress in mathematics and science show the same law--for the modern progress of geometry, for instance, a denial of Euclidian principles was first necessary. For the Marxist, of course, the whole history of mankind is the working out of this same law in the economic sphere.⁴⁶ A special case of this principle is found in the freedom of the will--a freedom that becomes possible only upon the recognition of those negating factors which make for determinism.⁴⁷

Of course the principal applicability of these principles in any Marxist writings lies in the economic field, and any summary of a confessed Marxist that does not take account of Marx's analysis of the dialectical process working in history is lopsided. We are not primarily interested, however, in Mr. Haldane qua Marxist, but rather qua proponent of a biological view of life. For this purpose, I think, the foregoing analysis is sufficient.

To describe the life theory held by Haldane is a rather difficult task. This difficulty is due largely to the character of the writings in which his answer to the problem is expressed; with scarcely any exception, these writings are not of a technical

45. "The Marxist Philosophy," in Adventures of a Biologist, p. 264.

46. Marxist philosophy and the Sciences, pp. 29-30.

47. Ibid., pp. 35-37.

but rather of a highly popularized nature, so that it is not always easy to disentangle the underlying arguments from the examples and metaphorical expressions in which they are embedded.

Basically there does not seem to be a great deal of difference in the life theory of Haldane before and after his conversion to Marx. Perhaps he explains this fact pretty well himself when he points out, in connection with the problem of the origin of life, the fact that with regard to this theory idealists and materialists are one, since the one considers all acts to be from God and the other considers no acts to be acts of God.⁴⁸ Besides, as we have already pointed out, Haldane considers the dialectic materialism with its attribution of opposing qualities to matter as "distinctly idealistic." It is noticeable, however, that the discussion on the nature of life in Haldane's Marxist writings are more numerous and on the whole more fully developed than in those written during his pre-Marxian days. We will try to describe as fully as possible the theories of the organism found in both phases of his life.

Common to both these periods is Haldane's rejection of any sort of theory insisting upon the existence of a soul as distinct from the body. He recognizes the soul theory as a consistent means of explaining the facts involved,⁴⁹ but brings

48. J.B.S. Haldane, "The Origin of Life," in Possible Worlds, p. 149. What Haldane apparently means is that idealism denies the efficacy (and the activity) of secondary causes altogether.

49. Ibid., p. 158, and cf. also Haldane's article, "What is Life?" in What is Life?, (N.Y.: Boni & Gaer, 1947) p. 53.

forth a variety of reasons both speculative and practical for his opposition to any such explanation.

In the first place there is no biological evidence for the existence of some sort of spirit which moves otherwise dead matter through some sort of activity of its own.⁵⁰ The total amount of energy produced by a living being, in doing work, and producing heat, and stored up as potential energy in the form of added weight can be checked against the total amount of energy taken into the organism (minus of course the unutilized energy in the waste products) with a very small margin of error--no more than the error in performing the same computation with a machine. There is no extra energy or work left over to explain by means of a soul. "We do not make energy, nor get it from any supernatural source. We use the energy derivable from oxidation of food as a machine would."⁵¹

Neither can it be said that we must postulate the existence of a soul to account for kinds of activity that are supposed to physical and chemical laws. "Biology has not yet reached the stage where any of its results contradict the law of physics, though of course they are not all explicable on physical grounds at present."⁵²

Another telling blow against the existence of a soul is struck by the independent life led by the parts of any living

51. J.B.S. Haldane, "Is Man a Machine?" in What is Life? p.4 This is Helmholtz' old argument against vitalism as violating the law of the conservation of energy.

52. J.B.S. Haldane, "Physics Declares its Independence," in Possible Worlds, p. 198.

organism. The cells of an embryo chick have been kept alive--feeding, growing reproducing--for years after they were taken from the embryo, although they show no signs of reforming into a chicken. "They (i.e. the individual cells) have a life of their own and can live a Robinson Crusoe kind of existence in suitable surroundings. Hence they do not derive their life from the soul or from anything outside themselves."⁵³

If the life does not depend on a soul, it cannot be said that consciousness does either. "A study of the effects on the mind of brain injuries makes it fairly certain that consciousness depends not on any one cell, which might be the seat of the soul, but on a very large number."⁵⁴

Another indication that there is no difference in the principle of operation between living and non-living things is furnished by the gradual transition found between them everywhere in nature. It is impossible, for example, to tell at what exact moment an organism dies, for many factors, e.g. consciousness, are lost long before death is considered to take place, and many others--the activities of individual cells--continue for some time after any sign of the life of the whole has ceased. "If there is a detachable soul, it can certainly be detached bit by bit....Death is usually a gradual process, well described by

53. "Science and Ethics," in Inequality of Man, p. 112

54. Ibid., p. 112. The studies Waldane mentions are described more fully in his essay, "What is Death?" in Adventures of a Biologist, p. 67. They concern the loss of certain conscious faculties, e.g. initiative, due to operations performed on certain parts of the brain.

by the word 'dissolution'."⁵⁵ It is just as impossible to say at exactly what instant the non-living being becomes alive, e.g. when non-living food begins to live the life of the organism. Finally between the organic and inorganic world there exist a group of substances--the so-called bacteriophage discovered by D'Herelle and the tobacco mosaic studied by Stanley--which ape the activities of living things so closely and are so lacking in other vital processes that it is impossible to tell, without setting up artificial standards, whether they are alive or not.⁵⁶ These lifelike substances will be seen again later.

There are certain practical objections also to the assumption that vital activities are caused by the soul. In common with all metaphysical explanations, the vitalistic theory discourages research into the physical causes of these activities.⁵⁷ Scientific research is essentially materialistic research, as we have already seen, and of course is useless if the cause of the phenomenon in question is immaterial.

Moreover Haldane has objections to any kind of a theory that smacks of personal immortality. A belief in the future beatitude and the spiritual welfare of the downtrodden and the oppressed makes it too easy for us to bear up under the unjust conditions in which they now exist--particularly if we are not

55. "What is Death," in Adventures of a Biologist, p. 67.

56. J.B.S. Haldane, "Can We Make Life?" in Adventures of a Biologist, pp. 26-27.

57. For Haldane's objections to such explanations, cf. for example, Arnold Lunn and J.B.S. Haldane, Science and the Supernatural, (N.Y.: Sheed and Ward, 1935) p. 315.

personally among the number of the poor. Present justice does not appear where future justice seems assured.⁵⁸

What alternative, then, can be offered to the theory of a besouled organism as the basis of life? The obvious explanation is that of a machine. "The older science either supposed that the universe and the human body were mere machines, or that they were machines to some extent guided by God and the soul respectively. No facts are known to science which give any serious support to the latter view. But it does not follow that the former is correct."⁵⁹ The mechanistic viewpoint, to be sure, explains a great deal that goes on in the body, and attempts to find forces other than chemical or physical operating in living things have always been failures. "Nevertheless, life, organic unity, and consciousness are facts a good deal more certain than the existence of cells and atoms. It is clear that aggregates of a certain kind do manifest qualities which we cannot observe in their components."⁶⁰

It is true that, having carried out the remains of mechanistic mechanism from the biologic premisses, Haldane proceeds to smuggle it back in under his coat. Speaking of the doctrine of emergence, he says, "This doctrine may conceivably be true, but it is radically opposed to the spirit of science which has always attempted to explain the complex in terms of the simple,

58. "When I am Dead," in Possible Worlds, pp. 217-218.

59. "Science and Ethics," in Inequality of Man, p. 112.

60. Ibid., p. 113.

and has on the whole succeeded...if the scientific point of view is correct, we shall ultimately find them (i.e. life and mind), at least in rudimentary forms all through the universe."⁶¹ In another passage, Haldane condemns the "extreme forms of the doctrine of emergence," explaining that, though there is "an element of truth in this view," e.g. in the case of mind, it is opposed to the spirit of science.⁶² Perhaps the key to this apparent struggle in Haldane's mind is the word, "extreme." In a less radical state, presumably, the doctrine would have been more agreeable; but it so, Haldane did not elaborate upon a more agreeable form nor explain how the "element of truth" in this view was to be reconciled to the endeavors of science.

Looking around for some theory to stand up as a logical opponent to vitalism, Haldane seized eagerly during his early period of thought upon the existence of a group of substances which he regarded as transitional stages between living and non-living things. If we want to understand how non-living matter forms the basis of the organism, the best place to start the analysis is in a simpler form where the activities that need to be explained are similar but not so highly developed.⁶³

The clue, then, to the connection between living and inert matter Haldane finds in the, at that time, recently discovered bacteriophage. This remarkable substance, when brought

61. Ibid., p. 113

62. Causes of Evolution, pp. 156-167

63. The following explanation is condensed from "The Origin of Life," in Possible Worlds, pp. 151-154.

into contact with bacteria, has two effects: it kills and disintegrates the bacteria, and secondly, it reproduces itself. Whereas at the time of application there may be a great many bacteria and a quite small amount of bacteriophage, at the end of the process there will be relatively a great deal of bacteriophage and no bacteria at all. Now this substance would ordinarily be considered as a living organism that "eats" bacteria except for a number of facts:

1. It is much smaller than any cell. Too tiny to be seen under a microscope, its size can only be determined indirectly by its ability to pass through very fine porcelain filters and by observing the effects that highly dilute solutions of the substance produce on germ cultures. From these measurements, it became clear that the bacteriophage was not only smaller than a living cell but also more diminutive than many known proteins that show no signs of life.

2. It survives conditions, e.g. of heat and cold and aridity, that kill all other living things.

3. It is active only in the presence of living things. Dead bacteria will not serve for its "food" nor will it reproduce in their presence.

Consequently there are two schools of thought concerning whether the bacteriophage is alive or not.

Oddly enough there seem to be highly exact analogates of this bacteriophage existing inside the cell as well as outside of it. An instance given by Maldane is the gene that is the cause of spotted coats in certain species of dogs. If one such

gene is inherited, the dog is perfectly normal, varying from others only in coloration. But if two such genes are inherited, the dog is puny and soon dies. Like the bacteriophage, such a gene is reproduced only in the presence of a living substance, and, again like it, the gene is, under proper conditions, fatal to its host.

The most obvious solution to the problem of how these substances operate is that they do not reproduce themselves, but rather act upon the organism that reacts, in part, by producing more of the stimulating substance. But if one part of the organism can reproduce itself in this way, there seems to be no cogent reason why others could not do the same, nor why the whole organism should not be considered as a group of such substances, each of which could react with the collection of others to reproduce itself after the manner of the bacteriophage. Here is how Haldane himself puts the proposal:

"Unless a living creature is a piece of dead matter plus a soul (a view which finds very little support in modern biology) something of the following sort must be true. A simple organism must consist of parts A, B, C, D, and so on, each of which can multiply in the presence of all, or almost all, of the others. Among these parts are genes, and the bacteriophage is a part which has got loose. This hypothesis becomes more plausible if we believe in the work of Hauderoy, who finds that the ultramicroscopic particles into which the bacteria have been broken up, and which pass through filters that can stop the bacteria, occasionally grow up again into bacteria after a lapse of several months."⁶⁴

Now there is no reason why such component parts could not be formed by purely natural forces, since many so-called

64. "The Origin of Life," in Possible Worlds, p. 153. We hear no more about Hauderoy's resurrected bacteria, so I presume there was some error in the experiment.

organic products can be synthesized outside the organism, and there is no a priori reason why all such products should not be formed. Since the scientist works by directing natural physico-chemical forces, there seems to be good reason for supposing that under the proper conditions amino-acids, fats, proteins, and carbohydrates could be formed by non-living agencies, and then, through some chance coalescence, produce the self-perpetuating combination described above.⁶⁵

Of course such an explanation offers no understanding of how this system of half-living chemicals could become conscious. Apparently this has to be explained in terms of some sort of elemental consciousness on the part of the units of non-living matter. "If we ever explain life and mind in terms of the atoms, I think that we shall have to attribute to the atoms the same nature as that of minds or constituents of mind such as sensation."⁶⁶ And as we have already seen, Haldane at that time, (i.e. before his Marxist phase) considered the unity of consciousness and of the organism as a mystery within science and perhaps a permanent one.⁶⁷

It is precisely from this puzzle of unity within the organism that Haldane's Marxist theory of the organism starts.

65. Haldane describes in some detail the possible physical conditions under which some such synthesis of organic elements might take place. As we are interested, however, only in the possibility and not in the specific conditions under which the possibility might be realized, I do not think it necessary to give an account of this theory.

66. Causes of Evolution, pp. 157-158.

67. "Some Consequences of Materialism," in Inequality of Man, p. 161.

The difference between the machine that classical mechanics found in the organism and a living being is found precisely in the individuality of the organism. Let us look first at what Haldane means by a machine and an individual and then at how he applies these definitions to the analysis of life.

"First, let us ask what we mean by a machine," says Haldane. "I think we mean a system capable of performing some function (say making a noise or cutting wood) which is made up of replaceable parts, and which can be fully understood when we understand about these parts....The opposite to a machine is an individual, something which from its very nature cannot be taken to pieces and put together again."⁶⁸

Before applying this distinction, we must take a precaution, one made necessary by the inadequate structure of our language. The word, "life," is a substantive and therefore leads us into the supposition that life is a substance. Such a prejudice is clearly perceived in the ancient supposition that life is breath, and in modern suppositions of a living as opposed to a non-living matter and of vital forces. Clearly none of these is correct--there is neither loss of weight nor of energy at death. It may be correct to refer to the living organism as a "thing" but life itself, as we shall see more clearly later on

68. "What is Life?" in Adventures of a Biologist, pp. 51-52. Notice that there are two essays by this same name written by Haldane. The other one, referred to earlier in this chapter, is from a book, the title of which also is what is Life? In order to eliminate confusion, the title of the book as well as the article will be included in each citation to either of these essays.

is less a thing than a process. If anything is to be compared to a machine, it must be the organism as a "thing."⁶⁹

In certain respects, of course, the idea of a machine is obviously applicable to the organism. The bones, for instance, can be understood in many cases as levers and the eye functions very much as does a camera.⁷⁰ Moreover the organism is like a machine in the replaceability of its parts. Even in so complicated an organism as man there are some "spare parts" that can be substituted for the "original equipment," e.g. in blood transfusions or skin grafts. In the lower animals and especially in plants, major sections of various organisms can be forced together and will be absorbed into one organism, as is the case, for example, in grafting the branches of one kind of tree onto the trunk of another.⁷¹

Insofar as a living thing has non-replaceable parts, however, and like Humpty Dumpty cannot be put back together again, it tends toward being an individual. To a certain extent, of course, this state of affairs is true in all organisms and it is especially true in man.⁷²

Organisms also differ from machines in their self-regulation. Not of course, that it is impossible to construct a self-regulating machine, e.g. a steam engine that keeps its steam pressure constant, but this self-regulation in machines is carried out on no such scale as it is in organisms. While the indivi-

69. Ibid., pp. 49-50.

70. Ibid., p. 51

71. "Is Man a Machine?" in what is Life?, p. 5

72. Marxist Philosophy and the sciences, p. 108

dual regulations can be understood mechanically, e.g. the system of "pressure gauges" and mechanical reactions on the muscular action of the heart, trying to understand the actions and reactions of all these systems on a mechanical basis is hopeless:

"If the amount of carbon dioxide or oxygen becomes sufficiently abnormal, the mechanism for blood pressure regulation will certainly break down; in order for them to be kept normal the activity of the lungs must be regulated by another mechanism similar to the one for regulating the blood pressure. In order for the lungs to function normally, the kidneys have got to keep the chemical composition of the blood normal in other respects. The adrenal glands must not produce too much adrenalin, or the blood pressure regulation will be interfered with; the pituitary gland must secrete pitressin in the right amount if the kidneys are to work normally, and so on."⁷³

In short, every self-regulation of a living organism depends on every other one, whether those regulations be of the parts of the organism to each other, or of the whole living being to its environment.

But this self-regulation is peculiar in another way too. This universal self-regulation implies that there is nothing fixed or static about an organism, whereas in a machine, most of the parts are fixed or static. In man, for instance, not even anything as apparently stable as his bone structure is permanent; old materials are being removed constantly and replaced by new. "The steadiness of form in an animal is more like that of a flame in an animal is more like that of a flame or a waterfall than that of a house or a statue. As we analyze life, it seems to resolve itself into self-regulation with no permanent structures to act as regulators."⁷⁴

73. Ibid., pp. 114-115.

74. "What is Life?" in Adventures of a Biologist, p. 53.

The fact is that the living thing has some individuality about it as well as being a mechanism. For although a breakdown in mechanism usually goes with death, it is not the same thing as death. Many are the mechanical breakdowns in the body that fall short of death, and conversely death does not necessarily imply a complete cessation of mechanical activities. The hearts of animals have been kept pumping after death, and it is possible to keep human cells alive for weeks after the death of the man to whom the cells belonged. "But it is not your life, merely the life of your cells. If I had murdered you, it would be no defence to point to your cells and say that you were still alive."⁷⁵ What ends at death is the individuality of the living thing.

Finally, as we have seen, mechanistic materialism is simply incapable of explaining any such fact as the unity of the mind. To understand this unity as the sum total of the consciousness of millions of disparate cells would be ridiculous, although of course it is a fact that the mind depends on those cells.⁷⁶

Perhaps even more specific than physical action as a sign of life is the fact of chemical change. Without the constant existence of such changes, even such seemingly inert organisms as seeds lose their spark of life. It is worth while, then, looking at life from the standpoint of chemistry as well as that of physics.⁷⁷

75. "What is Death?" in Adventures of a Biologist, p. 66.

76. "What is Life?" in Adventures of a Biologist, p. 53.

77. Ibid., p. 54.

From the chemical point of view, life can be thought of as a composite of chemicals with highly specific chemical reactions--each composite and reaction being highly specific and yet bearing the most remarkable resemblances to all other living things. In the process of anabolism, for instance, some living things build up their structural components from simple inorganic substances as do plants by the process of photosynthesis, while others must live at second hand off the organic products synthesized by others. Similar differences are found in aerobic and anaerobic catabolism. In the face of such dissimilarities, however, there is a likeness between all living things that proclaims their unity. Think of the similar structure and law-bound operations of the genes in all living things, for instance, or of the fact that only dextro-rotatory maltose is found in any living organism.⁷⁸

It used to be the scientific fashion to think of the chemical events going on, for example, in the digestive system of an animal, as non-vital and of the changes that went on inside the cell as being of a type that chemistry could not explain. At the same time, the protoplasm inside the cell was thought of as being a homogeneous, sui-generis slime entirely different in nature from the obviously chemical and non-living enzymatic secretions that work in the digestive tract. Recent chemical analyses, however, indicate that chemical compounds of a similar nature make up the protoplasm of the cell. It is even

78. Ibid., pp. 56-57.

possible by interrupting the nutritive processes within the cell at various stages to study the part which each one of these compounds plays in the final result produced by the action of the cell taken as a whole.⁷⁹

Thus we might say that the organism is a "particular pattern of chemical compounds" and that life itself is "a particular pattern of chemical change."⁸⁰ Insofar as this is true, the living thing could be compared to a burning thing. In both cases, as long as the object remains what it is, there is a chemical change necessary, and in both the change preserves a certain pattern. The burning thing even reproduces itself, so to speak, by causing other burning things. "In particular, a flame is like an animal in that you cannot stop it, examine the parts, and start it again, like a machine."⁸¹ Of course life is very much more complicated than a flame, but in many essentials they are similar.

Once again, however, the analogy of life with other chemical activities can not be carried too far--and once again the basic reason is to be found in the self-regulatory character of this pattern of chemical changes. For the changes in a living being depend upon each other and are so regulated as to keep the balance between themselves practically constant. The

79. J.B.S. Haldane, "Protoplasm," in Adventures of a Biologist, pp. 117-119.

80. "What is Life?" in Adventures of a Biologist, p. 57.

81. Ibid., p. 50. The comparison of life with fire, of course, is very ancient, having been made at least as early as Empedocles. cf. Aristotle, De Anima, II, 4, 415b28ff.

motion of a muscle, for instance, upsets the chemical balance of the blood in sugar and oxygen, an imbalance that would eventually make the movement itself impossible were it to become more severe. To offset any such possibility, the blood supply to the muscle is increased, calling for the chemical and physical changes in the action of the heart, the breathing is slightly speeded up to meet the increased demand for oxygen, the liver pours stored sugar into the blood's depleted supply, and this in turn calls for other adjustments to replace the balance of sugar in the liver and so on indefinitely. Every action of every part involves the co-operation of the other parts. Life, in short, is adaptive to an extent that no other chemical change is.⁸²

In whatever way we look at it, then, the living organism shows a degree of integration, of individuality, that no merely physical or chemical compound could possibly manifest. As we well might expect from the dialectical nature of reality, the organism is the meeting point of a contradiction, the contradiction between a machine and an individual, and it represents itself as a sort of progress towards greater individuality.⁸³ On the other hand, life is not unique in this mixture of mechanism and individuality--the combination is shared by everything which exists. A machine and an individual are merely abstractions. "There is no such thing," says Haldane, "as a 100 percent machine or a 100 percent individual."⁸⁴ No matter how great the

82. Ibid., pp. 58-59

83. Ibid., p. 54.

84. Marxist Philosophy and the Sciences, p. 109

knowledge of the parts of an engine we may have, there is always some aspect of its behavior we can neither foresee nor explain; otherwise new automobile dealers would not have to give out guarantees with their cars.⁸⁵ And in the most highly integrated system there is a good deal we can explain in terms of the parts. The difference of living from non-living, therefore, seems to be a difference of a greater from a lesser degree of individuality rather than a difference in kind.⁸⁶

The contradiction of machine and individual is not the sole one found in life. The very adaptation that constitutes a major claim for the organism's individuality shows evidence of such a contradiction. To be adapted to, let us say, a given environment implies an ability to change in reaction as the environment changes; but such an ability to change indicates an incompleteness in the perfect relationship of response to present conditions. An organism too highly specialized for making use of a certain set of conditions would be a total loss in any other circumstances.⁸⁷

An evidence of this struggle between perfect and imperfect adaptation is the opposition found within living things between the tendency to go on living and an opposed tendency to

85. Haldane traces this fact to an application of the Heisenberg uncertainty principle which says, in effect, that a complete knowledge of any particle is impossible because the necessary means of acquiring one sort of information destroy all chance of acquiring other knowledge of the same thing. cf. Marxist Philosophy and the Sciences, p. 89.

86. Ibid., p. 109

87. "What is Life?" in Adventures of a Biologist, p. 60.

death. It would seem at first glance that a tendency to dissolution is the very opposite of continued existence, yet it is only in virtue of such an inclination that life, as we know it, is possible at all.⁸⁸

Finally this imperfection manifests itself in the vortex of chance and finality that we call function. It seems as though the purpose of the heart is to pump blood through the body, yet this could not be true, or why would it continue pumping a saline solution even outside the body? Of our vegetative functions, most are blind and cannot be spoken of as having a real purpose--yet they fulfill that purpose whether it is their goal or not.⁸⁹

Upon this duality of perfection and imperfection the evolutionary history of life sheds a good deal of light. For if we point out the goal of evolution as perfection and its source as imperfection, then certainly the evolving organism must show signs of both.

Similarly it is only in terms of some such duality that evolution can be understood. If adaptation, for example, were to become too highly specialized to one environment, the power of making further evolutionary progress within such an environment would become impossible. An instance of this sort seems to be the horse, a species that is apparently at an evolutionary dead end. Such too highly specialized adaptation might even

88. Ibid., p. 61.

89. Ibid., p. 60.

lead to the annihilation of the species--if, for example, a hunter were to be evolved so deadly that it could kill all its possible victims within a short time, when the last victim had been devoured this lethal killer would have literally eaten itself to death.

To whatever extent the survival of the fittest is a tool of evolution, death too is the necessary condition of progress. If all, whether fit or not, survived equally, there would be no genetic advantage in adaptation and variation would remain, relatively, the rare specimens that they were at their origin. It is only because the more fit live a little longer and have a slight advantage in reproduction that their characteristics soon spread through the whole species. And it is only because those best adapted to living in a particular environment do thus spread their characteristics throughout their kind that the illusion of purpose seems to arise.⁹⁰

In view of the contradictory elements contained in life, it is really impossible completely to sound out its nature. The philosopher tries to define it, but no definition will cover its infinite and self-contradictory variety. The biologist studies it, well aware that he can never hope to fathom its full complexity."⁹¹ As with all the other sciences, the main purpose is control, and our techniques give us constantly more power over life, no matter how unsatisfactory the theory.⁹²

90. Ibid., pp. 61-64

91. Ibid., p. 64

92. Ibid., p. 64

Incomprehensible as they may be, however, explanations there must be that account for the perfections of the organism as opposed to its shortcomings, for its unity as opposed to its meristic features. For that explanation we must seek, no matter how inadequately.

This does not mean that we must search for a source of unity outside of matter. Not only is it part of Haldane's philosophic foundation that nothing has its origin outside of matter, but he still regards the half-living substances mentioned earlier as being proof that the boundary between life and the inanimate is continuous. Indeed, by this time a great deal more work had been done on these substances, especially on the tobacco mosaic isolated in a pure form by Stanley in 1935.⁹³

This remarkable substance can be dried out and kept in a bottle, where it manifests no other activities than those ordinarily found in crystals of nucleo-proteins, the group of chemical substances to which the virus has been shown by analysis to belong.⁹⁴ When dissolved and injected into a tobacco plant, however, this substance suddenly becomes "alive" and spreads throughout the tobacco plant, infects others, and at last, when collected again, will be found to have reproduced to millions of times its original volume.⁹⁵

The tobacco mosaic, like the bacteriophage discussed earlier and every other virus so far isolated, is made up of a

93. "Can We Make Life?" in Adventures of a Biologist, p. 27.

94. Marxist Philosophy and the Sciences, p. 102.

95. "Can We Make Life?" in Adventures of a Biologist, p. 27

protein combined with nucleic acid, both of which are ampholytes, i.e. constructed of acid and basic groups, and both of which, therefore, constitute a union of opposites.⁹⁶ Furthermore, when in a strong solution (and even to some extent in a weaker solution) the tobacco mosaic tends to be organized according to a highly organized pattern.⁹⁷ There are thus many points at which the likeness of the mosaic to a living thing is quite strong.

Haldane finds it significant that such manifestations of vital activities, whether inside a definitely alive being or not, never occur in a substance that does not contain one of the proteins described above, although not all nucleo-proteins exhibit such remarkable likenesses to living operations.⁹⁸ Nevertheless Haldane thinks the evidence gives a great deal of support to Engel's description of life as the mode of existence of proteins.⁹⁹ Since chemistry should soon reach the stage where synthesis of proteins is possible, it seems likely that such half-alive substances as the tobacco mosaic shall be built up in a laboratory in the near future.¹⁰⁰

Combining this viewpoint with the one we arrived at earlier in the analysis, we arrive at the following conclusions: that living things differ from non-living things in the very high

96. Marxist Philosophy and the Sciences, p. 106.

97. "Protoplasm," in Adventures of a Biologist, p. 122.

98. "What is Life?" in What is Life?, p. 56.

99. Marxist Philosophy and the Sciences, p. 102.

100. "Can We Make Life?" in Adventures of a Biologist, p. 27.

degree to which they show individualistic qualities not apparent in any of their parts, and that they also differ from the inanimate in a highly complex and highly specific chemical organization, i. e. of nucleo-proteins, found in them.

These two characteristics of the organism as opposed to the inanimate parts of which it is composed, however, are not unique in the study of this problem. It is characteristic of all highly organized compounds that they exhibit behavior not observable in any of their parts. An understanding of the citizens individually is not too successful in helping us arrive at an understanding of the state, and the case is the same at the other extreme of scientific analysis. "A molecule exhibits properties which are not found in atoms, when they are separated. Some of these properties could be deduced from known atomic properties, others could not."¹⁰¹

Thus there is no new difficulty here, but simply the repetition of a problem found uniformly throughout science. Where do these new properties come from? Apparently, says Haldane, they originate in the fact that the parts behave differently in a crowd than they do when under individual observation, pretty much as does the character of the meek little man in a lynching mob. "That is not to say that they are added from the outside. It is rather that the atom in isolation is incapable of certain kinds of behaviour."¹⁰²

101. "Protoplasm," in Adventures of a Biologist, p. 123.

102. Ibid., p. 123

The case is pretty much the same for the existence and unity of the consciousness. Here once again we encounter the problem of accounting for a characteristic, i.e. consciousness, in the whole that apparently does not belong to any of the parts, and for a unity in that characteristic that certainly cannot be accounted for on any such meristic basis.

It was always part of Haldane's belief that certain analogues to the mind already existed in the atoms or electrons from which the brain is constructed. And the first of these, he claims, have been found by a study of the uncertainty principle characteristic of modern quantum theory. Like the electron in this theory, events in the mind cannot always be accurately located in one place, i.e. in one part of the brain.¹⁰³ As it is impossible for an electron to have position and velocity simultaneously, two mental events will likewise interfere with each other, e.g. being angry and observing one's own anger.¹⁰⁴ Events in the brain, like the electron, seem to be rhythmical events.¹⁰⁵ And finally, the electron, like the mind, appears to be affected by events going on at a distance.¹⁰⁶ "I suggest," says Haldane, "that the mind has physical properties analogous to those of a single electron or atom, properties which are lost in a group of trillions of atoms with the low degree of organi-

103. Marxist Philosophy and the Sciences, pp. 163-164.

104. Ibid., p. 164.

105. Ibid., p. 165.

106. Ibid., pp. 166-168.

zation found in a stone, but which may be accentuated when the same number of atoms is organized in a mouse or a man."¹⁰⁷

How these characteristics became conscious is a problem to which Haldane devotes little space, because, of course, there is no concrete evidence on the point. He suggests that this awareness might have first arisen out of a conflict between an established pattern of behavior in an organism and an outside interference with the pattern, in much the same way in which we become aware of our breathing on the occasion of its being interfered with.¹⁰⁸

As in the case of life, so the crucial point in this solution is presented by the organization of the brain, for it is this organization that gives the mind its unity. "To many it seems more reasonable to regard the soul as a function of the co-operating brain-cells, just as a concert performance of a symphony, which, like the soul, has a unity of its own, is the function of the co-operating members of the symphony."¹⁰⁹

But it is on a note of agnosticism that Haldane concludes his theory of life. As long as the human mind cannot know the absolute truth, so long are we doomed to go on solving contradiction after contradiction concerning the nature of the organism only to find another puzzle barring our way to the last secret of life and death.

107. Ibid., p. 168.

108. Ibid., p. 154; Haldane attributes the origin of this theory to Samuel Butler.

109. "What is Death?" in Adventures of a Biologist, pp. 67f.

SECTION II
THOMISTIC SOLUTION

SECTION II

CHAPTER I

THE PHILOSOPHIC NATURE OF THE PROBLEM

Basic to any attempted solution of the problem of life must be a discussion concerning the science capable of making such a decision. Concerning this problem, of course, there are as many viewpoints as there are theories of knowledge, but at least as a means of over-all classification these outlooks can be reduced to three:

1. No analysis of the essential differences between living and non-living beings is even possible. The problem by its very nature is an invalid one, incapable of solution by human minds.
2. The problem is primarily philosophic and its solution lies completely outside the realm of empirical science.
3. The problem is soluble by the experimental sciences.

Obviously a complete discussion of the first point of view is impossible in the limited scope of this work; indeed the problem involved here is the complete epistemological difficulty posed by modern philosophy. Briefly the basis for our alleged inability to solve the nature of life generally turns out to be a denial of the existence or the validity of the intellect, the power of reading the innermost nature of any

being. Where such a power is lacking, of course, the most that can be known about anything is the surface appearance, the "phenomena" in the Kantian expression, and the invariable association of some of these appearances with each other. Worked out to a logical climax, such a view of human cognition simply means that only things not worth knowing in the selves can be grasped with any certitude, and that the guiding principles of life, the questions of real intrinsic importance are simply matters of blind, unwitting faith. It need hardly be emphasized that, whatever the philosophic protestations of its adherents, a view having such remarkable implications is impossible, from a practical point of view, for even its sincerest adherents. Apart from any such implications worked out in systematic fashion, however, many scientists are inclined to hold that a great number of the problems of speculative philosophy are unanswerable if they cannot be solved by the experimental method.¹

Because, then, of its impossibility as a practical basis for thinking and living, let us remove the "Insoluble Problem" tag from our question and set about looking for the branch of knowledge most likely to succeed in bringing about a solution to the problem. Now to Driesch, Hertwig, Roux, and others mentioned in the first chapter of this work, obviously the answer to the problem should be sought in the experimental field. On the other hand, the dominant trend in modern biology seems to be a denial of the power of biology to solve the problem, and a relegation

1. cf. for example the discussion of this point in Nordenskiöld, op.cit., pp. 606-607.

by default of the problem to philosophy.² Accompanying this renunciation, however, there is quite frequently a little sleight-of-hand: in this trick the magician, having given away the ace of spades, with every show of surprise re-discovers it in his vest pocket. Here the scientist finds a pragmatic, working solution to the problem of life in a provisional mechanism although he is well aware that the data at his disposal are not sufficient to give a complete answer to the problem. The excuse offered for the making of this provisional hypothesis is that it is only upon the basis of such a mechanical assumption that biology makes any progress since an assumption of vitalism considers the explanation of every unsolved problem to lie in the life-force.³ The precise sense of this argument and the extent of its validity had better be left for later treatment, but here it must be noticed that the argument cannot simply be dismissed as the prejudiced attempt of a mind pre-determined to steal for itself a mechanistic basis if it cannot purchase one honestly. Not only is what these scientists aver true, but I think it can be shown that it must be true, that there is no other alternative.⁴

In order to decide where the responsibility lies for solving the riddle of life, it will be first of all necessary to review briefly the place held in the hierarchy of human knowledge

2. cf. H.H. Newman, "The Nature and Origin of Life," in The Nature of the World and of Man, (Chicago: U. of Chicago Press, 1933), pp. 164-165.

3. Ibid., p. 165.

4. cf. discussion on this point in Section III, Chapter II of this work.

by philosophy and by biology and the way in which they approach whatever subject matter they have in common. Hence it will be convenient to treat first of all the nature of science in general, next the divisions of science, and finally, the orientation of two particular branches, the philosophy of nature and biology, to each other and to the rest of the sciences.

It would, I think, be a safe conjecture to say that the idea of a scientific knowledge as opposed to any other branch of human cognition first arose in connection with mathematics. Certainly no one can read the logical works of either Plato or Aristotle without being impressed by the peculiar emphasis placed on this knowledge of quantity both in defining and in working out the methodology of a typical science. And we have but to think of Descartes and Spinoza, of Bertrand Russell and Whitehead, of Galileo, of Newton, of Einstein, to assure ourselves that the emulation of the mathematical ideal has persisted among savants even to our own day.⁵

What then is the attraction found in mathematics for these seekers of knowledge? Why, first of all, its remarkable certainty. Mathematics is concerned with facts that not only are true but cannot be anything else but true, whereas non-scientific knowledge

3. I am not trying to suggest here that this acceptance of mathematics as an ideal has always taken the same form, but merely that the ideal has been consistent. The attempt of Plato and Aristotle to obtain for other branches of knowledge some of the desirable qualities of mathematics by devising for each branch a method proportioned to its proper subject matter is far removed from the ideal of Spinoza who tried to impose a strictly mathematical method on all science and even farther from the ideal of Carnap and Russell who would actually make science identical with the mathematical logic itself.

is concerned with things that are true only at a certain moment or in a certain locality, and the judgment of which, therefore, is subject to continuous revision.

There is a second difference too. The science of mathematics not only posits things as being necessarily true, but it shows why they are true and why they must be true; in short, it deals with the causes of the truths it deals with. The properties of a triangle are shown to have an inseparable and eternal connection with the particular kind of continuous quantity we call a triangle.

Of course these two differences are closely related. Indeed, without some such causal connection, being shown at least obliquely or remotely, the first condition of certainty could not be achieved either; the causal connection supplies the only adequate evidence for such a necessary fact. Any other sort of evidence has validity for only a given time or place, like raw sense experience, or is so unstable and untrustworthy in itself that, like authority, it can only under very exceptional circumstances give rise to certainty even about a temporary state of affairs.

Thus Aristotle says, "We suppose ourselves to possess unqualified scientific knowledge of a thing...when we think that we know the cause on which the fact depends as the cause of that fact and no other, and further, that the fact could not be other than it is."⁶

6. Aristotle, Posterior Analytics, I, ch. 2, 71b8-12. trans. by G.R.G. Mure, in Basic Works of Aristotle.

Such is the conception of the meaning of the word "science" that was received by Thomas Aquinas. It is, of course, radically different from the notion of a science held by the modern physicist or biologist, but at least the two are related as being genus and a species of the genus.⁷ Let us see, then where these sciences fit into the over-all scene as envisaged by Aristotelians.

Those sciences which are in the Aristotelian sense truly sciences, i.e. sought primarily for the sake of contemplation,⁸ are divided into three basic genera. "There must, then, be three theoretical philosophies, mathematics, physics, and what we call theology."⁹ What is the basis of this division? To this question, the answer of Aristotle is not clear, although he gives us hints in the second book of the *Physics*,¹⁰ and in book E of the

7. Dr. Vincent Smith disagrees with this view, classifying the "sciences" of Physics and Chemistry, at any rate, among the arts rather than the sciences. cf. his Philosophical Physics, (N.Y.: Harper, 1950) pp. 144-169. His argument, however, though convincing in itself, depends on certain peculiarities of the "science" of physics and is not equally applicable to Biology and Psychology. These branches of knowledge as we shall see at least obliquely later have certain claims upon the status of a science that cannot be easily disputed.

8. "And since they (the earlier philosophers) philosophized in order to escape from ignorance, evidently they were pursuing science in order to know, and not for any utilitarian end." Aristotle, Metaphysics, A, ch. 2, 982b 20-22, trans. by W.D. Ross, in Basic Works of Aristotle.

9. Aristotle, Metaphysics, E, 1, 1026a 18.

10. Aristotle, Physics, II, ch. 2, 193b 31-35. "Now the mathematician, though he too treats of these things, nevertheless does not treat of them as the limits of a physical body; nor does he consider the attributes indicated as the attributes of such bodies. That is why he separates them, for in thought they are separable from motion, nor does any falsity result if they are separated." trans. by R.P. Hardie and R.K. Gaye, in Basic Works of Aristotle.

Metaphysics.¹¹ Thomas Aquinas, however, gives a fuller analysis of this division in his introductory material in the Commentary on the Physics of Aristotle,¹² and even more exhaustively in a famous passage of his Commentary on the De Trinitate of Boethius. Here the argument is that sciences are distinguished by their objects, or as we perhaps say instead, by their subject matter. Not any difference at all in these objects, however, suffices to distinguish the sciences, but only, since the end of science is a known object, a difference in intelligibility. And such a degree of intelligibility can be constituted only by the degree of remoteness from matter and from motion, immateriality being precisely the basis of cognition. On the first level, therefore, where the object is neither capable of existing without matter nor capable of being thought of without matter (though it is thought of without certain conditions of matter), we have the general classification of the sciences known as Physics; on the second level, where the object exists always in matter but is separable from matter in thought, there is the science of Mathematics; and finally, in the highest area there is an object

11. Aristotle, Metaphysics, E, ch. 1, 1026 a 13-16. "For physics deals with things which exist separately but are not immovable, and some parts of mathematics deal with things which are immovable but presumably do not exist separately but as embodied in matter, while the first science deals with things which both exist separately and are immovable."

12. St. Thomas Aquinas, In VIII Libros Physicorum Aristotelis, I, lectio 1, 1-4. St. Thomas here discusses the characteristics of the objects of the various sciences, but he does not analyze the mental operations characteristically related to those objects in anything like the detail that he does in the Commentary on the De Trinitate.

equally capable of being without matter and being thought of without matter, and here is found the science of metaphysics.¹³

There is, however, another distinction to be made among the speculative sciences, a distinction important to our purposes, and based upon the twofold purpose of science. It is conceivable that some sciences might achieve only one of these ends--knowledge

13. "Sciendum tamen quod quando habitus vel potentiae penes objecta distinguuntur, non distinguuntur penes quaelibet differentias objectorum, sed penes illas quae sunt per se in quantum sunt objecta. Esse enim animal vel plantam accidit sensibili in quantum est sensibile, et ideo penes hoc non sumitur differentia sensuum, sed magis secundum differentiam coloris et soni. Et ideo oportet scientias speculativas dividi per differentias speculabilium, in quantum sunt speculabilia. Speculabili autem secundum quod est objectum speculativae potentiae, aliquid competit ex parte potentiae intellectivae et aliquid ex parte habitus scientiae quo intellectus vertitur. Ex parte quippe intellectus competit ei quod sit immateriale quia et ipse intellectus est immaterialis, ex parte vero scientiae competit ei quod sit necessarium, quia scientia de necessariis est, ut probatur I Posteriorum. Omne autem necessarium, in quantum huiusmodi, est immobile, quia omne quod movetur, in quantum huiusmodi, possibile est esse et non esse, vel simpliciter vel secundum quid, ut videtur I Metaph. Sic igitur speculabili quod est objectum speculativae scientiae, per se competit separatio et a materia et a motu vel applicatio ad ea, et ideo secundum ordinem a remotionis a materia et a motu scientiae speculativae distinguuntur. Quaedam igitur sunt speculabilium quae dependent a materia secundum esse, quia non nisi in materia esse possunt, et haec distinguuntur, quia dependent quaedam a materia secundum esse et intellectum, sicut illa in quorum definitione ponitur materia sensibilis, unde sine materia sensibili intelligi non possunt, ut in definitione hominis oportet accipere carnem et ossa: de his est Physica, sive scientia naturalis. Quaedam vero sunt quae, quamvis dependant a materia secundum esse non tamen secundum intellectum, quia in definitione eorum non ponitur materia sensibilis, ut linea et numerus; et de his est Mathematica. Quaedam vero sunt speculabilia quae non dependent a materia secundum esse, quia sine materia esse possunt, sive nunquam in materia, ut Deus et angelus, sive in quibusdam sunt in materia et in quibusdam non, ut substantia, qualitas, potentia et actus, unum et multa et huiusmodi: de quibus omnibus est Theologia, id est divina scientia, quia praecipuum cognitorum in ea est Deus." St. Thomas Aquinas, In Boethium De Trinitate, q. V, art. 1., ec. by Ayser.

(Fribourg: Société Philosophique, 1948)

of the fact--and another, dealing with the same subject from a somewhat different point of view, might attain not only the fact, but the explanation of the fact. Hence Aristotle divides sciences according to this well-known principle into science of the fact (scientia quia, *ὅτι ἐστίν*), and science of the reasoned fact (scientia propter quid, *διότι ἐστίν*).¹⁴ Formally, this difference in purposes between the two kinds of science shows up as a different sort of demonstration. For the ambition of a science of the reasoned fact is to attain perfect knowledge, and so it must know the fact in that cause wherein it is contained immediately and wholly, that is in its proper cause. Any other kind of demonstration, for example, one from a remote cause, as animal is the remote cause of man, or from an effect, as music is the effect of a musician, falls short of this ideal sort of knowledge and gives us instead a mere knowledge that a certain state of affairs exists.¹⁵

Now because the result of a demonstration to the fact alone is imperfect knowledge, being assertion without understanding or purely negative knowledge¹⁶ at best and uncertain know-

14. Aristotle, Posterior Analytics, I, 13, 78 b 34-35.

15. Aristotle, Posterior Analytics, I, 13, 79 a 22-30, cf. also St. Thomas Aquinas, Summa Theologiae, I, q. 2, art. 2.

16. Because a demonstration from a remote cause is not ordinarily sufficient to show that the effect is of a certain sort, but it is sufficient to show that it is not, e.g. because the parent is animal does not suffice to show that the offspring is a man, but it does suffice to show the offspring is not an orchid. cf. John of St. Thomas, Cursus Philosophicus Thomisticus, (Turin: Marietti, 1930), v. I, p. 787.

ledge at worst¹⁷ there is a natural tendency on the part of anyone having such knowledge to perfect it wherever possible. For this reason, there is a tendency, as Maritain notes, inherent in the very nature of a science of the fact alone to become a science of the reasoned fact.¹⁸ The significance of this fact in explaining modern "science" (in the limited sense) is vast.

Now among all the sciences of the reasoned fact, mathematics is, in a way, the simplest in its causal explanations. In mathematics, all explanation is reduced to tracing the constancy of properties back to their source in the nature of the figure, as for example, the fact that the diagonal of a rectangle bisects the figure can be demonstrated as having an inevitable intelligible connection with its rectangularity. And concerning this nature in which the source of such properties is found there are certain peculiarities--it is a nature separated from motion and matter, first of all, and it is therefore not a nature as really existing but one as only cognitively existing that concerns the mathematician. Hence the simplicity of this science, for the mathematician does not need to trace in the deduction of properties what, if any, effect the material component might have. Further, since only a cognitive existence is in question, since the nature is considered only as a possible essence in which state it is necessary, eternal, and immutable, there can

17. Typical wherever reasoning proceeds from an effect to a cause that is not its proper cause, as in a detective story.

18. Jacques Maritain, Les Degrés de Savoir, 4^e ed., (Paris: Desclée de Brouwer, 1946) p. 69.

be no question as to what external causes could be responsible for its existence. In Aristotelian terminology, mathematical science is concerned with the formal cause alone.

In the explanatory sciences on the first and third degrees of abstraction, in contrast, the object is a thing that exists--or at least can exist--in just the way it is thought of. Besides accounting for properties by form, therefore, these sciences must deal with explanations for a real existence--the agent and the end. On the first degree of abstraction still another fact must be considered--the necessary presence of matter in the intrinsic nature of its object. In these real's, therefore, we have three additional causes to be considered in giving explanations, the material, efficient, and final causes.

Leaving aside for the moment the august science of metaphysics, let us concentrate on analyzing the aims and methods of the sciences on the first degree of abstraction.

As we have already seen, the goal of a science of the reasoned fact on this level should be to account for the existence, nature, and properties of material beings in terms of an analysis of the nature into its intrinsic constituents and of a search in external factors for the reasons of the union and existence of those constituents.

Now such precisely is the aim of the philosophy of nature as laid down by Aristotle.¹⁹ Methodologically, beginning with the known properties of material beings, e.g. mobility, the

19. Aristotle, Physics, I, 1, 184a 9--184b 19.

science argues to the necessary principles of such properties--form, matter, mover, and motive--and in view of such an analysis finally shows the intelligible connection between such principles and still other properties--time, place, order, inherent contingency in existence, susceptibility to chance, and so forth.

If only our method of deducing properties from essences were universally applicable, we should presumably by this time have a knowledge of chemistry as exhaustive as we have of Euclidean geometry. Unfortunately such a happy condition is far from actuality. In the first place, instead of starting as mathematics does with known essences, the philosophy of nature has to start with effects of the essence and argue by a quia demonstration to the nature itself. Hence even under the happiest conditions, our knowledge of the reason for the fact--the explanatory essence--is indirect, acquired progressively in the manner characteristic of reasoning, and therefore subject to incompleteness, confusion, and doubt.²⁰

Even less happily, from the standpoint of a satisfactory human knowledge, the apprehension in an intelligible way of the various specific essences of natural things seems to lie almost completely outside our power. The substantial nature of man alone among all material things is available in its innermost quiddity to our intellect. Outside of this sphere our knowledge of species is restricted to a dialectical and hence probable knowledge that such species exist; there is no such thing as

²⁰ Jacques Maritain, Degrés de Savoir, p. 62.

knowledge of the specific difference itself.²¹ That is not to say that we do not have any knowledge of the essence of material things--even to know that they are beings is a certain understanding of their nature--but such knowledge is confined to the generic as opposed to the specific characteristics of these essences.

Under these circumstances it was obviously necessary, if our knowledge was to be extended to the vast realm of the incompletely intelligible, that we be satisfied with something less than an ideal form of knowledge. If we could not know the reason, at least we might know the fact provided a suitable method could be found.

Fortunately, as is the case with most logical devices, the solution existed long before the nature of the problem was recognized. From the beginning of recorded history men have been acting upon an assumption of practical certainty in cases where knowledge of the reason behind the fact was not possessed; knowledge of the best times for planting or of the necessity of cultivation was possessed, for example, in the earliest known agricultural societies, although the intelligible connection between these practices and the optimum development of plants was certainly unknown and, as a matter of fact, is still largely unknown today. The method consists simply in establishing a constant connection between subject and predicate by repeated observation. Ideally to establish the absolute truth of such a

21. Ibid., pp. 62-63. The reason for this ignorance is the submersion of these forms in the material principle, a principle, as the Eleatics and Heraclitus early perceived, that is completely unintelligible to the human mind.

connection, every instance in which it might occur should be experienced; however, for all practical purposes a wide but not exhaustive acquaintance with individual cases is sufficient.²²

This method, one of the many known generically as induction, is apparently that of the earliest of the lovers of knowledge--Thales and his followers;²³ it is in general the type of reasoning which Aristotle seems, at least implicitly, to think of as characteristic of any entire science devoted to facts alone,²⁴ and it is extensively exemplified in many of the Stagyrates works, particularly the biological treatises, De Partibus Animalium, De Generatione Animalium, etc., This too was the method advocated by Francis Bacon in the Novum Organum, albeit in the impossibly ideal form of complete exhaustion. Basically, this type of induction is still the principal tool of the descriptive parts of Biology and Psychology, and it is a near relative, at any rate, of the quantitatively oriented experiment characteristic of Physics and Chemistry.²⁵

Taken in its simplest form, however, this method is subject to two shortcomings; as mentioned, its results cannot ever

22. Aristotle calls the assertion made by a complete enumeration "induction" and that where the enumeration is not exhaustive "reasoning by example." At present both are simply called induction. cf. Aristotle, Prior Analytics, II, ch. 23-24, 68b 8--69a 20, trans. by A.J. Jenkinson, in Basic Works of Aristotle.

23. At least Aristotle seems to think so. cf. his reconstruction of Thales' reasoning, Metaphysics, I, ch. 3, 983b 20-28.

24. Aristotle, Posterior Analytics, I, 13, 78b 31-79a 15.

25. cf. W.R. Thompson, Science and Common Sense, (London: Longmans Green & Co., 1937) pp. 50-70 for description of methods.

have the certainty which the lover of truth desires without fulfilling a completely fantastic prerequisite of experiencing every single individual case pertinent to the question, and even supposing this condition were to be observed, the insatiable human longing for knowledge of the "why" will still not have been realized.

Since an explanation in terms of unknown essences is completely out of the question (it is this impossibility, remember, that makes these inductive sciences necessary), any giving of reasons in connection with these sciences must come from the realm of the non-philosophic sciences of reasoned facts, from the realm, in short, of mathematics. Here the student of natural phenomena is more fortunate, for while natures may be unavailable, their quantities are not. All that is needed is a suitable measuring instrument. Where such instruments are available, and where there is sufficient correlation between quantity and the accidental qualities of the subject under consideration, it is only natural for an alliance to arise between the inductive sciences and mathematics, an alliance that has produced the imposing structure of modern physical science.²⁶

Not too surprisingly, the assumption of such a correlation between quantitatively measurable motions and qualitative changes in material things is soundly based. The recurring success of philosophical atomism throughout the history of thought would be completely inexplicable were there not some solid foundation in

26. Paritain, Degrés de Savoir, p. 83.

truth for their first premise that all change can be reduced to the measurable one of locomotion. For even if we deny this naive assumption of identity between quantity and quality or between alteration and locomotion, nevertheless there is no overlooking the fact that quantity is a primary condition for the existence of any other material phenomena--try imagining an unextended color for example,²⁷ and that change of place is an absolute prerequisite for any other kind of change whatsoever.²⁸ That such a correlation exists, therefore, is undoubtedly true, and the practical proof of the matter is found in the enormous success of the modern empirical disciplines.

That a science of this nature, well-founded though its premises may be,²⁹ must never aspire to a real causal explanation is the penalty it must pay for its otherwise fruitful union with mathematics. To consider material being only under its numerical aspect is not to explain the causes of its mobility and motion, but to destroy any possibility of such explanation, for mathematics, as we have seen, views things as immobile, as simple,⁴¹ eternal, unchangeable forms. When the mathematician

27. cf. St. Thomas Aquinas, In De Trinitate, q. 5, art. 3.

28. Aristotle, Physics, VIII, ch. 7, 260 a 26--261 a 27. St. Thomas Aquinas, In VIII Phys., lect. 14, The reason for this primacy of locomotion is, of course, the necessity of bringing mover and moved into physical contact so that the one can act upon the other.

29. i.e. those premisses having to do with the correlation between quantity and quality.

applies his ruler to motion, he pries out only its immobile features for examination--he studies motion by paralyzing it.³⁰

This same lack of causal explanation in the modern physical sciences is seen perhaps even more clearly in an examination of the principle of inertia, the foundation of the whole empirical structure. As its very name indicates, this principle agrees to consider the subject undergoing motion as completely inert, completely passive; the whole responsibility for the motion is delegated to an extrinsic force--to another being in motion which in turn is inert and put in motion by another. The causes in question are always extrinsic; there can never be anything intrinsic to the moving thing except passivity. From a philosophic point of view, a science based on such a view is caught in a bottomless whirlpool of passivity; in Aristotelian terms the universe of experimental science is a universe of prime matter. In such a universe, since only the actual can be an agent, there can be really no such thing as a cause, and, of course, no causal explanations.³¹

These two factors, the alliance with mathematics and the foundation on the principle of inertia, the keys at once to the

30. Vincent Smith, *op. cit.*, pp. 31-34. This is even true of the calculus whose explicit purpose is to study motion. Even here the mathematics deals with the rate of change, or rather the ratio of the rates of several changes--a ratio that is in itself something static and by no means identical with the motion itself.

31. *Ibid.*, pp. 28-29 and 151-152. Of course it is true that every thing in motion is being moved by another, but insofar as the moved thing is itself actual, it exerts a certain determining effect on its own motion.

triumphs and limitations of modern experimental sciences, are strictly applicable to physics and chemistry alone. The reduction of qualities to quantitative equivalents and the discovery of external causes that can be correlated exactly with intrinsic motions is at present impossible in many of the problems encountered by the biologist and in even more of those studied by the psychologist and sociologist. These scientists, therefore, are still largely dependent upon the qualitative rather than the quantitative observation and upon the descriptive rather than the algebraic expression of results.³²

The failure of mathematics to provide the biological and psychological sciences with a reasonable propter quid explanation of the observed phenomena poses a dilemma. Either they must be content to remain forever sciences of the fact, eschewing all attempt at explanation, or they must fall under the influence of a non-mathematical explanatory science, specifically philosophy. From the point of view of the natural scientist, neither is a very satisfactory sort of solution: the first because relinquishing the status of the science of the reasoned fact means abandoning its superior perfection, and, more important perhaps, its greater certainty, the second because, as we have already seen, philosophy makes no pretense of knowing the specific differences that furnish the proper cause for so many of the properties studied by the natural scientist.

32. Thompson, op. cit., pp. 114-115. Large areas of biological inquiry, eg. that of heredity, have recently been subjected with some success to mathematical analysis. It remains true, however, that biology is primarily a descriptive science.

The result is that there exists between the sciences of living things and the philosophy of nature an alliance that is much closer than that existing between physics and philosophy and much looser, much less formal than that existing between physics and mathematics.

To say that there is an alliance between Biology and the Philosophy of Nature is not simply to affirm the unity of things studied, ie. of what the Scholastic philosophers call the material object. That such a similarity of material objects exists is, of course, undeniable; both are concerned primarily with the study of living things and their characteristic activities. Such a unity, however, exists between many sciences--between physics and the Philosophy of Nature, for instance--where there is no subordination of this kind.

Neither is the affirmation of such an alliance intended as a denial of sharply-marked differences between the two sciences, for these differences too undoubtedly exist. For the philosophic analyses of nature, of substantial forms, Biology substitutes the descriptions of the size, shape, color, texture, etc., of the organism as a whole and of each individual organ, tissue, or cell. For the study of the reason, the purpose, of the organisms existence, the biologist has to content himself with the physiological relationship between organ and activity. Where the biologist investigates the relation between these organs and activities and certain external forces that are not regarded by anyone as being adequate to explain the effects involved, the philosopher is concerned with the intrinsic "what

it is" that accounts in general for the nature of the activities shown by living organisms. The list could be extended throughout the whole series of questions asked by science, but the answer must always remain the same. The biologist is interested in the description, succession, and inter-connection of the phenomena of life, the philosopher in the nature of those phenomena and of the underlying substance. The biologist could be said to be concerned with causes only incidental or accidental in their nature and hence not productive of really intelligible explanations; the philosopher's aim is to give reasons in terms of real causes, of proper causes.

Consequent upon this first difference there is a second, a difference in method. Briefly, Biology is experimental in method, the Philosophy of Nature is analytical. Beginning with ordinary sense experience (subject to certain epistemological criticisms), Philosophy proceeds in a way already described through an analysis of the nature of the phenomena seized by sense perception, through an analysis of the intelligible nature behind it, to the deduction of properties, divisions, and so on. At the end of the process the conclusions arrived at by this intellectual method of proof can be checked against reality once again by sense experience.³³ In Biology, on the other hand, starting point, proof, and verification are all supplied by that controlled experience known as an experiment.³⁴ The subject of

33. Maritain, Degrés de Savoir, pp. 111-112.

34. "Experiment" in Biology does not mean quite the same as it does in physics. In the latter science, attention is paid

experiment, having been placed in a more or less artificial environment, is subjected to various changes in external circumstances manipulated by a control as exact as possible to find out what effect these might have on the subject's form, behavior, development, and so forth. Not of course, that the thinking of the biologist is unimportant or unnecessary; the posing of questions, formulation of theories, construction of tests, devising of experiments--all these things demand logical thought. But the formal method of demonstration is rather experimental than intellectual.³⁵

Such then are the basic similarities and differences between Biology and the corresponding part of the Philosophy of Nature, and these have not proved fruitful in showing us any extraordinary connection between these two sciences. Let us look in another direction, contrasting the similarities of Biology and Natural Philosophy with those between physics and Natural Philosophy. Even a casual inspection shows that there are at least two points on which Biology more closely resembles Philosophy than does Physics: that Biology asks, and seeks answers to, supra-phenomenal questions, and that Biology extends its interest to the domain of formal and final causes.

only to the quantitative element to the exclusion of qualities, a situation that is not and, as we have already pointed out, cannot be true in Biology from the very nature of the science.

35. cf. Brennan's parallel analysis of the differences between philosophical and experimental Psychology in Thomistic Psychology, pp. 50-53. cf also Maritain, Degrés de Savoir, pp. 110-111

Physics, as is well known, very early in its modern career discarded entirely any consideration of final causes, whether from an absolute denial of their existence or from a protest against their over-facile use as explanations. To this happy state Biology has never been able to arise, despite the longings in that direction of more than one eminent biologist. The history of Biology is full of abortive attempts to rid it of the factor of purpose; one of the most remarkable of these attempts was the frantic activity of the proponents of Darwinian evolution, who spawned new final causes faster than they could disinherit the old. The survival and high estate of Physiology, at any rate, testifies to the survival of such factors in Biology even today.³⁶

The tendency of Physics to eliminate formal in favor of efficient causes, to replace intrinsic activity with inertia, has already been pointed out. As in the case of final causes, this is perhaps an element of Physics that many biologists would like to emulate, but it is a goal hopelessly out of sight. Whether they like to do so or not, biologists are forced to deal with living things as actualities with certain stubborn activities of their own, and not merely inert occasions for the addition of vector sums of outside forces. Hence, the necessity, as Maritain points out,³⁷ of certain autonomous concepts and laws specific to biology, unexpressable in the algebraic deduction of physics, and irreducible to the laws of chemistry, concepts

36. cf. Thompson, op. cit., p. 143.

37. Maritain, Degrés de Savoir, p. 129

and laws that rest, wittingly or not, upon philosophical principles.³⁸

Closely associated with this tendency is another noted by Maritain,³⁹ the tendency of Biology to imitate philosophy by asking supra-phenomenal questions. If the questions asked by Biology cannot be answered at all or only with hopeless inadequacy on the phenomenological level, then it is only natural that the answers be sought on a higher level. The outstanding example of this tendency in biology is the very question we are seeking to answer in this work, the question of the nature of life. It is one thing to ask the questions, however, and another to answer them, and we should inquire as to whether Biology is able either by itself or in co-operation with other sciences to answer such questions.

In isolation, of course, Biology could never give a demonstration of answers to such questions. The method of demonstration in Biology is experimental, experiment deals with the observable, and nothing supra-phenomenal is by its very definition directly observable. No experimental science, therefore, can deal directly with anything except phenomena.

There seems to be no reason, however, why some sort of knowledge of the supra-phenomenal could not be attained by the Biological sciences through the mediation of philosophical

38. For the connection between this analysis and a preceding objection against Vitalism, namely that it impedes Biological progress, cf. Section III, Chapter 2 of this work.

39. Maritain, Degrés de Savoir, p. 130

principles. The method might be described as follows:

By means of a philosophic inquiry, the nature of some generic substance "Y" is determined, and from that nature it is deduced as a property that under conditions "A, B, C," it will produce the action "Z". Then by experimental means, out a representative of class "X" under conditions "A, B, C," and observe whether or not it produces action "Z." If it does not, then it can be known with certainty that "X" does not have "Y" for its generic substantial nature. If "Z" is produced, however, no certain knowledge will be produced, unless it can be shown that "Z" is characteristic of "Y" and of nothing else, for otherwise the demonstration will depend upon an affirmation of the consequent.

Now this is precisely the sort of demonstration that is attempted by Driesch in his dissection of the embryonic sea-urchin. Driesch first analyzes on philosophical grounds the kinds of causal behavior to be expected from machines, showing this causal behavior to be of the type that he calls 'singular causality.' He then proceeds to show by experimental means that a certain type of causality found in the activity of a sea-urchin cannot adequately be described as singular causality. He comes to the conclusion, therefore, that the sea-urchin could not possibly be merely a machine. We will examine this experiment again later with a view to determining the validity of its conclusion. From the formal point of view, however, there appears to be nothing wrong with the reasoning.

In this sense, therefore, Biology is able to give answers to questions concerning the supra-phenomenal. But this knowledge, insofar as it partakes of the certainty characteristic of science, must be purely negative, and might better be described as knowing about the essence than as knowing the essence. It may be that it is possible to know that there is a supra-phenomenal element in living things by experimental means, it may be that such means will add at least negatively to our knowledge of what that element is or rather what it is not. But it is impossible that anything short of the philosophic intuition, the real reader of the inward secrets that is intellectual abstraction, should ever grasp the being of these supra-phenomenal elements as they are in themselves. The answer to the existence of life may be available to both scientist and philosopher; the knowledge of what life is and what its principle might be is reserved for the philosopher alone.⁴⁰

40. Arntain, Degres de Savoir, p. 130.

SECTION II

CHAPTER II

THOMISTIC SOLUTION OF THE BASIC PROBLEMS

Having seen in the last chapter that the problem of life is one that in its fullness can be solved only by the philosopher, let us turn now to the solution of this problem proposed by St. Thomas Aquinas. And since there are various philosophical analyses and factual observations necessary as a background for this solution of the problem, it seems advantageous to discuss these prerequisites before applying them to the problem itself. In this chapter, therefore, the philosophic basis of the solution of the problem will be laid; in the next two, the principal difficulties concerning the nature of the organism will be discussed.

Now the living things with which we are dealing, i.e. animate beings of the material order, belong in their natural and intentional mode of existence to the first degree of abstraction; in short they are mobile beings. In order therefore to understand the generic nature of these vital objects, it will be necessary to discuss the nature and causes of motion, the definition of motion, and the need for a mover. Since we are dealing with a specific kind of mobile being, moreover, it will next be necessary to discuss the specifying factor in motion, a

factor that is to be sought in the goal of motion.¹ Because of the fact that the living organism is a complex whole, and one of the principal difficulties in the question involves the reconciliation of this complexity with this wholeness, a discussion of the ancient problem of the one and the many must follow. Finally, the solution of the difficulties concerning the relation of vital principle and matter demand a study of the constitutive principles of material substance

A. The Nature and Cause of Motion

In treating the nature of motion, St. Thomas follows closely the analysis proposed by Aristotle in the third book of the Physics. This analysis, like the whole of the Aristotelian Physics depends upon the distinction of being into potency and act.

This division, as is well known, was originally arrived at by Aristotle as an answer to the twin problems of change and multiplicity. His predecessors, indeed, had already seen how difficult it was to arrive at the idea of a pluralistic universe of motion and change on the basis of the ideas of being and non-being, but it remained for Aristotle to seek the root of the problem in the multiplicity of meanings in the word "being." And the first, the basic division of meaning, one that impreg-

1. The discussion of the finality of motion, of course, belongs logically in the first section dealing with the nature and causes of motion. However, because of its importance in the problem of the specification of motion, I have preferred to give it independent treatment.

nated the whole of the universe, was the division into potency and act.

An actual being is a perfect being, a being that already exists, a being in a state of fulfillment. A potential being is imperfect; it does not yet exist but rather it can exist; it has the capability, the tendency to fulfillment, rather than the fulfillment itself. In relation to water, for example, hydrogen already burned in oxygen is in a state of actuality; the water really exists. Non-oxidized hydrogen, on the other hand, has a capacity for changing into water, but it is not water yet. It is, therefore, said to be potentially water.²

Nor can the reality of either the act or the potency be impugned. For act is really existing being and of this there can be no doubt. If potency were not real, on the other hand, it would be impossible to explain the constancy in the production of certain effects by certain causes. If the architect, for example, does not have a real power to design good buildings even when he is not doing so, (a power that is lacking in non-architects), why is it that in the actual performance of the art of designing, the architect so regularly outdoes the non-architect? Why should the art in its perfect state so constantly reappear in one individual unless it be real in him, albeit in a different status, even when he is doing something entirely different? Or why should hydrogen burn easily in oxygen and helium not burn at all unless, even while both are inert, there exists in the

2. Aristotle, Physics, III, ch. 1, 200 b 12--201 b 15. Metaphysics, Θ , ch. 3, 1047 a 24-29.

hydrogen a capacity (a valence the chemist says) for being oxidated, whereas in the helium no such capacity exists?³

Now every change must necessarily involve these twin concepts of potency and act, for if there were no differences between the state of things before the change and after the change, there would have been no change. The difference produced, therefore, must be the existence of a new size, or color, or position, or even substance--in every case of a new actuality. And whereas this new actuality did not formerly exist, it must have been real as a capacity before, for if it had not been possible for it to exist, it would never have come into existence.

Since motion is merely a continuous, successive change, it too will involve potency and act. The motion itself, however, can be identified with neither of these, but rather seems to be a something midway between the two, a mixture of both. Being a sweater, for example, is an actuality, and being a ball of yarn is a potentiality, but being knitted is neither the sweater nor the yarn, nor even a half-knitted sweater, but the process by which one becomes the other. With respect to the sweater, therefore, the process of being knitted is still relative, imperfect, and therefore potential, otherwise the thing would be perfect in relation to sweater and imperfect in the same respect simultaneously. On the other hand the process of being knitted is a development made possible by the fact that the yarn is poten-

3. Aristotle, Metaphysics, Θ , ch. 3, 1046b 33-1047 a 4.

tially a sweater, so with respect to the potential sweater, the knitting is a fulfillment.

Now the sweater is the fulfillment of a potency in yarn that no longer exists in the state of potency. For once the sweater exists, the yarn is no longer potentially that particular sweater; it is actually that sweater. Similarly the ball of yarn itself is the development of the yarn insofar as it had the potentiality of being yarn. The 'being knitted' therefore is the development of a potency in the yarn, not of the actualized potencies of sweater or yarn, but of the potency of the sweater while it is still in potency to being a sweater. Motion, we conclude, must be defined as "actus existentis in potentia secundum quod huiusmodi,"--the fulfillment of what exists potentially insofar as it exists potentially."⁴

That such a thing as motion, made up as it is of potency and act, could not possibly be a self-sufficient being explanatory of itself and self-sustaining, is axiomatic in the philosophy of St. Thomas and Aristotle. Nothing moves itself. And while both list a multiplicity of arguments in support of this vital fact,⁵ the clearest and most persuasive is that which depends on the foregoing analysis of motion as the act of what

4. St. Thomas Aquinas, Summa Contra Gentiles, I, ch. 13, Aristotle, Physics, III, ch. 1, 201 a 10. The argument leading up to the definition is basically, though far from exactly, the one given by Aristotle in the section following the definition. cf. Physics, III, ch. 1, 201 a 10 -- 201b 15.

5. St. Thomas in the Summa Contra Gentiles, I, ch. 13, lists three arguments for this proposition, all taken from the Physics of Aristotle. The first is given in Physics, VII, ch. 1 241 b 24--242 a 15; the second in book VIII, ch. 4, 254 b 7 -- 255 a 19, and the third in Physics VIII, ch. 5, 257 a 33--257 b 12.

exists potentially in so far as it exists potentially.⁶ Briefly the argument may be summarized thus: if a moving thing moved itself, it would be necessary for that thing to be simultaneously actual and potential in the same respect. This of course is impossible; hence it is impossible that anything move itself.

The truth of the hypothetical proposition stating that a self-moving thing is simultaneously actual and potential is obvious from the consideration of two other principles: that whatever is moved is moved insofar as it is in potency, and that whatever is the agent source of any operation is in act. Of these two, the first, concerning the potentiality of the moved, is already obvious from our analysis of motion, for a thing can only be said to be in motion as long as it has not yet attained the perfection or actuality that is the term of its motion, as long, therefore, as it is still in potentiality to that actuality. The truth of the second proposition, that dealing with the actuality of the operator, is obvious from the very nature of an operation. For an actual operation needs an actual subject⁷ lest it be something existing neither in itself nor in anything else, and therefore not existing at all. Furthermore, the subject must contain in some way the actuality of the operation and if the operation is transitive--being the source of an actuality in something else--then the operation must contain the actuality produced in the object, and the subject, in turn, must contain

6. This is the third of the above proofs.

7. That is, unless the operation is the subject, in which case the operation is actual by the same actuality as the operator.

that actuality, otherwise it would have come out of nothing. As both Aristotle and St. Thomas are fond of pointing out, the teacher cannot teach unless he already possesses the fund of knowledge he is passing along, and the only thing that can be the cause of heating is what possesses heat in some fashion. It therefore follows that the person teaching himself would already possess the knowledge he is trying to learn; a self-heating substance would be already as hot as it is going to get.⁸

The impossibility of this situation is patent. It is an immediate violation of the principle of contradiction to say that a thing may be actual and potential in the same respect simultaneously, for while potency is being as contrasted with nothing, it is non-being as contrasted with the being of act. It is impossible, therefore, for anything to move itself.

There is no alternative, therefore, to saying that whatever is moving is being moved by another. It is sometimes suggested that there is a third alternative to a thing's being moved either by itself or by another, the alternative that it is possible for it to be moved by nothing. This however is purely a verbal alternative and does not take into account the complete unreality of nothingness. For to attribute to nothingness the positive characteristic of being a source is to overlook the fact that nothing has no attributes at all; it cannot be a real source because it is not a real anything. The sole

8. Aristotle, Physics, VIII, ch. 5, 257 a 33-257 b 12.

possibility, therefore, is that the motion of a being finds its source in some other being.⁹

As a note to this discussion of the motor cause, it might be apposite to point out that the need for a mover continues as long as the motion itself. For as long as a thing is moving, there is a continuing transition from potency to act, together with the need of an actualizing factor, an agent cause of motion.

B. The Finality of Motion

That there exists motion and that motion, or at least the inception of motion, demands a cause are propositions that are pretty widely accepted even today, obvious though the philosophical giving of reasons for these statements may be to moderns. But the universality of the statement that every agent acts for an end (or that every motion is toward some goal) has not merely been called into question, and all its metaphysical reasons with it, but it has for the past 400 years been completely ignored, or at most mentioned only to be dismissed with the negligence befitting a naive anthropomorphism.

Not, of course, that these thinkers would deny all existence to ends or purposes. These philosophers make an interesting spectacle, it has been well said, that spend their whole lives

9. The whole argument is tersely and clearly summarized by Thomas Aquinas thus: "Tertio, (Aristoteles) probat sic. Nihil idem est simul actu et potentia respectu eiusdem. Sed omne quod movetur, in quantum huiusmodi, est in potentia: quia motus est actus existentis in potentia secundum quod huiusmodi. (Physica, III, I, 201 a 10). Omne autem quod movet est in actu, in quantum huiusmodi: quia nihil agit nisi secundum quod est in actu. Ergo nihil est respectu eiusdem motus movens et motum. Et sic nihil movet seipsum." Summa Contra Gentiles, I, ch. 13

with the purpose of showing that there is no purpose in men's acts. Most modern scientists and philosophers, however, are agreed in confining goal-seeking activity to intelligent beings, a restriction that is not without good reasons.

Nevertheless, it is a cardinal point in the philosophy of Aristotle and St. Thomas that every action has its goal, and, moreover, that this goal is the ultimate determining factor in producing a specific kind of activity. Since the nature of life for both of these philosophers is known by the analysis of certain highly specific actions, and since the end is the specifying factor, it seems quite probable that a discussion of the goals of these activities would take an important part in their discussion of life activities. Our background must include, therefore, an analysis of finality, of some related problems such as chance, and of the accuracy of our knowledge of finality as treated by St. Thomas Aquinas. In connection with the notion of finality itself, we will discuss first of all the origin of the idea of finality, secondly what is comprised in this idea, and thirdly what proof St. Thomas gives for the universal applicability of this notion.¹⁰

There does not seem to be much doubt about the source of our knowledge of end-seeking. Obviously the idea is not something immediately generated by the senses, but there is apparent at least one case in which we are immediately aware both of the subject and of its goalward tendencies, the case of ourselves. And

10. The following discussion is based upon St. Thomas' argument in Summa Contra Gentiles, III, ch. 1, although the order has been changed.

because of the similarity between our own actions and those of other human beings, because of the impossibility of explaining these actions without making the assumption of a similar, intelligent finality underlying them, we immediately extend this idea to our species.¹¹

Basically, there are four elements that can be postulated of the end-seeking activity of such an agent. First of all the end is, as its name indicates, the terminal point to which an action proceeds and in which it comes to rest. Secondly, there is the qualification that the end cannot be simply any point in which an action comes to rest, but the one specific terminal point of action that determines the action to be what it is and, in fact, to be at all. Otherwise, we would not ever say we had failed in our purpose, for every action comes to some sort of a termination; but we do say we have so failed unless the one specific goal of action is reached in virtue of which the action was started. We say, for example, that the mechanic has failed if he does not get a machine in running order, although he may well have achieved some sort of assembled condition of the parts.¹²

In addition, we are aware that in ourselves, at least, the end exerts its influence upon our actions through a cognitive existence in the mind, and lastly that it issues in action

11. R. Garrigou-Lagrange, God, His Existence and His Nature, trans. by Dom Bede Rose, (St. Louis: Herder, 1946), I, 199.

12. cf. Aristotle, Metaphysics, Δ, ch. 2, 1013 a 33, also Physics, II, ch. 3, 194 b 32, and Nicomachean Ethics, I, ch. 7, 1097 a 21.

only (in most cases) by being selected as one of many alternatives by an orectic power.

The last two conditions are dependent upon the existence of intelligence (or at least of some kind of cognitive power) in the acting subject. If finality is understood in this sense, there is not only good reason for denying its universal applicability, but an absolute necessity to restrict the principle. However, if only the first two conditions are considered, those of a termination point for the sake of which an action exists, it is immediately apparent that we cannot restrict this notion of finality any longer to cognitive beings, because we know of non-cognitive beings that act in this way. St. Thomas' example of such a thing is the arrow flying toward the target. The target, in this case, is the termination of the arrow's flight, and it is for the sake of this termination that the flight exists. This we know to be true because the archer has imposed this end upon his missile. But to know that some things act on account of ends and to know that all things do so are two different things. It is in the analysis of the latter position that we are interested.

The necessity of positing an end for every agent arises from the impossibility of accounting for the difference between one change and another without such a goal. Clearly the fact that we are able to distinguish between one kind of change and another cannot have anything to do with the fact that both are change, for in this the two would be similar rather than dissimilar. As a matter of fact, the change is not, as we have already seen, self-sufficient, and thus what the change is or is not, that it

is this kind of change and hence not any other, cannot in any way be traced back to the change itself, otherwise we find ourselves in the familiar dilemma of explaining how the thing is actual (as determiner) before it is actual (as determined). We must, therefore, look beyond the change itself for an explanation of what it is.¹³

We have already discussed the source of the actuality of motion in the mover. To say that the agent and the agent alone is responsible for the difference between one action and another is to miss the point of the argument, for it still does not explain why the agent should produce one variety of change rather than another. This is explicable in the Thomistic view only from the standpoint of the fact that the agent itself must have a certain determining tendency toward an end that explains in turn the sort of agent it becomes and the kind of action it performs.

That such a tendency to an end is present in agents existing in the half-world of potency and act, it is easy to show. For before an agent produces an action, it must have the ability to act, otherwise it would be doing what it cannot do, a manifest impossibility. Now this ability, or potency, constitutes a tendency towards something determinate, otherwise it would be a

13. I have begun with this analysis of change because it is primarily with motion that we are here concerned. While strictly speaking, some agents are not the efficient causes of change, but the source of ~~immanent~~ acts having nothing to do with potency, and while, therefore, this analysis does not really prove that every agent acts for an end, it is sufficient, I think, to prove that every mover moves for an end, and that is our principal focus of interest here.

tendency towards nothing, and if a thing tended to nothing, it would be completely inert. Briefly, on the part of both the mover and the moved, there is a potency towards the actuality that is the completion of the motion, towards the perfection that gives meaning to the relative thing that is the motion itself. This tendency is what we call the finality of the motion; the actuality produced by the motion is called the end.¹⁴

Obviously such a relation between motion and end exists in potential agents. As a matter of fact, there must be a determination of every agent whatsoever by an end. For just as obviously as all motions are alike in the fact that they are motions, so all agents are alike in being agents; thus their proper nature as agents must be the cause of likeness rather than unlikeness in the action. It would be truer to say that the difference in the actions is due to the fact that they are produced by different kinds of agents; but here we run into the peculiar fact that we seem to have got our causal relations mixed up. It is rather because it produces a certain kind of action that an agent is an agent of a certain kind than the other way around: a lie is not a lie because it is told by a liar, but rather primarily the liar is a liar because he tells lies. No explanation can be found for what kind of an agent a thing is in the nature of the thing as agent, for like motion itself, the agent is a relative sort of thing and hence must be determined in its nature by something extrinsic to itself. Obviously such an extrinsic determinant

14. V. Smith, op. cit., p. 95.

cannot be another agent--such a solution is simply to push the problem back to another thing where the same insufficiencies will be found, and eventually this pushing backwards can only result in the intellectual frustration of an infinite series. If the mover, the efficient cause, of the agent is eliminated as a specifying factor, only one possibility remains--a determinant in the form of an attracting term, in short, a final cause.¹⁵ Every agent, then, must act for an end.

At the conclusion of this argument, St. Thomas points out an additional distinction that will be useful later in our discussion of the finality of living things, a distinction of actions into two analogous kinds.¹⁶ The first of these is known as transitive action, and consists of action upon a distinct patient, i.e. action in the predicamental sense; the other is known as immanent activity and is an action that, taking place without any extrinsic patient, remains within the agent, and is, rather, a species of quality than a predicamental action. In transitive action, the term, being outside of both agent and activity, is nonetheless that in virtue of which both exist, as, for example, the edifice is with regard to the action and art of the building. Similarly, in immanent activity the end is the intrinsic determinant of activity, and, in creatures, is the

15. J. Maritain, Preface to Metaphysics, (N.Y.: Sheed & Ward, 1948), p. 144.

16. St. Thomas Aquinas, Summa Contra Gentiles, III, ch. 1. "Actio vero quandoque quidem terminatur ad aliquod factum, sicut aedificatio ad domum, sanatio ad sanitatem: quandoque autem non, sicut intelligere et sentire. Et si quidem actio terminatur ad aliquod factum, impetus agentis tendit per actionem in illud factum: si autem non terminatur ad aliquod factum, impetus agentis tendit in ipsam actionem."

extrinsic cause of the power by which it is performed; an example of this sort of an activity is that of thought. In either case, however, the action has an end; in the first instance, the end is the result of the action; in the second, the end is the action itself.¹⁷

One of the principal difficulties brought against the principle of finality is the existence of chance. Now that such a thing as chance exists, at least on the level of our own experience is an undeniable fact. Equally undeniable is the fact that what we call chance results are results that happen without any specific tendency towards them on the part of the agent. We call an automobile collision an accident, a chance, precisely because it is something that happens that is not, normally speaking, the tendency of either the automobile or the driver. We can define chance as anything that happens outside the intention of the agent. That the roulette wheel revolves is not chance at all, but the intention of the agent, the croupier; that black wins instead of red is simply a matter of chance, at least if the wheel is not crooked.¹⁸

The very fact, however, that we have to define chance as something outside the tendency of the agent is an indication that there must be some tendency for the result to be outside of, that chance must presuppose finality. And such we find actually to be the case. Obviously no chance effects would happen in a

¹⁸. For this distinction, cf. also Aristotle, Metaphysics, Θ, ch. 6, 1049 b18-35.

¹⁸, V. Smith, op.cit., pp. 103-109.

motionless universe, for in such a universe nothing at all would happen. Chance, then presupposes motion. Motion, however, presupposes finality, for if it were not for moving towards a determinate goal, the being would not be moving at all. Far from denying the need of finality, therefore, chance actually presupposes and bears witness to its reality.

There still remains the problem of how chance is possible in a universe dominated by finality. But this problem may be easily solved by considering an actual chance occurrence, for example, an automobile accident. Here the driver is prevented from reaching the goal that forms the final cause of his journey by an obstacle in the form of interference by another driver who is also acting for an end. Or perhaps the driver happens to be stopped short of his goal by a lamp-post or a rock, either of which is where it is because of the action of some other agent, conscious or unconscious, which was similarly acting toward some goal. In any case, the chance event represents an intersection and interference, often mutual, between an agent and some other cause which occasions the failure of the agent in his end. A rather interesting extension of this reasoning reveals that sometimes, when several levels of causality are involved, that which is a chance event from the aspect of one of several co-ordinate and conflicting causes may be nothing of the sort from the point of view of a superior cause that controls all of them. Thus the billiard player causes collisions of balls that are chance events from the aspect of the natural tendencies of the balls, but nothing of the sort from the point of view of the

billiard player; similarly it is a commonplace of theistic metaphysics that although chance exists from the standpoint of creatures, there is no such thing for God, who directs all things to their end.¹⁹

Important as chance is in the theoretical sphere as an objection to finality, it does not play as decisive a role in convincing the anti-finalists of their positions as do two other more personal objections. One of these is the conviction widespread among modern thinkers that the idea of finality is an anthropomorphic conception; the second, closely related to the previous difficulty, is the natural repugnance occasioned in intelligent men by the sometimes preposterous explanations of events given in terms of final causes.²⁰

The lack of truth in the first objection should be already clear from our analysis of final causality. True though it is that the idea of finality takes its origin in our internal experience of our own actions, we have already seen that the idea is scrupulously purified of those elements which would certainly destroy its universal applicability. Our reason for affirming universal finality, therefore, is not an illegitimate transference of our own experience to the world around us, but the intrinsic impossibility of motion without an end.²¹

19. Maritain, Preface to Metaphysics, pp. 1/3 ff. For an exhaustive treatment of the ramifications of this problem, cf. Aristotle, Physics, II, ch. 4-6, 195 b 31--198 a 12.

20. W.R. Thompson, op.cit., pp. 132-133.

21. Garrigou-Lagrange, op. cit., I, 199.

It is unfortunately true that many exaggerated claims are made for the explanatory powers of final causes. Bacon objected quite rightly to the tendency to swallow up all other kinds of causal explanation in finality. To give the final cause, even when it is known, is not the same as giving the efficient or the material cause. Furthermore, there are not lacking those who claim not only to know the natural end of every action or quality (e.g. flies are black so they may be easily swatted) but even claim to be able to read the purposes of God. Obviously, knowing that every agent acts for an end is a vastly different thing than knowing what end every particular agent acts for. And just as we are unable to know the specific nature of many natural things, but can only approach those things obliquely by induction, so the specific tendencies of these same beings often remain hidden from us and can only be reached by experimental means. It is only in the most general terms that we can speak philosophically of either the intrinsic or extrinsic causes of such beings.²²

To reject a whole mode of explanation, however, simply because it is subject to abuses is an extreme worse than the evil it is intended to cure. And as a matter of fact, no matter what their protestations, no scientist is able to do without final causes, although he may call them by another name. The physicist investigating the boiling point of water is dealing with an intrinsic tendency of this substance that has its finality in a qualitative change from liquid to gas. Even more impressively,

22. V. Smith, op. cit., p. 96.

the biologist is unable to carry on his work without final causes as the whole branch called physiology testifies. In spite of all objections, the law of finality is recognized inescapably by the human mind as a ruling principle in reality.²³

C. Unity and Multiplicity

Perhaps the most perplexing problem arising in connection with the nature of life is the determination of the degree of unity to be found in the organism. As we have already seen,²⁴ the answer given to this problem is one of the two basic issues with which we have to deal, and it is on the foundation of a solution to this problem that we find a distinction ordinarily drawn between mechanists and vitalists on the one hand, and, on the other, holists in general and animists in particular. It is not the ambition of this section to settle this problem, but merely to set down certain understandings and divisions basic to the solution of the problem from a Thomistic point of view.

The importance of the problem of unity in knowing the determinate nature of a being is not confined to the problem of life; on the contrary, it is only in terms of a solution to this problem that we can be said to know anything at all in its intrinsic nature. Obviously such is the case in considerations of discrete quantities,²⁵ for number can only be understood in terms

23. W. R. Thompson, op. cit., pp. 140 f.

24. cf. Section I, Chapter I, pp. 36 f.

25. St. Thomas Aquinas, In Librum Aristotelis Metaphysicorum, I, lect. 2, no.1939, (Turin: Marietti, 1939)

of the multiplication of unities, and it is easy to see that the understanding of the dimensions of a continuum depends upon its measurement in terms of something regarded as undivided, e.g. the human foot.²⁶ It is equally true, although not quite so obviously, that all knowledge must take place by understanding the complex through the simple, the divisible by the indivisible, the multiple in terms of the one.²⁷ Hence, says Aristotle in the introductory chapter to the *Physics*, "We do not think we know a thing until we are acquainted with its primary conditions or first principles, and have carried our analysis as far as its simplest elements."²⁸ Thus the modern physicist seeks to know his object by carrying through a series of quantitative divisions, the philosopher by an intellectual analysis in terms of causes.

To say that a knowledge of a thing's unity is necessary to the analysis of its determinate nature is by no means the same thing as saying that unity is prior either in knowledge or reality to being. The "one" must be considered in all cases as having a subject of which it is a determination.²⁹ Consequently, the "something" that is the source of the reality of its unity must be conceived prior to the unity itself. Before we can explicitly form the idea of indivision basic in the concept of unity, the fact of division itself must be recognized. Hence, the fact

26. Ibid., lect. 2, no. 1944.

27. Ibid., lect. 2, no. 1952.

28. Aristotle, Physics, I, ch. 1, 184 a 11-14.

29. St. Thomas Aquinas, In I Metaph., lect. 3, no. 1966.

this being is not that being, a fact involving a prior judgment on the reality of being, must precede the formation of the idea of the one. "What comes first to the intellect is being; secondly that this being is not that being, and thus we apprehend division as a consequence, thirdly comes the notion of the one."³⁰

Though unity is understood as a determination of being by adding to it the idea of lack of division,³¹ it is clear that this determination is not added in such a way as to diminish the extension of the concept of being: every being must also be a "one." "For every being is either simple or composite. But what is simple is undivided, both actually and potentially; whereas what is composite has not being while its parts are divided, but after they make up and compose it."³²

Consequently it is impossible that the indivision added to being by unity should be a real addition. Certainly it cannot add anything outside of and distinct from being, as, for example, rational or white add something real to animal, something extraneous to the nature of animal taken in itself. In this way nothing at all can be added to being, since there is nothing extraneous to its nature.³³

30. "Ita quod primo cadit in intellectu ens; secundo, quod hoc ens non est illud ens, et sic secundo apprehendimus divisionem; tertio unum." Summa Th., I, q. 11, art. 2, ad 4^{um}.

31. Ibid., I, q. 11, art. 1.

32. "Nam omne ens aut est simplex aut compositum. Quod autem est simplex est indivisum et actu et potentia. Quod autem est compositum non habet esse quamdiu partes eius sunt divisae, sed postquam constituunt et componunt ipsum compositum." Ibid., I, q. 11, art. 1.

33. St. Thomas Aquinas, De Veritate, q. 1, art. 1.

Hence the difference, if any, between unity and being must come from within being itself. Now such a difference, when real, must be such that it contracts the concept which two things have in common. If the two realities are different because of that very intrinsic principle in virtue of which both bear the same name, this can only be because one of these principles is not the other, and each of the variations covers only part of the extent of the basic concept.³⁴ In the case of being, then, such a real difference could be constituted only in special modes of being, modes that differ from each other and of which each can extend to only a part of the vast range of reality covered by the concept "being."³⁵ And such differences, though they must exist,³⁶ cannot be applied to any concept like unity which, as we have seen above, extends to the whole of being.³⁷

It is plain, therefore, that what unity adds to being is not a new reality but a new idea, the idea of indivision, the genesis of which in terms of the contrast between being and division, the privation of being, we have described above.³⁸ What the "one" refers to in reality, therefore, is the very thing itself to which it is attributed.³⁹

34. Ibid., q. XII, art. 1

35. Ibid., q. q. I, art. 1.

36. Otherwise we fall into the monism of Parmenides, cf. Aristotle, Physics, I, ch. 2, 186 a 33-34.

37. St. Thomas Aquinas, Summa Th., I, q. 11, art. 1.

38. cf. also St. Thomas Aquinas, De Veritate, q. I, art. 1, and q. XXI, art. 1.

39. In X Meta, lect. 3, no 1980.

The "one" in its proper sense, therefore, indicates a thing that is undivided in itself, and in this sense we call the thing one "per se." But by extension, we can apply the name to things that are really different taken in themselves, but are somehow related to something that is undivided. This sort of unity Saint Thomas calls accidental.⁴⁰

An accidental unity may be found between two or more accidents or between one or more accidents and a substance. In either case, the diverse entities involved are called one because of their modification of one substance; the accident and the substance are said to be one because the former modifies the latter.⁴¹

It is usual in the Thomistic tradition to distinguish two other general types of accidental unity besides those borrowed by St. Thomas from Aristotle's Metaphysics. These are the so-called unity of aggregation that belongs to a group of independently existing substances by their co-presence in one place,⁴² (for instance, a pile of stones), and a unity that flows from a common relation to one extrinsic cause whether agent or end. Thus a set of novels may be said to be unified even if their only connection is in the one man who wrote them, or a set of tools because they can all be used to build a house.⁴³

40. St. Thomas Aquinas, In V Meta, lect. 7, no. 843.

41. Ibid., lect. 7, no. 844.

42. i.e. one general place, and not, of course, one proper place.

43. St. Thomas Aquinas, Summa Th., I-II, c. 17, art. 4.
"Quae vero sunt diversa secundum substantiam, et unum secundum

With regard to per se unity, there are four principal kinds; the first is the unity of the continuum, the second of that which is continuous and has besides one form or species, the third that of the individual, and the last that of the universal.⁴⁴

In the first two of these divisions, the emphasis is placed primarily upon the unity given to a thing by a continuous material quantity,⁴⁵ and hence in the ideal case these varieties of unity belong to those things that meet the test for a continuous unity suggested in book Δ of the Metaphysics, viz. that the motion of such a thing should be one and indivisible.⁴⁶ By derivation, then, these sorts of unity are extended to those things which have an imperfect sort of continuity, such as that of a bent (i. e. angled) line or that of a forced or artistic unity such as is imposed by nails or glue.⁴⁷ The difference between these first two is the addition in the second kind of another source of unity, a unity of shape, e. g. a triangle, or of a species, e. g. an animal.⁴⁸

The last two divisions differ from the first in placing the emphasis on the unity of the definable nature (ratio) of

accidens, sunt diversa simpliciter et unus secundum quid: sicut multi homines sunt unus populus, et multi lapides sunt unus acervus, quae est unitas compositionis aut ordinis.

44. Aristotle, Metaphysics, I, co. 1, 1052 a 18-37.

45. St. Thomas Aquinas, In Δ Meta., lect. 1, 1932.

46. Aristotle, Metaphysics, Δ, ch. 6, 1016 a 5-6

47. St. Thomas Aquinas, In X Meta., lect. 1, 1922.

48. Ibid., lect. 1, 1925.

the thing instead of on its continuity or motion.⁴⁹ Hence in this sense a being is one whose definition is one. Between themselves, these two differ principally by reason of their communicability and their mode of existence, for the individual is regarded as a being that is indivisible both in definition and by reason of its inability to be predicated of a number of other things, whereas the universal, while having one definition, can be communicated to and predicated of many.⁵⁰ Moreover only the individual can exist in reality; the universal as such is capable of existing in the mind alone.⁵¹

Between the second and third of these divisions of unity, (i.e. between the continuum having an additional unity from the sameness of form and the individual) there is obviously a great affinity. However we can distinguish at least two basic differences between them. In the first place, as we have already noted, it is the motion in the second division, and behind the motion the continuum, that is principally regarded as being incapable of division without destroying the unity. It may be that the associated form will be destroyed too by such a division as, e.g., in the case of a triangle, but this result does not necessarily follow. If the one form were that of whiteness, for example, the whiteness would not be destroyed though the continuum were divided. In the case of the individual, however, the

49. Ibid., lect. 1, no. 1929.

50. Ibid., lect. 1, no. 1930.

51. Ibid., lect. 3, no. 1963.

emphasis on incommunicability makes it plain that it is the individual nature that cannot be divided without destruction, and any destruction of the continuum is purely secondary.

Moreover in the second division there is indeed an emphasis on the addition of a form, but there is no attention paid to whether this form is qualitative or substantial. Indeed, Aristotle speaks of these forms as something that can be produced by nails or glue.⁵² He insists, to be sure, on the superiority of natural forms over these productions, but had he been speaking of substantial forms, the question of their being so generated could not have arisen at all. Incommunicability, on the other hand, finds its root in the substance, and thus "the first 'one'" in this way of individuality "is one in substance."⁵³

Of all the problems connected with the study of unity, perhaps none is more vexing than the practical application of the analysis to the business of knowing the determinate nature of things. The unity of a continuum is not difficult to discern; by nature at any rate it is of such a kind as to fall under the direct observation of the senses,⁵⁴ and besides we have the test of the unity of its motion to fall back on.

In the case of a unified, individual substance, however, the case is much more difficult. Such a unity, being identical

52. Aristotle, Metaphysics, I, ch. 1, 1052 a 24.

53. "Primum unum secundum hos modos, sit unum substantia." St. Thomas Aquinas, In I Meta., lect. 1, no. 1931.

54. Of course there can be errors in such observation since a continuum is not the proper object of any given sense and can therefore be perceived differently from different aspects or "scales of observation." cf. Summa Th., I, c. 17, art. 2.

as we have seen with the very substance itself, cannot fall any more than can the substance under the direct observation of the senses. Consequently such a unity must be known only by indirection--by arguing to its existence from something that is directly observable. As we have already seen,⁵⁵ the only available means of knowledge when the causes are unknown is through a demonstration quia from the effects. Such also is the case with unity.

Naturally this method, like all others, must be tailored to fit the problem, so we will have to postpone all discussion of specific applications until we see what sort of difficulties we encounter in solving the riddle of unity in the organism.

D. The Unity of the Material Substance

One of the most serious difficulties in the way of accounting for an individual unity within the organism lies in the diverse and, one might almost say, contrary principles of activity that can be observed therein. On the one hand there is contained within an organism a material component that cannot be fairly said to be living in virtue of itself unless, perhaps, all material things were to be said to be alive.⁵⁶ On the other we are confronted with a sort of activity--growing, walking, thinking--that does not seem in the least characteristic of the causal efficacy of matter.⁵⁷ The result is that it is very difficult to

55. cf. supra, Section II, Chapter 1, p. 128.

56. St. Thomas Aquinas, Summa Th., I, q. 75, art. 1.

57. cf. for example Driesch's rather ironic remarks on "living matter" as the cause of these operations in Science and Philosophy of the Organism, pp. 292-293.

maintain simultaneously that the organism is one substance and that it is the source of all these activities. It almost seems as though we are forced to choose between the position of vitalism--the view that there are at least two substances involved, one material and inanimate, the other living and immaterial--and the position of mechanism--the doctrine that there are a great many non-living substances involved which, by their co-operation produce a series of activities differing vastly from inanimate ones in their complexity and in nothing else.

We are not as yet in a position to show that neither of these alternatives is correct. What we are in a position to show is that the difficulty is not confined to the realm of organisms and that there is available on Aristotelian grounds a solution which may possibly be applicable here.

It is clear that the same difficulty recurs in a slightly altered form even in the field of the inanimate. Here the material substance seems to be the battleground of opposing tendencies of inertia and activity, of necessity for extrinsic movers and of intrinsic causal efficacy. The attribution of so-called secondary qualities of matter to the observer instead of to the observed is an eloquent testimony to the philosophic conflict set up by this duality, for the basis of this attribution is our inability to account for these active characteristics on the basis of the inert, extended aspect of matter which alone is considered by modern science.⁵⁸ The question thus arises of

58. e.g. in Descartes, Principia Philosophiae, Pars IV, CXCVIII.

the possibility of accounting for both principles in the same substance.

The Aristotelian and Thomistic solution of this problem affirms absolutely the difference between the principles of these diverse tendencies and their union in the same subject. When it comes to the possibility of such divergent tendencies on the level of a substance, their answer is the same: that both tendencies are present in every material substance, and they are accounted for by diverse yet unified principles within that substance.

In the works of these philosophers, the problem is always attacked at the point of change or motion, for in this situation, the origin of the active tendencies, there occurs a certain separation and reunification of these principles which testifies at once to their union and their diversity. In such a change, as we saw in the beginning of this chapter, there is necessary first of all a continuing subject which is in ~~itself~~ itself inert and potential with regard to whatever determinations it may gain or lose in the course of the change. Called matter or potentiality, this subject is necessary as an alternative to looking on each change as a creation from nothing, a hypothesis that makes no sense in view of the regularity and order observed in change. Moreover there is necessary the novelty or determination which is the result of the change, and this is called form or actuality. Without the reality of this form and its union to the subject there would have been no change at all.⁵⁹

59. Aristotle, Physics, I, ch. 7, 189 b 33--191 a 8

This same general solution is available in the case of substances because of the apparent existence of substantial changes.⁶⁰ In this case too we would need a sort of matter to serve as subject and potentiality for the change, except that here the matter, since it is in potentiality to all the substantial determinations resulting from the change, cannot in itself be actually anything at all. Thus it deserves Aristotle's description of being 'not a 'what' nor a quantity nor a quality nor any other characteristic by which being is determined.'⁶¹ And the act or form resulting from the change and necessarily united to the matter to make the change real must be the first act of this matter because the substantial act underlies and is presupposed by all others.⁶²

These two principles, then, are united in one subject, and besides are united in such a way that they make up one substance. For neither of these principles can be a substance itself. The matter cannot exist independently because it is not a "what," and only a definite thing can exist.⁶³ The form cannot be a substance because it presupposes a subject, matter,

60. The question of whether these changes do or do not exist is a much discussed one and cannot be settled here. However, if later we can demonstrate the substantial nature of the organism, the fact that these are generated and die will testify to the reality of such changes.

61. Aristotle, Metaphysics, H, ch. 3, 1029 a 20.
λέγω δ' ὕλην ἢ καθ' αὐτήν μήτε τί μήτε ποσόν μήτε ἄλλο μηδὲν λέγεται οἷς ὤρισται τὸ ὄν.

62. St. Thomas Aquinas, De Principiis Naturae, no. 5, in An Introduction to the Philosophy of Nature, ed. by B. A. Rocourak, (St. Paul: North Central Publishing Co., 1946), p. 9.

63. Aristotle, Metaphysics, H, c. 3, 1029 a 27-31

whereas the substance cannot exist in anything else.⁶⁴ But together they form a unit which is complementary, constituting a definite "what" and presupposing no subject. Thus is one substance composed of diverse principles.

Before we can apply this solution to the organism, however, we shall have to discover whether the living being is the result of a substantial change. And this, in turn, involves a decision on the substantial unity or multiplicity of the organism. To this problem we shall address ourselves in the following chapter.

64. St. Thomas Aquinas, De Ente et Essentia, ch. 2.

SECTION II

CHAPTER III

THE UNITY OF THE ORGANISM.

There are two principal questions involved in the debate over the reality of the vital principle. One of these is the problem of whether the living being is a machine--i.e. a collection of independent substances working together--or a single substance. The other is the question of how this whole, whether collection or substance, is under the domination of some principle that differentiates its activities from those of inanimate things. On the basis of this double division, therefore, we can distinguish four general schools of thought: the machine theory, represented for example by La Mettrie, the machine plus soul theory espoused by Descartes, the holistic materialism that appears at least radically in some Gestalt psychologies, and finally the animistic theory--the proposal that the living being constitutes an organic whole with a unique principle of differentiation. The first of these problems, that of diversity and unity within the organism, will be treated in this chapter, the other will be dealt with in the chapter following.

That the organism is a unity of some sort no one doubts. Neither is there any question of the fact that the organism is and must be diversified. The point of discussion is to explain

how these two factors are to be reconciled, for reconciled they must be if we are not to abjure entirely the scientific treatment of this problem. Briefly the mechanist solves the problem by postulating a multiplicity of substances united--as a machine is--by a co-operation in terms of a common function. Ordinarily this organization is thought of in spatial terms; it may, however, be considered as a chemical organization as well, an organization that requires certain spatial configurations but cannot be reduced to them. What holism, at least in its pure form, holds to be true is that the diversity exists upon an accidental, phenomenal level, whereas the unity occurs at a more basic level--that level, for those who insist upon the self-intelligibility of the thing, being the level of substance. Reducing these doctrines to the Aristotelian terminology used in our last chapter, we could say that the mechanists attribute to the organism an accidental unity in terms of a final cause, the holists a per se unity of some sort, frequently undefined, and what we might call the Aristotelian holists a per se, individual unity.¹

If all sides in this discussion were talking about substance in exactly the same sense, this question would be difficult enough to solve, but unfortunately this agreement on terms

1. It is a fact that a great many schools of thought that held a holistic doctrine would be inclined to deny substantial unity, and even the existence of substance itself, as is the case, for example, with the Semanticists who want to regard everything as a series of relations without any relata. Such doctrines, however, ordinarily deny substance in a Cartesian or Kantian sense, i.e. as a sort of permanent, solid extension. In the case of the Semanticists, a relation, being capable of existing without a subject and forming the basic principle of operation, has obviously been made over into a substance in the Aristotelian sense..

is not the case. The substance of classical mechanism is the atom of Democritus and the Epicureans, extended, hard, and immutable. On a view of substance like this, obviously no sort of individual unity in an organism is even conceivable. A system of thought that looks at the organism as an individual has to take a non-mechanical view of the nature of substance--one which approaches more closely the Aristotelian idea of something that exists independently,² or, in the words of Thomas Aquinas, the being "to whose quiddity or essence it belongs to have a 'to be' not in a subject."³ It is obvious that in the first sense of substance, this Aristotelian idea is implied but is subordinated to the other characteristics named, whereas in the second sense the presence or absence of the attributes credited to substance in mechanistic philosophy is strictly a matter of the kind of substance in any given case. Clearly there is a relative permanence about substance as opposed to the other categories of being, since the beings that depend on the substance cannot last longer than the substance, but this sort of permanence is far different from immutability. As for the other characteristics, material substance is certainly subject to extension, and much of it seems to have resistance, but such attributes are not essential notes of substance as such.⁴

2. Aristotle, Metaphysics, Z, ch. 1, 1028 a 35

3. St. Thomas Aquinas, Summa Th., III, q. 77, art. 1, ad 2^m. "Quidditati autem sive essentiae substantiae competit habere esse non in subiecto." Also Ibid., I, q. 3, art. 5, ad 1^m.

4. In Aristotelian and Thomistic philosophy extension is an accident of the category of quantity and hardness in that of quality. cf. St. Thomas Aquinas, In V Meta., lect. 9, 891-892.

The problem of whether or not material substance is the kind of being described by the mechanists can be solved by experience alone. The one common thing that all systems of mechanism have in common is the absolute denial of the possibility of any change in substance. If, therefore, we could find a single example where such a change has undoubtedly taken place, the difficulty of the asserted immutability of substance would be eliminated. If the example in question were certainly a substantial unit produced out of a substantial multiplicity, then all a priori reason for accepting the mechanistic claim as applied to the organism would disappear. And if, by any chance, this object should be decisively alive, we should have established at least that the multiplicity characteristic of living things is not necessarily mechanical, and we could attain a presumption that might even amount to a certainty that such an organic unit had to be an individual.⁵

Conveniently enough, we have just such an example at hand. Everyone, in fact, is his own example. We are exactly aware of ourselves as a substance, one which has come into being, one which has been generated as a unit out of a great many other things, and finally one which is alive.

5. I am not at all concerned here with trying to prove the existence of substance. To try to demonstrate this, as Thomas Aquinas says, is the mark of a man who does not know what is self-evident from what is not. (cf. In II Phys., lect. 1, no. 8) What I am concerned with showing is that material substance, even qua substance, is not completely immutable and that out of a plurality of non-living substances one living substance can be generated.

When I say that I am aware of myself as a substance, I do not mean, of course, that I am conscious of myself as an existing thing in complete isolation from the rest of reality. It is possible to arrive at knowledge of our own substance by means of cognisance of our activity. It is in thinking, seeing, fearing, doubting that I become aware of myself. But become aware of myself I do--it is not just a disembodied act of thinking of which I am conscious, but of the concrete fact that I think. I do not have to argue to the existence of my substance--I simply perceive it in the operations the substance performs. "Everyone perceives that he has a soul and lives and exists in the fact that he feels and understands and exercises other vital operations of the kind."⁶

Moreover this substance that we perceive within ourselves is obviously a unit. One obvious evidence of this unity is the fact of memory. I am absolutely certain of the identity of myself who am writing this sentence with myself ten minutes or an hour or a year ago. My thoughts change, my location in the world has changed from time to time. But I know with absolute certainty that the subject to whom and in whom all these modifications occurred is one and the same. The only way of explaining this certainty is to grant that the subject is the

6. "In hoc enis aliquis percipit se animam habere, et vivere, et esse, quod percipit se sentire et intelligere, et alia huiusmodi vitae opera exercere." St. Thomas Aquinas, De Veritate, q. I, art. 8. St. Thomas is using the word "soul" here in the neutral sense in which the earlier Greek philosophers spoke of it. The question of how we go about finding out what kind of a soul there is, or whether it is material or spiritual arises later in the article.

same. "To remember the experiences of another would be to remember having been someone else; in other words to simultaneously affirm and deny one's own identity, a pure and absurd contradiction."⁷

It is possible, moreover, to establish the unity not only of the historical ego but also, so to speak, of the present ego. What I mean is that it is possible to establish the fact that the various parts of the human being are parts of one and the same subject, that whatever diversity there is, in short, is strictly a diversity of modifications of the subject and not of the subject as such. This fact is shown by the fact that I attribute the actions of all the parts to the one ego. For example, at the moment I am aware of thinking with my mind, of writing with my hand, and of having an itch in the middle of my back. I certainly cannot suppose that I am aware of being three substances, mind, hand, and back simultaneously.⁸ This would again involve the contradiction of being and not being the same thing at the same time.

Such, at any rate, are the conclusions of the naive reason. It must, however, at least be recognized that there exists an explanation of these facts alternative to that of the substantiality of the ego. This theory, based upon the analysis of Hume and Kant, implies that there is at most an accidental (or more strictly phenomenal unity) between these various psycho-

7. Margerie, Philosophie Contemporaine, p. 140, quoted by Michael Maher, Psychology, 9th ed., (London: Longmans, Green & Co., 1923), p. 465.

8. St. Thomas Aquinas, Summa Th., I, q. 76, art. 1.

logical states, and that it is merely to this unity, or to a hypothetical explanation thereof, that we give the name the "ego." Emptied of all the content of the varying mental states, however, the ego turns out to be a sort of an entitative vacuum that explains nothing.⁹

It is impossible to enter here into a complete analysis and explanation of all the variations of such theories, but we can at least indicate some of the more obvious difficulties besetting the contradiction of the naive apprehension. Actually, there are usually two philosophic difficulties involved: the impossibility of proving the existence of substance, and the consequent difficulty of knowing any specific substance.

Concerning the impossibility of proving the existence of substance, St. Thomas points out that the reason this fact cannot be demonstrated is because it is too obvious. "It is ridiculous," he says, "to try to demonstrate that a nature exists because it is obvious to the sense that many things exist by nature that have their principles of motion within themselves. To want to demonstrate what is obvious by what is obscure is the mark of a man who does not know what is knowable in itself from what is not."¹⁰

9. cf. Emmanuel Kant, Critique of Pure Reason, trans. by N. Kemp Smith, (London: Macmillan, 1929) 2nd ed., pp. 406-411.

10. "Ridiculum est quod aliquis sentet demonstrare quod natura sit quum manifestum sit secundum sensum quod multa sunt a natura quae habent principia sui motus in se. Velle autem demonstrare manifestum per non manifestum est hominis cui non potest iudicare quid est notum propter se, et quid non est notum propter se." St. Thomas Aquinas, In II Phys., lecc. 1, no. 8.

In our attempt to understand the second point of the Empiricists concerning the unity and substantiality of the ego, we must observe that there is indeed an accidental unity between the various conscious states, since they are not the same state, they cannot very well be said to be per se one. If we regard this unity as being the ego, then there is no doubt that the ego is an accidental unity.

But the difficulty about an accidental unity is that in itself it is no unity at all--the unity is actually provided by something outside the accidental unity. The fact that these psychological states are unified depends, therefore, upon something else besides the differing states themselves. And this unity must be that of a common subject in which both are present. In the absence of such a subject there would be no common meeting-place, no ground of comparison and differentiation or unison.

Understood in this sense, the unity of the ego is quite compatible with the disunity of the mental states in such odd cases as those of split personality. For that which is per accidens always presupposes that which is per se, hence the accidental unity of conscious states always demands the individual unity of the ego; however a per se unity does not necessarily result in a per accidens unity, consequently a unified ego may be the subject of a split personality. Indeed the alternation of personalities frequently observed in such cases could only be explained on the basis of the continuity of the ego through all personality changes.

Neither is there any question about the fact that this substance has, in a sense, been produced out of a multiplicity of other substances, i. e. out of various obviously distinct chemicals, and that it can by suitable means be reduced to simple, distinct substances of this sort again. Consequently there is no question of the fact of substantial change either. A universe made up of a multiplicity of Eleatic worlds is simply insufficient to explain the existence of relatively permanent, but absolutely contingent self.

As we noticed earlier, these facts prove also the fact of the substantial unity of at least one living being, and destroy any pretext on the part of the merists of showing that a living being must be made up of a substantial diversity of parts. A little more reflection upon the same line would show us that this unity is a necessary condition of my being alive, and that anything that does not share in its own degree in this unity, although it may be a machine, is certainly not alive. But more will be said on this subject in the next chapter.

However, even if we arrive at certainty concerning life as it is found in our own individual case and, by extension, in other human beings through the method of analyzing the individual self-consciousness, this fact alone does not solve our problem for us. What we mean ordinarily by the question, "What is life?" is "what is the nature of the principle causing the peculiar behavior of men and animals and plants?" In spite of man's identity with himself as a substance, it is still possible to ask whether plants and animals are machines or not. There are very

serious objections to projecting a unified self-consciousness like our own into animals and insuperable ones in the way of attributing anything of the sort into, say, a squash. We may, however take it as established that there is no a priori reason for thinking that the animals or the squash cannot possibly be a substantial unit, and that there is a good precedent for thinking not only that it might be such an individual, but that it is a being of that kind.

But how are we to tell certainly whether or not these plants are machines or individuals? First of all, it must be clear that we must look for our clue in the operations of the organisms, since the characteristics of a material essence can be determined only through its operations.¹¹ Our question, therefore, must be that of how the activities of an individual substance differ from those of a machine. Now Aristotle discusses this precise point at the beginning of book II of the Physics, in his discussion of the definition of "nature."¹² For "nature" is precisely the name given the substantial essence in regard to its activities.¹³ The accidental unity of a machine must be considered as coming about as the result either of chance

11. St. Thomas Aquinas, The Soul, trans. by Rowan, (St. Louis; Herder & Co., 1949), art. XII: "Anything whatever that acts acts according as it is in act. For fire heats not inasmuch as it is actually bright but inasmuch as it is actually hot. It is for this reason that every agent produces an effect similar to itself. Therefore the principle by which an agent acts must be known from its effects."

12. Aristotle, Physica, II, ch. 1, 192 b 6--193 b 22.

13. St. Thomas Aquinas, Summa Th., I, q. 39, art. 2, ad 2, "Natura designat principium actus."

or of art,¹⁴ and it is precisely in contrast to the products of these forces that Aristotle derives the definition of "nature." Let us recapitulate this passage, therefore, and see what clues may be found in his analysis or in its implications that will enable us to differentiate between the operations of a substance and those of a machine.¹⁵

If we succeed in finding from this consideration a decisive difference between the activities of a substance and those of a machine, we may next proceed to an examination of the operations of organisms to find out in which class of beings the living things belong.

The first difference between a nature and the other kinds of object is that the work of nature has certain activities characteristic of itself, whereas the work of chance or art does not. To illustrate this, Aristotle uses the example of a man, obviously a nature, and a bed. "Man," he says, "is born from man, but not bed from bed."¹⁶ Many other activities besides that of generation, of course, are found characteristically in the natural thing, man, as opposed to the artificial thing, the bed, e.g. walking, thinking, fearing, and so on.

This is not to say that the artefact has no activities. A bed has certain activities that it performs--it supports a cer-

14. St. Thomas Aquinas, In II Phys., lect. 1, no. 2.

15. The discussion that follows is based principally upon the passage in Aristotle's Physics, II, 1, 192 b 8--193 b 22; St. Thomas Aquinas, In II Phys., lect. 1-2, and in V. Smith's Philosophical Physics, pp. 49-58. The last two references are basically commentaries on the first.

16. Aristotle, Physics, II, ca. 1, 193 b 8-9.

tain amount of weight; it produces a certain colored radiation, it affects the sense of touch as warm or cool, rough or smooth. A wooden bed, if planted, might even send off shoots and grow. The point is that it is not in virtue of being a bed that it does any of these things, but in virtue of the rigidity, pigment, fertility, and other qualities of its parts. "A knife," St. Thomas comments, "has in itself a principle of downward motion, not insofar as it is a knife, but insofar as it is iron."¹⁷

All this can mean is that the actions of the works of chance and art are determined entirely by something which is not themselves, whereas the actions of natural things are not so externally regulated, but instead are at least partially determined by something within--by an intrinsic principle of motion and rest. Thus as we say above, the actions of the bed are not due to its nature as a bed, but from two other sources: to an external mover and to the natural things of which the bed is composed. Both of these elements are different from and, therefore, in a sense, outside of the bed considered as a work of art. The same restriction could be placed on a chance effect. As the intersection of two natural causes, whatever of actuality is found within the effect can be traced to the natures involved instead of to the element of chance. In the order of the fortuitous, we can find merely the origin of disorder and of lack of actuality.¹⁸ With Thomas and Aristotle, therefore, we can say

17. St. Thomas Aquinas, In II Phys., lect. 1, no. 2. *Cultellus enim habet in se principium motus deorsum, non in quantum est cultellus, sed in quantum est ferreus.*

18. Ibid., lect. 10, no. 12.

of natures that "All these things differ from those which are not by nature because they seem to have in themselves an intrinsic principle of motion and rest."¹⁹

Aristotle, therefore, defines nature as a "source or cause of being moved or being at rest in that to which it belongs primarily, in virtue of itself and not in virtue of a concomitant attribute."²⁰ He insists upon the aspect of nature as cause that is primarily and per se such, because in certain cases, as with the bed, there is an intrinsic cause of operation within the concrete object called a bed, not, however, insofar as it is a product of art, but insofar as it is a nature, i.e. of wood or iron. Like the musician who heals, not insofar as he is a musician but rather because the same individual happens to be a physician as well, the bed, which happens to be united in the same subject with a natural thing, can be called an accidental but not a proper cause. The nature, however, is the proper cause of motion and rest.²¹

Now from this state of affairs there follows a very interesting consequence: the only thing which is intelligible as such is a natural thing. Since a being is not known except through its operations, anything without a proper operation must as such be unknown. And art, of course, has no proper operations.

19. Ibid., lect. 1, no. 2. "Et differunt haec omnia ab his quae non sunt a natura, quia omnia huiusmodi videntur habere in se principium alicuius motus et status."

20. Aristotle, Physics, II, ch. 1, 192 b 22-23.

21. St. Thomas Aquinas, In II Phys., lect. 1, no. 3. For proper vs. accidental causes, cf. Aristotle, Physics, II, ch. 3, 195 a 28--195 b 30.

Another way of putting the same thing that may throw an additional light on the discussion is to point out that the intrinsic principle of motion and rest of which we spoke is to be identified with being, either active or passive. "Nothing acts," says St. Thomas, "except insofar as it is in act."²² The principle of moving something, therefore, is active being. In the same way, an intrinsic principle of being moved is a potentiality. "In those things to which it is proper to be moved there is a passive principle which is matter."²³ If the works of art and chance, therefore, are lacking in an intrinsic principle of motion and rest, this can only be because, as such, they are lacking in both actual and potential being. And since what is not is unintelligible, art and chance will also be unintelligible.

If art and chance, therefore, are to be understood at all, it must be in the same way in which they operate, i.e. in virtue of something else to which the operations can be ultimately referred. And these others are of two kinds: the natural things out of which the artistic thing is composed, and the extrinsic cause that is the source of the composition. Ordinarily, for art at least, the second of these factors is the more important for intelligibility: a common meeting place in nature in nature for the mind of the artist and the mind of the one seeking to understand the artefact is more necessary than any amount of knowledge of the parts. It is essential to understand

22. St. Thomas Aquinas. In II Phys., lect. 1, no. 3.

23. Ibid., lect. 1, no. 4.

a picture that there be some acquaintance on the part of the beholder with the thing the artist is trying to depict, and no amount of analyzing pigments will do as well. In order to understand art, it is necessary first to have some understanding of the artist.²⁴

Obviously everything cannot be bound by the same limitations with regard to intelligibility as are the results of chance and art. If everything had to be understood in terms of what is extrinsic to itself, then it is plain that we should have set forth on an infinite search for an intelligibility that not only cannot be attained, but cannot even be approached. If there is any such thing as understanding or science possible, then there must be something within our experience that is at least partially understandable on its own terms and not simply on those of something extrinsic to itself.

If we apply the test of intelligibility to nature that we put to use with negative results in the case of art, we can see a way out of this difficulty. Only a thing that has operations of its own is understandable, and a natural thing has operations of its own. Whatever is intelligible is so in proportion to its being, inasmuch as being and truth are convertible.²⁵ As an intrinsic principle of activity, a nature is a being, either active or passive. Insofar as nature is active being, therefore, it should be intelligible in virtue of itself. As a potential

24. V. Smith, op. cit., pp. 51-52.

25. St. Thomas Aquinas, Summa Th., I, c. 17, art. 1.

being, matter, it is unintelligible in itself, but becomes intelligible in relation to its actuality.²⁶

This fact alone, however, does not completely solve our problem, because beings are known to us only through their operations or motions. If, therefore, the motion must be understood in terms of another actuality outside of the mover, we are in no happier condition than we were before. If the first being is understood only in terms of a second being, intelligible only in terms of its operations and so forth, we have steered our way right back to the highway that infinitely approaches something intelligible without ever getting there, or indeed, without ever getting any closer. And the only way off this road to frustration is to find some respect in which the operation is concerned with and gets its intelligibility from the agent itself, and not from another extrinsic being. In our earlier discussion of the nature of motion, we saw that the whole intelligibility of motion comes from actuality, which is its end. Consequently, if a nature is to have any intelligibility--or by the same token any being--it can only be insofar as that thing can be said to be the end of its own operations. It is precisely because of this fact that a being is, as it were, closed in on itself--that the very condition of its being is that it have a cause for the sake of which it acts in the very nature itself--it is because of this fact, I say, that Aristotle calls the form an "entelechy," a thing having its end within itself.²⁷

26. Aristotle, Metaphysics, 4, ch. 10, 1036 a 8-9.

27. Aristotle, De Anima, II, ch. 1, 412 a 28.

But how are we to understand this intrinsic possession by a nature of its own end? Obviously this statement is a literal and exact statement of fact in the case of a passive potentiality. In this case, as Aristotle points out,²⁸ the "what" and "that for the sake of which" are one. That is, the perfection which is the actuality of the passive power is also the end of that passive power, for an ability can exist only for the sake of its completion.²⁹ This is the very nature of an ability or a capacity for becoming something.

In the case of an active power, the situation is not so obvious. The end of the active power certainly cannot be the production of itself as a form, otherwise it would have to exist (as producer) before it existed (as produced). It is true that the form produced in certain kinds of causal activity--specifically in univocal causality--is the same in species as the form that is the agent cause, and in this sense the agent might be said to have its end within itself. However to have a form that is the same in species with the produced form is one thing; to be in possession of the individual form produced as an end within itself is quite another. Besides in the more basic kind of causality, called equivocal by St. Thomas, even this specific identity is lacking. The perfection contained in the cause is of an entirely different order than that achieved within the effect, although the latter imitates its principle.³⁰

28. Aristotle, Physics, II, ch. 7, 198 a 26.

29. St. Thomas Aquinas, In II, Phys., lect. 11, no. 2

30. Ibid., lect. 11, no. 2

Nevertheless there is a sense in which the end must be within the active principle of any given change as well as within the passive principle. Thomas Aquinas expresses this principle thus: "The last end of every maker, as such, is himself."³¹ The explanation of this seeming contradiction of his own explanation of the meaning of Aristotle is found in a distinction which Aristotle expresses in the De Anima, and which St. Thomas adopts on several occasions, the distinction of final goods between the end of the deed, (finis operis), and the end of the agent (finis operantis).³² The end of the deed is the form produced by the maker, and as such must be distinct from the agent, at least insofar as it is an agent. It is in this sense that St. Thomas is talking about the form of the agent and its end as being different in the case of an agent.³³ On the other hand, the end of the agent is that for the sake of which the agent produces the form that constituted the end of the deed. And this must be something intrinsic to the agent, precisely insofar as it is an agent. For as Francis a Sylvestris points out, it is the end of the agent that is principally intended by the agent, and this end must be present to the agent.³⁴ This truth can be proved in the following way: Any cause that exerts its influence

31. St. Thomas Aquinas, Summa Contra Gentiles, III, 17. *Finis ultimus cuiuslibet facientis in quantum est faciens, est ipsemet.*"

32. Aristotle, De Anima, II, ch. 4, 415 a 3. St. Thomas Aquinas, In II Librum Sententiarum, d. 1, c. 11, art. 1.

33. St. Thomas Aquinas, In II Phys., lect. 11, no. 2.

34. Francis a Sylvestris, (Ferrariensis), In Summa Contra Gentiles, III, 17, V, 3.

on the effect through attracting the agent must be present to that agent, otherwise it could not act as a real cause influencing the agent to act in this way rather than that. Union between cause and effect is a necessary condition of any kind of causality. Moreover, since the form to be produced does not yet exist in the subject of the effect, it must exist as an attracting term within the efficient cause itself. Now it is precisely the definition of a final cause that it exerts its causality by being that for the sake of which the agent acts, that is by being the attracting term of the agent's action. Hence the final cause must exist as an attracting term within the efficient cause itself. Now it is precisely the definition of a final cause that it exerts its causality by being that for the sake of which the agent acts, that is by being the attracting term of the agent's action. Hence the final cause must necessarily be something intrinsic to the agent cause itself, or else there would simply be no reason for the agent to act.

St. Thomas proceeds to point out that if the form produced by the agent as the finis operis is related to the benefit of another, then even this other must be to the primary agent as a means to some further good, (bonum utile), an ultimate good that produces rest or satisfaction in the agent (bonum delectabile), or some perfection of the agent itself, though not insofar as it is an agent (bonum honestum).³⁵ Hence the finis operantis as the agent's self is the absolutely final attracting term--the

35. "Et si aliquid aliquando propter aliud non faciat, hoc refertur in bonum suum vel utile vel delectabile vel honestum." St. Thomas Aquinas, Summa Contra Gentiles, III, 17.

true end in the strictest sense. The fact that the produced form is produced for the benefit of the agent is constant. The way in which the effect is a good for its cause, on the other hand, varies from one case to the next.

John of St. Thomas discusses the intrinsic relation that must exist between agent and end in the following passage:³⁶

"The good, in order that it may be an end, must without any doubt attract not merely under the aspect of transcendental goodness in its absolute acceptation, but rather under the aspect of convenience or order to another of which it is a good. For the end is that for the sake of which something is done. Therefore it must be suitable with respect to that which happens for its sake. Otherwise, if it did not have a relationship of suitability, there would be no reason for anything to happen for its sake."

This analysis makes it clear, then, that every agent acts for an end that is at least in some sense intrinsic to itself. Moreover, since a thing's mode of action is dependent upon its mode of existence, to be an agent in the absolute sense it is necessary to be a substance.³⁷ A substance, therefore, may be known by the fact that it acts for its own sake. A gathering of substances, whether organized or not, whether due to art or chance, insofar as it acts as a whole at all, acts for the sake of something outside of itself as a whole; in one sense each of the parts carries out its own activities for its own sake; in

36. John of St. Thomas, Cursus Philosophiae Thomisticae, "Naturalis Philosophiae," I, q. XIII, art. 1, (Turin: Marietti, 1933), II, 273-274. "Bonum, ut sit finis, sine dubio non debet habere solam bonitatem transcendentalem sub conceptu absoluto, sed sub conceptu convenientis et ordinate ad alterum, cui est bonum, quia finis est id cuius gratia aliquid fit. Ergo debet esse conveniens respectu eius quod fit propter illud, alioquin in gratia illius non erit, si non habet ordinem convenientis ad iusum."

37. cf. supra, note 11, p. 182.

another the assemblage of parts as such works to the benefit of the agent responsible for the gathering together of the parts.³⁸

Now the most obvious fact of the organization of those things that are without any doubt alive is the fact that they do work for their own benefit. All of the specifically vital activities of the organism acquire their intelligibility primarily from the relation which they have with the good of the living thing as a whole. It is true, as the Mechanists point out, that the operations of the organism are carried on by one part or group of parts within the organism and not by others. Even in the simplest organism, for instance, certain parts are entrusted with the series of actions through which the organism nourishes itself. Certain parts are responsible for the intake of food, others for its digestion, others for the distribution of the processed food to the parts of the organism, and still others for the disposal of the unusable food. But although it is the parts that are directly concerned in the action, it is not the good of the part that is directly and finally achieved by their action--the good of the parts is achieved only indirectly if at all--directly the being for whose benefit as a final end the part acts is the whole organism. Sometimes the part acts for the preser-

38. "Parts" in this context should be understood as either chemical or physical parts of the organism. In some cases the simpler organisms do not have specific parts that perform each of the specific activities mentioned. Distribution of food materials within certain monocellular organisms, for instance, seems to be carried out in part by the physical process of osmosis, in part by the constant circulatory motion characteristic of living protoplasm as a whole within the cell. Other activities, however, are due to specific parts--enzymes, membranes and so on.

vation or generation of all parts of the organism indiscriminately; sometimes one or several parts operate for the benefit of some other part, particularly for the benefit of a part necessary for the well-being of the plant or animal as a whole. The process by which the organism nourishes itself is an example of the former kind of activity; the remarkable series of events known as regeneration, e.g. the growing anew of severed parts in a starfish, is an instance of the latter kind of activity.³⁹ In either case, however, the being which profits is the organism. The active part ordinarily benefits only to the extent that all parts share in the welfare of the whole. In certain cases, far from benefiting, the operating part actually sacrifices itself for the good of the whole. This is the case with the operations of the phagocytes within the human body, cells that protect the body from the invasion of infections at the cost of their own identities. These cells devour foreign organisms that threaten health, but the result is that the phagocytes themselves die.⁴⁰

This unity of end in the benefit of the whole organism is not confined to the specific kinds of activity mentioned above, but is obvious in all of the properly vital activities. The processes of metabolism are all directed, as we have already seen, to the good of the whole organism. This same kind of teleological unity is discernible in the case of the process of morphogenesis--the process through which the organism attains

39. Michael R. Guyer, Animal Biology, (New York: Harper, 1948), 4th ed., p. 701.

40. Ibid., p. 342.

its optimum size and structural organization. Once again this is a complex of activities, each of which is carried out by some specific chemical or structural part of the organism,⁴¹ and no one of which is intelligible taken in isolation from the others, nor directly in relation to the good of the active part which produced it. The sole intelligibility of these actions comes from their cooperation in view of the one end--the being and, indeed, the well-being of the organism.

Just as clearly, the locomotive powers of the animals, carried out through the agency of certain muscular and chemical actions, operate not merely for the well-being of the muscles or limbs or pseudo-podium or whatever may be the part immediately concerned, but for the benefit of the whole dog or cat or amoeba. The end of consciousness, too, of no matter what kind, is intrinsic to the whole animal, for the knowledge itself to which consciousness leads is within the organism; and any further action to which the knowledge may lead is carried out by one of the previously mentioned powers of operation, hence the knowledge, in this case, would have the same end as the activities it sets in motion. Of course the same statement can be applied to the end of the emotional and volitional operations of organisms, since it is through the medium of these that knowledge is able to set in motion the operations through which the organism acts on its environment.⁴²

41. Ibid., pp. 491-500.

42. St. Thomas Aquinas, Summa Th., I, q. 80, art. 1.

The one living operation that poses a difficulty in regard to this internal finality is the reproductive activity, for in this case, that which is produced and that for the benefit of which this product is generated are both one and the same thing exterior to the generating organism, namely a new organism. However Aristotle points out that in the sense of a finis operantis we can discern an internal as well as an external finality in connection with this function:⁴³

"For any living thing...the most natural act is the production of another like itself, an animal producing an animal, a plant a plant, in order that, as far as its nature allows, it may partake in the eternal and divine. That is the goal towards which all things strive, that for the sake of which they do whatsoever their nature renders possible...Since then no living thing is able to partake in what is eternal and divine by uninterrupted continuance (for nothing perishable can for ever remain one and the same), it tries to achieve that end in the only way possible to it, and success is possible in varying degrees; so it remains not indeed as the self-same individual but continues its existence in something like itself--not numerically but specifically one."

The self-regulation in the more complex organizations, a self-regulation that, as we have seen, strikes even the dialectical materialist, Maldane, as being a remarkable characteristic specific to living things,⁴⁴ is once again an instance of this intrinsic finality, for not only do the various organs work normally in such a way as to benefit the other parts of the body, but they also, in case of an abnormality in one of the parts, adjust themselves to provide whatever is necessary for the well-

43. Aristotle, De Anima, II, ch. 4, 415 a 28--415 b₁ 8. cf also St. Thomas Aquinas, Summa Th., I, q. 78, art. 2, ad 2^a.

44. cf. supra, Section I, Chapter 3, pp. 103-108.

being of the organism and even of the affected part under unusual or pathological conditions.⁴⁵

Our argument for the substantial unity of the organism may be condensed as follows: arguing by example, we first established that there exists one organism, i.e. the ego, of which we are conscious that it is not a machine but rather an individual substance. By this means we established, first, that it cannot be the nature of a living thing to be a machine, either in the sense of a product of art or that of an effect of chance, and, second, that it may be its nature to be an individual. To change this second conclusion from a contingent to a necessary conclusion, we undertook to find some test of substantial unity by analysing the difference between a substance and the product of art or chance, and by pointing out the relation that the active and passive powers, which can belong to a substance alone, have with the end of their operations. The conclusion of this analysis was that one specific test of a substantial unity was that the end of its action had to be something intrinsic to itself. Since the end of an organism in all its characteristic activities is something intrinsic to the organism, it is obvious that the living being is a substance and is not merely a machine.⁴⁶

Reinforcing and confirming the force of this argument concerning the substantial unity of the organism is the cumulative

45. cf. Haldane, "What is Life?" in Adventures of a Biologist, pp. 53-58.

46. I say not merely a machine since the organism bears a resemblance to a machine in certain important respects, otherwise the mechanistic view of the nature of plants and animals would never have arisen. We shall return to this point in Section III.

strength of the many probable arguments used by the adherents of animism throughout the ages. These arguments, like the one above, depend on an analysis of the actions of the organism, but they analyze these operations from a slightly different point of view. They are properly concerned with showing that the effect of the organism is a unity of some sort, although it is not always clear that the sort of unity they are speaking of is a direct result of a substantial unity in the agent. Thus the effect of the organism's operation is patently unified in quantity insofar as the organism is the result of its own activities. Moreover the various parts of the organism cooperate to produce qualitatively unified effects; for instance the muscular organs, glands, ducts, valves, and other organs that make up the digestive system aid each other in producing the qualitatively unified product of the typical organic material constituting the organism. In the case of regeneration, parts of many different systems of organs cooperate to produce an effect at once quantitatively and formally unified, e.g. a new limb, and the same situation is clearly true in the case of the process of morphogenesis.

The force of these arguments is, as I said, mainly cumulative. Many and perhaps most of all unified products produced could conceivably be imitated artificially by a machine, but it seems completely incredible that any system produced by art or chance could produce such a bewildering variety of effects, changing under changing circumstances, and yet, for all their variety, effects unified by the fact that they too will cooperate

with each other to produce and maintain a still greater diversity in unity.⁴⁷

This conclusion is lent still more credibility by the fact that the source of any unity of any kind whatsoever must be traced eventually to a substantial unity. Being in a relative sense cannot be explained except by being in an absolute sense.⁴⁸ And since unity is in reality the same as being,⁴⁹ it is obvious that unity of any kind must be reduced eventually to a substantial unity as to its cause.

However, the immediate cause of a quantitative unity is another quantitative unity, and all that is needed to explain a qualitative unity is a similar unity.⁵⁰ Hence it is by no means completely proved by these arguments, though it is certainly made highly probable, that the substantially unified being that is ultimately responsible for the accidental unities found within the organism is the plant or animal itself. It is for this reason that it is possible for sincere scientists, whose analysis remains on a phenomenal level, to object against these arguments from quantitative and qualitative unity in vital effects that no one of the organic activities has parts that

47. Van der Veldt gives an excellent summary of these arguments based on the quantitative and qualitative unity of organic effects in his article, "The Recognition of Individual Bodies," The New Scholasticism, v. XVII, no. 3, (July, 1943) pp. 201 ff.

48. St. Thomas Aquinas, In Duos Libros Analyticorum Posteriorum Aristotelis, I, lect. 7, in fine.

49. St. Thomas Aquinas, Summa Th., I. q. 11, art. 1.

50. Aristotle, Metaphysics, I, ch. 3, 1054 a 30-32. St. Thomas Aquinas, In I Meta., lect. 3, 1999-2000.

cannot be explained on mechanical principles, and that only the complexity of living organisms prevents such an explanation of the whole. It is only in terms of a study of how finality operates in a substance as opposed to its direction in a non-substantial being that the distinctive element establishing the living thing as a substantial unity can be isolated. The presence of internal finality removes all possibility of the organism's being considered a machine.

SECTION II

CHAPTER IV

THE NATURE OF LIFE

If the organism is not a machine, but is instead a substantial unity, what precisely is the nature of this substance? Are the observable differences between living and non-living substances sufficient to justify postulating an essential difference between them, or is this difference one that exists merely on the accidental level? And if the difference is on the substantial level, what part does the aspect we call "life" play in the organism? Is it just another name for the substance, or is it rather something different from the substantial nature? And if the latter alternative is true, what is the relation between the life and the substance? These are the questions this chapter is to investigate. These problems can be reduced to two basic queries: what is the nature of living substance, and what is life?

Let us remind ourselves briefly that, unable to comprehend the essence of substances by a direct intuitive glance, our intellects can solve the questions we might ask concerning these natures only through an analysis of its effects, namely those activities that are perceptible to our senses. This is the method we shall continue to use in this chapter.¹ And

1. St. Thomas Aquinas, De Anima, art. XII.

these activities, in turn, are to be understood in terms of their finality.²

Let us also remind ourselves of some fact previously established that are of primary importance in our inquiry. First of all, the living organisms of which we are speaking are experienced by us in the material world, and the generic part of the definition, therefore, will be taken from something that living beings have in common with inanimate substances. Now the generic characteristic of beings of this kind is their mobility,³ hence the genus of organisms is that of mobile beings, provided the organism belongs in the genus of substance at all. That it does belong in that genus is a second major factor to be considered in our analysis--a fact settled in the preceding chapter. Finally we must remember that where the basic issue lay in the time of Aristotle it still lies today--namely in the peculiarities of motion in living things and in the unique fact of consciousness.⁴

Now there are basically two different ways of studying these activities peculiar to living organisms in order to establish the nature of life. One is to select the most obviously vital activities--activities that are separated by the widest gulf from those of inanimate nature. The other method is to study the most universally distributed phenomena of life. Unfortunately these two sets of operations are by no means the same. Since

2. Ibid., art. XIII

3. St. Thomas Aquinas, In De Trinitate, q. V, art. 2

4. Aristotle, De Anima, I, ch. 2, 403 b 27

nature is arranged in a more or less continuous series with the least perfect type of a superior being resembling closely the most nearly perfect representative of the inferior, the common denominator characteristics of all living organisms is an operation (or group of operations) that very closely resembles activities found in the most complex of inanimate substances. For this reason St. Thomas Aquinas points out that we would not recognize plants as living except that we first have the fact of life impressed on our consciousness by more striking instances-- "Life in plants is hidden."⁵

There is another reason besides the obviousness of the gap between these higher vital activities and inanimate operations for preferring to begin the analysis of life from these superior activities: although all of the vital activities are found in us, the only ones of which we are conscious in introspection are the activities of locomotion, appetite, and knowledge. Of the activities on the vegetative level we are largely unaware-- indeed ordinarily the only time we become aware of them is when they break down. For these reasons St. Thomas Aquinas begins his analysis of life from the study of things which are "obviously alive," i.e. animals, in which these more definitive activities are present in at least rudimentary form.⁶

5. St. Thomas Aquinas, In De Anima, II, lect. 7, 311. "In secunda ostendit, quod opera potentiae vegetativae sint ab anima: quod ideo necessarium fuit, quia cum his operibus deserviant qualitates activae vel passivae, posset alicui videri quod essent a natura, et non ab anima: et praecipue quia in plantis est vita occulta et latens."

6. St. Thomas Aquinas, Summa Th., I, q. 18, art. 1.

To take full advantage of both of these superiorities, it seems to me preferable to begin an analysis on this basis with a discussion of conscious knowledge. It is true that St. Thomas seems to begin with locomotion in the passage mentioned, for he bases his investigation upon the behavior of animals wherein the local motion is obvious but the knowledge is not. Moreover locomotion is closer by nature to the vegetative activities by being obviously a material change, whereas this is not so patently the case with knowledge, whereas this is not so patently the case with knowledge. However, within our own introspective experience, it seems to me, the clearest sign of our own life involves the existence of consciousness, so that while we can grasp a simple, mechanical explanation of locomotion, nothing seems less likely than such an explanation of conscious perception. Besides we shall discover some common, although analogous, elements in knowledge that can easily be applied, even if not in the same way, to the changes that are properly speaking motions.

Advantageous as this approach may be, it suffers from the defect of being incomplete--it applies directly only to certain living things and not at all. There is no assurance that any characteristic found in a given cross-section of vital activities is proper to all such activities unless it is also found in the one operation or group of operations universally found in the universe of living things. From this point of view, the usual approach to the study of life through the analysis of metabolism, morphogenesis, and reproduction as opposed to the powers of the inanimate is perhaps preferable. However there seems to be no

reason why the advantages of both methods cannot be combined by beginning our study in the clear light of the most obviously vital activities, and of providing this beginning with the universality it requires by supplementing this analysis with a later inspection of the more basic types of vital operation. Thus Thomas Aquinas adds his analysis of the vegetative activities long after the nature of life has been established to his satisfaction.⁷

In connection with the application of this method, it would be advantageous if we could establish some basic method whereby we might discern with absolute certainty when two substances differ from each other specifically and not merely numerically. It is important that this problem be restricted to the difference between one substance and another, because the differences that separate one category of being from another, e.g. substance from quantity, is another, though somewhat similar, problem. One fairly easy mode of proof, however, is available in the second case that cannot be used in connection with our own problem, the method, that is, of showing the variability in one and the same subject of two different characteristics. An animal, for instance, may change its size without changing its color, and both size and color may co-exist in one subject.⁸

7. Thus the analysis of life in I, q. 18, art. 1 and 2 of St. Thomas' Summa Theologiae is supplemented by the analysis of all the vital activities including those of the vegetative order in I, qq. 77-82.

8. St. Thomas uses this method, for instance, in establishing the difference between the irascible and concupiscible appetites, cf. Summa Th., I, q. 81, art. 3.

However, no two substantial forms can co-exist in the same subject, no matter whether these forms differ in kind or merely in number.⁹

The problem with which we are left, then, is one to which there seems to be no completely satisfactory answer. The chief obstacle to a satisfactory solution lies in the fact that the principle means of coming to know about specific differences is found in the observation of properties. And unless the connection between a characteristic and its cause in the essence can be demonstrated, it is impossible to test whether or not the determination is or is not a property in the strict sense, or simply a widely distributed feature common to a considerable portion of a given species. We might, for example, ask of zebras whether they are to be considered a true species having a typically striped appearance as a property, or whether they are specifically the same as horses and asses, differing from the rest only as, let us say, blue eyed men differ from brown eyed.

When, however, it is possible to establish an intelligible connection between a characteristic and its essence, the problem becomes relatively simple. In this case, to show a specific difference between one substance and another, it is sufficient to demonstrate a difference in the proper activities exhibited by the two.¹⁰ The differences between properties can then be

9. cf. the discussion on this point in St. Thomas Aquinas, Summa Th., I, q. 76, art. 4.

10. cf. Aristotle's discussion of the method of arriving at a definition by the analysis of the properties in the Posterior Analytics, II, ch. 8-10, 93 a 27--94 a 19.

judged by the two criteria laid down by Thomas Aquinas in the Disputed Question De Anima.¹¹ A proper activity may be distinguished from another provided it has a different final cause-- for instance if the end of one such activity is in the genus of substance and another in the accidental sphere--or if two activities that have the same end differ in the mode of production-- as if, for example, one agent were to produce a given effect from a pre-existing subject and another without such a subject. We must be careful, however, in the last instance to make sure that the difference is really a basic difference in the relation between the principal agent and its effect and not, for instance, something incidental to that relation such as a difference in the instrument used to produce it. Cutting wood is always the same activity regardless of whether an ax or a saw is used.

Now applying these criteria to the animal activities which St. Thomas considers as being obvious signs of being alive and of which we are aware by introspection, we find that the mental fact described collectively as knowledge differ in kind, and not merely in mode of production, from anything found in the inanimate world.¹² St. Thomas Aquinas' analysis of the fact of knowledge is fundamentally an acute commentary on Aristotle's statement in the De Anima that, "By a sense is meant what has the power of receiving into itself the sensible forms of things without matter."¹³ By extending this examination to knowledge

11. St. Thomas Aquinas, De Anima, art. XIII.

12. Ibid., Art. XIII.

13. Aristotle, De Anima, II, ch. 12, 424 a 17-18.

in general, as a matter of fact, Thomas is able to show that "The immateriality of a thing is the basis of its having knowledge."¹⁴

Basically this analysis may be reproduced as follows: in order that we may assume any sort of validity for knowledge at all, there must be some similarity between the knowledge in the knower and some particular aspect of the known thing. Thomas and Aristotle would express this state of affairs by saying that the form of the thing known must be in the knower.¹⁵ It follows, therefore, that the knowing subject must possess besides its own form the form of other things as well. In this way, the knowing thing reaches out beyond itself to become identified with the rest of the world, for the form is that whereby a thing becomes a "what."¹⁶ Consequently, the knower, in possessing his own form, is himself, but in acquiring the forms of others, he becomes the others as well. Consequently, as Aristotle points out, in knowledge the soul is, in a certain way, all things.¹⁷

It is important to notice the qualifying phrase, "in a certain way," in this statement. Aristotle and, following him, St. Thomas certainly do not mean that an animal, in perceiving a tree, is at one and the same time an animal and a tree besides in exactly the same sense. We must recall, then, in what sense

14. St. Thomas Aquinas, Summa Th., I, q. 14, art. 1. "Immaterialitas alicuius rei est ratio quod sit cognoscitiva."

15. Ibid., I, q. 14, art. 1. "Species cogniti est in cognoscente."

16. St. Thomas Aquinas, De Ente et Essentia, ch. 1.

17. Aristotle, De Anima, III, ch. 8, 431 b 21.

animal is what it is in order to establish in what sense it can also be a tree.

The intrinsic constituents of the essence of the animal as an individual material substance are, as we have already seen, matter and form.¹⁸ Whenever such a combination arises, then, we shall have a thing that exists in the sense in which the animal exists in itself. When the union between these two principles is between prime matter and substantial form, the object that will acquire a natural existence is a substance; when an accidental form is joined to matter, what exists is a substance modified in some way, e.g. an extended animal.¹⁹ In both cases, however, the existence or modification is of the kind we find in the animal as its own being or quantity.

There is a good reason for this fact, and that is found in the limiting nature of matter. Matter is simply passive potentiality, and it is a principle of Thomistic metaphysics that if an act is limited, it can be limited only by a potency.²⁰ The reasoning behind this conclusion can be summarized thus: it is only in a state of actual existence that things become perfect. An actuality, therefore, tends to perfect that in which it is found.²¹ Since this is true, it is impossible that act be also the principle by which this same perfection is limited, otherwise

18. cf. supra, Section II, Chapter 2, pp. 168 ff.

19. Aristotle, Physics, I, ch. 7, 190 a 32--190 b 5.

20. St. Thomas Aquinas, Summa Th., I, q. 7, art. 1.

21. Ibid., I, q. 4, art. 1, "Secundum hoc enim dicitur aliquid esse perfectum secundum quod est actu."

it would simultaneously tend to make its subject perfect and imperfect in the same respect. Consequently any intrinsic limitation must come from the other principle of being, i.e. potentiality. That potentiality is fitted for the task may be seen from the analysis of its nature, for a thing is said to be in potency when it has not yet arrived at the complete existence that is identified as act, though there is, of course, an aptitude for that complete existence. In potency, therefore, there is something lacking, and, since in a perfect thing there is nothing lacking,²² it follows that potency, as such, is apt by its very nature to be a limiting factor on perfection. The amount of knowledge possessed by an individual, for instance, is not limited by lack of things to be known but rather by the capacities, i.e. the intelligence, industry, and opportunities of the knower.

It is because of this limiting function of potentiality that St. Thomas Aquinas assigns to the material part of the essence the individuality of corporeal beings. "If it is asked why this form is different from that, there is no other reason than that it is in different designated matter."²³ The question of exactly how this doctrine is to be interpreted is outside our present interest, but it is clear that for Thomas Aquinas an individual essence is a contraction of a form that is common to

22. Ibid., I, q. 4, art. 1, "Perfectum dicitur cui nihil deest secundum modum suae perfectionis."

23. St. Thomas Aquinas, In De Trinitate, q. IV, art. 4, ad 4. "Sed si quaeratur quare haec forma differt ab illa, non erit alia ratio, nisi quia est in alia materia signata."

many other individuals, and consequently must be due to the potential, that is, the material principle.²⁴

If a thing is thus limited to being one thing which is an individual when its form is received in matter, it follows that if, in knowledge, an animal extends outside itself to having other forms besides its own, these forms cannot be received in the matter of the subject. In knowledge the received form does not drive out the already existing natural form of the knower, but in the case of a reception of form in matter, this destruction of a previous form is precisely what happens.²⁵ Moreover it is patent that the form possessed in knowing does not acquire the individuality of the knower, but either retains the individuality it had in the known thing, or is stripped of individuality altogether. The known form must be received, as John of St. Thomas declares, in its "otherness."²⁶ If this were not true, the thing known would be the knower itself and the subject in knowledge could never even begin to pass outside itself. Once again, however, the effect of receiving a form in matter is to destroy the "otherness" the form had in the agent by assimilating the form to its own individuality.

24. St. Thomas Aquinas, Summa Th., I, q. 14, art. 1. "Coarctatio autem formae est per materiam."

25. Aristotle, De Generatione et Corruptione, trans. by H. H. Joachim, in Basic Works of Aristotle, I, ch. 4, 319 b 14.

26. John of St. Thomas, Philosophiae Naturalis, IV P., q. iv, art. 1. Cursus Philosophiae, III, 104. "Cognoscentia autem in hoc elevatur super non cognoscentia, quia id, quod est alterius ut alterius, seu prout manet distinctum in altero, possunt in se recipere, ita quod non solum sunt id, quod in se sunt, sed etiam possunt fieri alia a se."

When Aristotle says, therefore, that in knowledge the form of the known is received without matter, Thomas Aquinas understands him to mean not only that the form alone, without the matter of the agent, is received in the knower, for in this knowledge would be just like any other reception of form, e.g. in natural generation, but also that it is received in the knower in something else besides the matter. The subject in which the form is received, therefore, must be the form of the knower. That is what accounts for the ability of the knower to be the known and itself as well; if the kind of material existence the knower has as itself is called its natural existence, the immaterial kind it has as the known object can be called its intentional existence.²⁷

27. St. Thomas Aquinas, In De Anima, II, lect. 24, 552-553. "Dicendum igitur, quod licet hoc sit omni patienti, quod recipiat formam ab agente, differentia tamen est in modo recipiendi. Nam forma, quae in patiente recipitur ab agente, quandoque quidem habet eundem modum essendi in patiente, quem habet in agente: et hoc quidem contingit, quando patiens habet eandem dispositionem ad formam, quam habet agens: quodcumque enim recipitur in altero secundum modum recipientis recipitur. Unde si eodem modo disponatur patiens sicut agens, eodem modo recipitur forma in patiente sicut erat in agente; et tunc non recipitur forma sine materia. Licet enim illa et eadem materia numero quae est agentis non fiat patientis, fit tamen quodammodo eadem, in quantum similem dispositionem materialem ad formam acquirit ei quae erat in agente. Et hoc modo aer patitur ab igne, et quicquid patitur passione naturali.

quandoque vero forma recipitur in patiente secundum alium modum essendi, quam sit in agente: quia dispositio materialis patientis ad recipiendum, non est similis dispositioni materiali, quae est in agente. Et ideo forma recipitur in patiente sine materia, in quantum patiens assimilatur agenti secundum formam, et non secundum materiam. Et per hunc modum, sensus recipit formam sine materia, quia alterius modi esse habet forma in sensu, et in re sensibili. Nam in re sensibili habet esse naturale, in sensu autem habet esse intentionale et spirituale."

Our reasoning thus leads us to the realization that the kind of activity involved in knowing is different in kind from anything found in non-cognitive things, since in cognition there is produced a different sort of existence arising from a different relation of form to the subject. And this difference in activities, in turn, justifies us in concluding that a subject exhibiting the property of cognition differs in its very nature from one which shows no such activity.

But Thomas Aquinas contends that knowledge differs from the activities of non-living things not only in regard to what is produced but also in the way in which the effect is brought about.

In order to understand wherein this difference lies, we must recall our treatment of motion in an earlier chapter of this work.²⁸ There it was shown that, inasmuch as a perfection must already exist in the agent that produces it, and must similarly be lacking in the subject in which it is produced, these two must be different. This truth is expressed in the traditional formula that whatever is moved is moved by another.²⁹

Now this truth is, at least to casual observation, quite literally exemplified in the inanimate world.³⁰ It is generally agreed that the principal source of any change in a non-living thing is extrinsic to the thing itself. It is not merely the

28. cf. supra, Section II, Chapter 2, pp. 143 ff.

29. St. Thomas Aquinas, Summa Contra Gentiles, I, ch. 13.

30. There are certain apparent exceptions to this general statement. These will be considered later in this work.

motive power that is furnished by the outside force, but a major part of the determination of what kind of a change also belongs to this external cause. The reaction of a baseball in violent contact with a bat differs entirely from the reaction of the same baseball in a fire.

Now in a certain way, as all realists agree, this same situation exists in human and animal knowledge. For to the realist, natural things have an existence independent of and prior to any animal's knowledge of them, whereas the animal does not have any knowledge of natural things without at least an indirect experience of their existence.

St. Thomas, therefore, and Aristotle, being realists, agree that natural things act upon a potentially cognitive subject, and impress upon that subject the form under which the object becomes known.³¹ In this respect, then, knowing is like any inanimate activity, for the fact that it is knowledge of a certain thing depends upon an extrinsic cause, in relation to which the knowing subject is passive.

However there is another aspect of this relation of subject to object in knowledge that must not be overlooked, and that is the fact that the specific reaction of the subject on the receipt of the causal action is to know the agent. Now while it is obviously possible for a natural agent to impress its form on something else--as a hot thing heats other surrounding objects-- it is just as clearly impossible for it to be responsible for the

31. Aristotle, De Anima, II, ch. 5, 417 b 17--418 a 4. St. Thomas Aquinas, In De Anima, II, lect. 12, 373-382.

fact that it is known. In the first place an agent, when it acts, always produces its proper effect, (i.e. the effect it causes primarily and simply in virtue of being this kind of agent), as is evident from the very idea of proper cause. Since the action of material agents, however, does not always produce knowledge, it is obvious that knowledge is not an effect that a natural agent can produce by its own power.³² This conclusion is confirmed by considering that every different cause properly produces a different effect. Now while the effect of the causality of a natural thing upon a cognitive subject does produce a difference in regard to what is known, all of the effects are alike in this, that they are knowledge. Consequently such an effect cannot be produced by the natural thing, but must be something for which the knowing subject itself is responsible.³²

In a way, this is a perfectly normal reaction of a being actuated by some outside agent. As soon as a passive subject is reduced to act, it is natural for it to act itself, since everything acts insofar as it is in act. Thus a material thing that has been heated in turn acts upon other surrounding objects. The peculiarity of the act of knowing is that it is an act that does not act on anything else: there is no effect of the operation of the cognitive being other than the operation itself. Consequently the perfection produced by the agent is a perfection of the agent itself.

32. Aristotle, De Anima, II, ch. 12, 424 b 7-9. St. Thomas Aquinas, In De Anima, II, lect. 26, 563.

The end of the act of knowing, therefore, can be said to be intrinsic to the knower. Nor is this merely true in the sense that the finis operantis is intrinsic to the operating subject in the case of knowledge--insofar as this is true, the act of knowing is like the act of any other substance. But what is distinctive in this case is that not only the end of the agent is intrinsic to the agent, but the end of the act as well, since there is no other end for this act but itself.³³ It is in this way that the act of knowing differs from the acts of inanimate beings not only in the kind of thing which is produced, but in the way in which the agent produces it. Nor in inanimate things, the finis operis is always in another being, although of course the finis operantis is intrinsic to the agent; in the knower, both kinds of end are intrinsic to the knowing subject.³⁴ There is, therefore, in the latter case an entirely different relation between the proper causes of the action than there is in the former, and such a difference is enough, as we have seen earlier, to establish a fundamental difference between one kind of agent and another. The cognitive subject, therefore, must differ in kind from the non-cognitive.

33. Thus St. Thomas specifically gives the act of knowing as one that has no other end but itself. cf. Summa Contra Gentiles, II, 1, "Actio vero quandoque quidem terminatur ad aliquid factum, sicut aedificatio ad domum, sanatio ad sanitatem; quandoque autem non, sicut intelligere et sentire."

34. St. Thomas Aquinas, Summa Th., I, q. 18, art. 3, ad 1. "Duplex est actio: una quae transit in exteriorem materiam ut calefacere et secare; alia, quae manet in agente, ut intelligere, sentire, et velle. Quarum haec est differentia: quia primus actus non est perfectio agentis quod movet, sed ipsius moti; secunda autem actio est perfectio agentis."

However decisively a knowing being differs from the world of the inanimate, this argument suffers from the disadvantage that cognition is an effect of living that we are directly aware of in only one case. It is true that we can be sure that knowledge exists in other human beings besides ourselves, and in other animals as well, by reasoning from the kind of behavior they exhibit. Nevertheless, it remains a fact that the other actions from which we start reasoning about the existence of knowledge in a given animal are more obvious to us than is the existence of the knowledge itself.

The most obvious sign of life in things external to ourselves is found in locomotion. This particular action has the advantage of being directly observable in outside things and of being immediately perceptible to our own internal consciousness in ourselves. Since the latter sort of experience tells me definitely that I am the mover in this case, it is quite obvious to Aristotle and St. Thomas that the living subject is the efficient cause of locomotion.³⁵ Furthermore it is equally clear that the effect of locomotion is intrinsic to the animal, insofar as the result of locomotion is a new place for the thing undergoing the motion, i.e. the animal. Although the kind of effect in this case is a kind that is found throughout the material realm, therefore, the way in which the effect is produced is unique in

35. The modern mechanist, of course, must deny that this is the case. The specific opinions on this point will be considered at some length in the third section of this work.

animals.³⁶

The way in which locomotion is produced in animals is not absolutely identical with the way in which knowledge is produced, but there is a great similarity. The difference lies in the fact that in knowledge the action produced by the knower is its own end--there is no product involved in knowing besides the knowing itself--whereas, in locomotion, the place at which the animal arrives and which constitutes the end of the action is distinct from the action by which it is attained. Nevertheless the two operations have this in common, that in both cases what is produced is a perfection of the agent.³⁷ This characteristic, therefore, is the one that must be common to all living things, that they produce perfections in themselves. Furthermore this characteristic is peculiar to living organisms, inasmuch as inanimate things produce perfections only in something other than themselves, though they do so for their own benefit. St. Thomas expresses this difference by saying that a living thing "moves itself according to some kind of self-motion."³⁸

Although it is not equally clear that this self-perfecting goes on in the process of nutrition and the other, more universal

36. That locomotion not only is but must be universal to all material being is shown by Aristotle in Physics, VIII, ch. 7, 260 a 27--261 a 27. There he shows that no other sort of motion is possible in the absence of locomotion. For Aristotle's discussion of the difference between locomotion in living and non-living things, cf. Physics, VIII, ch. 4, 254 b 8--255 a 20.

37. St. Thomas Aquinas, Summa Th., I, q. 18, art. 3, ad 1.

38. Ibid., I, q. 18, art. 1: "Ex quo patet quod illa propria sunt viventia quae seipsa secundum aliquam speciem motus movet."

operations characteristic of all life, vegetative and animal, analysis shows conclusively that such is the case. The difficulty in seeing that nutrition falls under the classification of self-motions arises from the fact that in nutrition there is not merely one substance involved, as is the case in locomotion, but two-- or at least two classes of substance: the organism and the food. It is necessary to see what part both classes of substance play in the process in order to find the community between this process and the vital activities we have already discussed.

The process by which the organism is nourished need scarcely be described. The food is taken into the organism, wherein it first of all undergoes a process of digestion, a breaking down of the molecules of the food into a simpler form. This operation is useful in two ways: it breaks the food down into a size small enough that it can pass easily through the body's membranes, and it also destroys the specific nature the food had before, a form dissimilar from that of the consuming organism, and reduces it to a form that serves as a common "building-block" to both the food and the consumer. For instance, the protein structure of a frog and a fly are quite different; however, they are both made up of certain amino acids, and when the frog eats a fly, the process of digestion in the frog breaks down the protein structure in the fly to the basic acids from which, in turn, a protein structure typical of the frog may be built up.³⁹

39. Michael Guyer, op. cit., pp. 209-210.

The simplified form of the food is then used in one of two ways: either to produce something belonging to the organism itself--sometimes to replace living parts of the organism that have been worn out by the organism's activities, sometimes to produce parts that are generally regarded as non-living, but structurally or functionally necessary to the organism⁴⁰--or in order to produce the energy necessary for the continued activity of the organism.⁴¹ The latter use is made of the food by a process of oxidation of the digested foodstuffs; the former takes place by a synthesis of the simplified organic substances into which the food has been analyzed, a synthesis that generally takes place on the cellular level.

In the process thus described, a characteristic peculiar to nutrition is found: that the subject in which the effect is produced is substantially different from the agent, but the effect is not. That is, at least with regard to the food assimilated into the organism, the substance acted upon is the food, and it is the food that undergoes a substantial change, but that which is produced is the substance of the plant or animal itself. At any rate, the goal, in the sense of the finis operis of the change that takes place, is the form of the living substance.⁴²

40. For non-living nature of enzymes etc., cf. J.B.S. Maldane, "Protoplasm," in Adventures of a Biologist, p. 117. cf. also J. Maritain, "Philosophie de l'organisme, Notes sur la fonction de la nutrition," in Revue Thomiste, XLIII, no. 2 (Juillet-Sept), 1937, p. 264.

41. Guyer, op. cit., pp. 17-18.

42. Maritain, op. cit., in Revue Thomiste, p. 267.

The problem of discovering whether or not the operation of nutrition is a self-perfecting of the organism as were the operations discussed previously depends upon our ability to discover the agent responsible for nutrition. This agent, at first sight, seems to be the organism itself, but we must consider the possibility that this is not the case. And if the agent is not the organism itself, it may be something entirely external to the living thing, such as for instance the sun or even the food itself, and it may be something extrinsic to the organism in the sense that the parts of a machine are outside the machine. Let us examine both of these alternatives.

We must agree, in considering the first of these possible alternatives, that food is necessary to nutrition, and so is the presence of certain other natural forces, e.g. the light and heat of the sun. Sometimes the presence of the natural force is necessary only as a condition; a certain amount of heat is necessary for the process of digestion, for instance, because no digestion would take place with the digestive juices frozen solid. In other cases the natural force plays a more important role because by means of its own proper activity it produces some part of the series of processes that we call nutrition: this state of affairs is true, as an example, in the case of the role played by sunlight in the photo-synthesis of a plant's food.⁴³

In any case, it is necessary for us to remember here that the principal agent is the one that is responsible for the

43. J.B.S. Haldane, "Protoplasm," in Adventures of a Biologist, p. 116.

kind of effect produced. The principal cause of a building is a builder and not a hammer, for whereas a hammer, by its natural hardness, produces a natural effect of repulsion on any object with which it may come into violent contact, e.g. a nail, it cannot be responsible for the part this natural repulsion plays in building a house. Understanding 'cause' in this sense of a principal agent, we become immediately aware that neither the food nor the sun nor any other natural force completely outside the organism can be the^a cause of the effect produced, inasmuch as no one of these or even the mixture of all of them is sufficient to explain what is produced. The same general kind of food is used by many different kinds of living thing, and moreover this food is frequently digested to a more or less indeterminate state--a sort of a common denominator of many living things--before it is synthesized into the substance of the individual organism. The determinate nature of the organic substance, which is different in each case, cannot be accounted for through the causality of food, which is the same. And the same argument applies to the other forces external to the organism.⁴⁴

It remains then that the agent responsible for this effect should be in some sense internal to the living being itself. Whether this agent is entirely internal in the sense of being the very substance of the organism or whether it is a part of the whole, distinct in substance and only mechanically united to the organic substance remains to be seen.

44. Maritain, op. cit., in Revue Thomiste, pp. 265-266.

The fact that makes a consideration of this last possibility necessary is the presence within the organism of certain parts that are generally agreed to be inert and therefore outside of the substantial nature of the living being. Specifically, we are here concerned with the enzymes that play such an important part in the digestion and subsequent synthesis of the organism's foodstuffs. It is argued that these substances when isolated from the plant or animal in which they are found, are still capable of performing the activities they carry out within the organism, and that, furthermore, there is no single stage of the process of digestion and assimilation that cannot be understood in terms of the action of some of these enzymes.⁴⁵

Now this claim may or may not be justified, but even if it is, the argument entirely misses the point. It might similarly be claimed that there is nothing in a house that could not be explained in terms of hardness in a hammer or crowbar, of sharpness in a saw or plane--nothing, that is, beyond the fact that the effect is a house. Similarly it is impossible to account for the fact that the over-all finality of the operation of the nutritive process is the production of a part of the organized substance of the plant or animal, on the basis of the finality of the enzymes themselves. The chemical action of the enzymes may account for the hydrolysis of the starches taken in as food, or for the synthesis of a sugar typical of a given species of

45. J.B.S. Haldane, "Protoplasm," in Adventures of a Biologist, pp. 117-120.

life, but they do not account for the fact that the sugar becomes part of the very substance of the plant.⁴⁶

It is important to remember, in connection with this argument, that the organism is a unified substance. What is being produced by the process of nutrition, therefore, is the organic substance itself. Moreover it is important to remember that the principal agent, as opposed to subordinate agents or instruments, may be known by two signs: that, because the perfection of the effect cannot come from nothing, the principal cause must pre-contain that perfection either univocally or analogously, and, secondly, it must be the substance which is the principal agent that benefits from the production of the effect, inasmuch as every agent acts for its own sake. It was precisely in view of this second test, and because the only thing that could be understood as benefiting directly from the over-all activity carried on by the parts of the organism is the plant or animal as a whole,⁴⁷ that we came to the conclusion of the substantial unity of the organism in the last chapter. On this basis, then,

46. This is essentially the argument of Aristotle against Empedocles. The latter claimed that the upward growth of the top of a plant could be explained by the presence within it of the element of fire, and the downward growth of the roots by earth. Aristotle answers that up and down have a functional significance for the plant, insofar as the leaves, fruit, and so forth, have parts to play in the total economy of the organism different from that played by the roots, so that, although it may be possible to explain the upward and downward tendency of the various parts of the organism in reference to the universe by fire and earth, the functional diversification of what is up and what is down can have nothing to do with the nature of fire or any other element. cf. De Anima, II, ch. 4, 415 b 28--416 a 5.

47. cf. J. Arthur Thomson, The System of Animate Nature, (N.Y.: Holt, 1924) pp. 631-633.

the principal agent of the organic activity of nutrition must be the organism. A similar conclusion is reached by a search for a cause that precontains the form of the effect and is therefore capable of specifying that effect. For the only agent involved in the nutritive process that fulfills this requirement is plainly the living substance of the organism. On both counts, therefore, the principal agent of nutrition is the plant or animal itself. Whatever independent, non-vital agents are involved in the activity can at most be responsible for partial aspects of the effect and not for its totality; hence they seem to be no more than subordinate causes of nutrition. As Maritain points out, it is only a knowledge of the substantial unity of the organism that makes inevitable the conclusion that nutrition is a truly vital activity.⁴⁸

If, then, the organism as a whole be granted to be the efficient cause of the act of nutrition, it follows that once again in this operation we have a case of the self-perfection or self-motion that we have found to be characteristic of life in our analyses of knowledge and locomotion. It is true that in this case, there is a much closer approach made to the mode of operation characteristic of non-living substances, since the organism acts transitively on the food. However, in view of the fact that the agent and the form produced are not only specifically but numerically the same, it is clear that the over-all picture of this process is one which shows the same essential relation-

48. Maritain, op. cit., in Revue Thomiste, p. 268.

ship between efficient and final causes--though not the same relation between these two and the material cause--that is displayed in the more obviously vital processes.

Since the analytical approach to the vital processes we have not considered would be similar to that we have already used, and since we are not primarily concerned with the peculiarities of each of these living operations, but merely what they have in common as signs of life, nothing is to be gained by an extended treatment of these other activities. It will be enough to point out briefly how the characteristically vegetative activities bear this same distinguishing note of being self-perfections that we have already discussed.

The process of growth or morphogenesis is without any doubt an operation of the same sort as nutrition. The agent is once again the organism, since it is by nourishing itself that the living being grows and attains its qualitative organization.⁴⁹ Moreover the specific size and organization attained are perfections of the plant or animal. Consequently here too we find a self-perfecting characteristic of a living organism.

The case of the process of reproduction is a little more difficult. For although the action of reproducing is performed for the benefit of the parent organism, inasmuch as it is only by this means that the plant or animal can participate in immortality,⁵⁰ nevertheless the thing produced is numerically

49. Aristotle, De Anima, II, ch. 2, 413 a 25-30

50. Ibid., II, ch. 4, 415 a 26--415 b 8.

different from the generator, even though both belong to the same species. In other words it seems that here we have an operation of the organism that is like the actions of non-living substances: having a finality that is intrinsic in the sense of the end of the agent but extrinsic in the sense of the end of the deed.

Even in this case, however, it is possible to understand the finis operis as being intrinsic in one way, though not in another:⁵¹

"Generation in inanimate things is entirely extrinsic. But the generation of living things takes place in a higher way through something intrinsic to the living thing itself, that is the seed, in which there is a principle capable of forming the body. And therefore there must be some power of the living thing through which this seed is prepared, and this power is the generative power."

What St. Thomas apparently means here is that the seed is first of all produced as something not only united to but substantially identical with the generator. Thus John of St. Thomas comments upon the foregoing passage:⁵²

"Non-living beings generate by a generation in the common sense, a generation out of wholly extrinsic matter. Living things, however, do so by a generation in a special sense, one that takes place out of the very substance of the living thing, wherefore it is a generation in which the propagation takes place out of a principle joined to the living thing and communicated to the generated."

51. St. Thomas Aquinas, Summa Th., I, q. 78, art. 2, ad 2. "Generatio in rebus inanimatis est totum ab extrinseco. Sed generatio viventium est quodam altiori modo, per aliquid ipsius viventis, quod est semen, in quo est aliquod principium corporis formativum. Et ideo oportet esse aliquam potentiam rei viventis, per quam semen huiusmodi praeparatur; et haec est vis generativa."

52. John of St. Thomas, "Philosophiae Naturalis," p. IV, q. 8, art. 1, Cursus Philosophiae, III, 84. "Non vivencia generant

St. Thomas, however, also seems to understand this generation through an intrinsic principle in the sense that there exists as something intrinsic in the generated an active principle which is really the power of the generator,⁵³ a power different from the soul of the generated thing but through which that soul is caused to come into being through the proper disposition of matter.⁵⁴ In this way too would the generation of an organism differ from that of the inanimate because of the presence of an intrinsic principle.

Enough now has been said to establish definitely that all living operations differ specifically from those of non-living things in the manner in which they are produced, that is in the relation existing between the efficient and final cause, and that some of them differ in the very kind of effect produced. Since both such differences require substantial differences in the being displaying such operations from those which do not, it follows that living beings must be different in kind from non-living.

generazione communiter dicta, quae est totaliter ex materia extrinseca, viventia autem speciali generatione, quae est ex propria substantia viventis, ratione cuius est generatio propagativa ex principio coniuncto ipsius viventis et communicato ipsi genito."

53. St. Thomas Aquinas, Summa Th., I, q. 118, art. 1, ad 3. "Illa vis in activa quae est in semine, ex anima generantis derivata, est quasi quaedam motio ipsius animae generantis."

54. Ibid., I, q. 118, art. 1, ad 4. "Huiusmodi igitur materia transmutatur a virtute quae est in semine maris, quosque perducatur in actum animae sensitivae; non ita quod ipsa et vis quae erat in semine fiat anima sensitiva; quia sic idem esset generans et generatum." Clearly a great deal of bad science is mixed with these remarks. However the passage from John of St. Thomas and the point made in that passage are sufficiently clear to establish the vital nature of the act of generation.

It would be well to pause here for a moment to consider a difficulty. It is a demonstrable truth, according to Thomistic and Aristotelian philosophy, that nothing moves itself. Now then can we claim self-motion as being a characteristic of vital operations? A little reflection shows immediately the truth of Aristotle's pronouncements that "when a thing moves itself, it is one part that is the movent and another part that is moved."⁵⁵ If the whole moves itself, this can be true only in an indirect sense and accidentally, e.g. the animal moves itself as a whole in locomotion only in virtue of the fact that a set of muscles moves a leg.

The necessity of one part's being moved by another, incidentally, throws considerable light on why only a thing capable of being called an organism can exhibit vital activities. Like a machine, the animal or the plant must have parts so arranged that one can act on the other to attain a given end.⁵⁶

From the facts that the difference between vital and non-vital operation is sufficient to require a specific difference in their causes, and that the organism is substantially a unity rather than a multiplicity, it becomes quite clear how the reason for this difference is related to the whole. It cannot be related to the physical body of the organism merely extrinsically as the efficient cause of the life processes, otherwise some conclusions can be arrived at that contradict facts already well

55. Aristotle, Physics, VIII, ch. 5, 257 b 12-13.

56. Ibid., VIII, ch. 4, 254 b 30-33.

established. If the cause of life is credited with being the agent alone, it follows that the body is reduced to the status of a mere machine, since a nature must have an intrinsic principle of motion and rest, and we are here making the principle of activity extrinsic. But in that case the whole vital activity of everything below man ceases to make sense, for it is only on the supposition that the material part of the organism really belongs to the substance that anything at all can be said to benefit from the living operations. It is the material part that acquires new matter in nutrition, the material part that increases in size and complexity in morphogenesis, and that is multiplied in reproduction. These acts are of no conceivable benefit to a life principle unless they are of benefit to a substantial whole of which the life principle is only a part.⁵⁷

Putting the argument in another way, we can apply here once again the principle of the correspondence between the way a thing exists and the way it acts. Since all vital activities, at least up to the level of intellection, imply a material action, (for in what sense could an immaterial thing be said to grow?), the agent that acts must be a material substance.⁵⁸

Of course, it might be claimed that the life principle is itself a material substance that is distinct from the corporeal thing that we call the organism, but such an assertion makes very little sense indeed. There are two distinct objections

57. cf. supra, Section II, Chapter 3, pp. 192-197.

58. St. Thomas Aquinas, Summa Th., I, q. 75, art. 3.

to such an interpretation. The first of these is the same difficulty we encountered above and may be put in the following fashion: That for the sake of which the agent acts is the agent itself. Now the organism is that which is benefited by the vital activities of the organism. The organism, therefore, is the principal agent in these activities. Hence the principle by which it becomes the agent must be intrinsic to the organism, not extrinsic to it.

Or we might put our objection in this way: this extrinsic body that is the source of life must itself either display these types of self-motion of which we have been talking or else it does not--that is either it is alive or it is not. If it is not alive and does not display these activities, then the "living" thing is merely a union of non-living substances which achieve vital effects by their organization, i.e. the living being is simply a machine. This alternative we dismissed in the last chapter as unintelligible, and it has grown no more intelligible since. If, on the other hand, this vital principle is itself alive and a material substance, then we must ask what makes this material substance alive just as we did of the organism. For it is not because it is a material substance that this vital principle is alive, otherwise all such substances would be alive and would nourish themselves and grow and reproduce, a state of affairs that is plainly not the case. There must then be some determining element which makes this material substance of a vital principle to be alive. This determining element itself then must be a body or not. If it too is a material substance, we have patently

marooned ourselves on the endless treadmill of an infinite regression. Sooner or later we shall have to arrive at a material substance that is really alive--as all these intermediate bodies are not since they are moved only by another, external body--and this living substance must be determined to live by a principle which does not itself contain matter, although it may be material in the sense that it depends upon matter.⁵⁹

Whatever it is, then, that differentiates the living from the non-living cannot be separate from the organism itself, but must rather be part of that organism--a substantial part as opposed to a quantitative or mechanical part. Now because of the intellectual analysis of change undertaken by Aristotle and Thomas Aquinas, the parts of the substance are designated as matter and form; of these the matter is the principle of community between substances inasmuch as in it the change takes place as in its subject, and the form is the principle of differentiation since it is identified as the novelty produced by change. The matter of the living thing, then, forms its point of resemblance with the universe of the inanimate; what must have changed is the form. That is to say, the organism differs from lifeless being, not in the possible range of what it may eventually become, but in what it is now. The life principle is the substantial form of the organism.⁶⁰

59. This argument is a somewhat blown up version of St. Thomas' reasoning in the Summa Th., I, q. 75, art. 1.

60. Aristotle, De Anima, II, ch. 1, 412 a 20.

It does not really matter, of course, what this principle of life is called, although some expressions are perhaps less fortunate than others as symbols of this principle. The term "soul" used as a translation of St. Thomas' "anima" and Aristotle's "ψυχή" as a title for this substantial form, is by no means beyond exception, for it has been used so extensively to designate the human life principle that it has come to be almost inseparably associated with the peculiarly human psychic characteristics that manifest life within our internal experience. For this reason it seems rather incongruous to say that the carrot has a soul--it sounds as though the carrot were being attributed the power of appreciating poetry. This interpretation, however, is not at all what Thomas and Aristotle meant to imply about living things by ascribing soul to them; what they meant is simply what is justified by the evidence available--the soul is the substantial form of living things and the basic explanation of the unique operations that they exhibit.

Hence the two well-known Aristotelian definitions of the soul: "The soul is the first act of a natural body having life potentially in it,"⁶¹ and, "it is the soul by or with which primarily we live, perceive, and think."⁶²

In the first definition, Aristotle calls the soul "the first act" to signify that the soul is an act on the substantial as opposed to the operational level--that is, the soul is not

61. Ibid., II, ch. 1, 412 a 28.

62. Ibid., II, ch. 2, 414 a 3

the activities of nutrition, locomotion, knowing, and so on, but rather that which makes these activities possible. The activities come and go or proceed with different degrees of intensity, but the presence of the basic substantial nature underlying and rendering possible these activities remains necessary in order that they can come and go. "Both sleeping and waking presuppose the existence of soul."⁶³ Such a form, then, must not merely be prior relative to the operations, but must be absolutely first in the living being, for if a form is received into something already actual, it is not substantial.⁶⁴

By the second part of the definition, Aristotle explains that the natural body having life potentially within it should be understood as the body having the full-fledged organization necessary, as explained above, for carrying on the immanent motions characteristic of life.⁶⁵ This cannot be either the body after it is dead, nor any natural or artificial body that does not yet have a soul, but only the besouled body itself; even in this state, the body is said to have life potentially because by its very nature, the body is the material as opposed to the formal constituent of the organism, and matter is the same as potentiality.⁶⁶

63. Ibid., II, ch. 1, 412 a 24-25.

64. A substance is a being to whose nature it belongs to exist in itself, and the substantial form, as the act of the substance, is that which gives the substance this independent existence. A form that modifies an already actual thing is accidental. cf. St. Thomas Aquinas, Summa Th., I, q. 76, art. 4.

65. Aristotle, De Anima, II, ch. 1, 412 a 28--412 b 5.

66. Ibid., II, ch. 1, 412 b 25-27.

The second definition of the soul, like the first, assigns to the soul the function of being the life principle, but it does so more specifically by referring to the grades of life individually. By the word "live," Aristotle refers to the vegetative level, for it is impossible that anything corporeal be said to live at all except insofar as it has these vegetative activities.⁶⁷ The other kinds of life which Aristotle traces back to the soul are the life of the animal and that of man, designated respectively by the words "perceive" and "think."

It must not be thought that, because Aristotle--and following him Thomas Aquinas--do not consider the soul as solely the efficient cause of the animate actions appearing in the body, it does not fulfill that function; though primarily the form of the body, the soul also operates as agent and final cause of the vital operations.⁶⁸ The form, as a matter of fact, is always the originative source of the activities proper to any species of substance,⁶⁹ for substances are enabled to do what they do by the fact that they are what they are, and what they are is determined by the form; the soul, therefore, as the form of the body, is the agent responsible for the organism's living activities.⁷⁰ In a similar way, the soul is the final cause of its own activities, inasmuch as matter, by its very nature

67. Aristotle, De Anima, III, ch. 12, 434 a 22-26.

68. Ibid., II, ch. 4, 415 b 10-11.

69. Aristotle, Physics, II, ch. 7, 198 a 26-28.

70. St. Thomas Aquinas, In De Anima, II, lect. 7, 323.

as potentiality, is ordered and disposed for the sake of form, which is the act or perfection for the sake of which the relatively imperfect potentiality exists.⁷¹

We have now seen in the last two chapters what seems to be the reasoning behind the Thomistic and Aristotelian viewpoint that the living operation differs generically from the non-living, that the differential characteristic of the vital operation is its character of being a self-motion, and finally, that the principle responsible for this difference is related to the organism as its first act, that is, its substantial form. It now remains for us only to discuss what the nature of the life might be that we attribute to this organism.

Before we can decide what part the "life" of the organism plays in the living whole, we will do well to decide on what level, substantial or accidental, we are to look for the answer. Although there is a certain plausibility in saying that the vital operations themselves constitute the life of the thing, because it is only through these vital operations that we are able to know whether a given being is alive or not,⁷² it is obvious that when we say that a thing is alive, we do not mean that it is necessarily at that moment performing any one of the activities that we have discussed, but merely that it could perform these activities if the circumstances were suitable. When we wonder whether a plant root is alive during the winter or not,

71. Ibid., lect. 7, 321.

72. St. Thomas Aquinas, Summa Th., I, q. 13, art. 2.
"Quandoque tamen vite

sumitur minus proprie pro operationibus
vitae, a quibus nomen vitae assumitur."

we are not concerned with whether or not it is growing and forming seeds and synthesizing sugars in the frozen ground, but whether it will be able to do so in the spring. The difference between the life and its operations is plainly seen from the multiplicity and variability of the operations themselves as contrasted with the unity and constancy of the life attributed to the subject.

For these operations, which are of an accidental, qualitative nature, there must be, as we have seen, an explanation on the substantial level. Now in a sense, the soul itself is the explanation needed; this assumption we have been making implicitly thus far in the present chapter. However, as the nature of the operations of any substance must have their basis in the nature of the substance, so the actuality of the operations must have as a basis the actuality of the essence. Both of these statements are equally applications of the fact that a being can act only insofar as it is in act. Hence insofar as a living being produces a certain kind of operation, it must have a certain kind of soul; insofar as these operations are actual, this fact must depend upon the actuality of the organism's existence. Now this establishing of the possibility of operation is precisely what the life of the organism does for it. "An animal is said to be alive because it has a soul through which, as through its proper form, it has an act of existing; it must be concluded that the 'living' is nothing except the 'existing' proportionate to the form from which it proceeds."⁷³

73. St. Thomas Aquinas, Summa Contra Gentiles, I, 98.
"Ex hoc animal dicatur vivens quod animam habet, secundum quam

Although we use the word "life" as a substantive, therefore, it is clear that in the extra-mental world, life does not exist as a thing. Rather, in the organism, the living is an activity, the very basic activity through which the living thing is real. "To live" is "to exist" in a thing that has a soul, that is, in a thing that is capable of perfecting itself.

habet esse, utpote secundum propriam formam, oportet quod vivere nihil sit aliud quam tale esse ex tali forma proveniens."

SECTION III
EVALUATION OF THE BIOLOGICAL THEORIES

SECTION III

CHAPTER I

AN EVALUATION OF THE VITALISM OF HANS DRIESCH

Remarkable and striking as the work of Driesch has been in examining the aspect of biological problems most obviously inexplicable on physical or chemical grounds, that work has commanded more respect than agreement among his fellow biologists. Among philosophers that still hold to the specific distinction between the living and the inanimate, Driesch's following is considerably larger.¹ From a human point of view, this situation is entirely understandable, inasmuch as, in view of the tremendous reputation enjoyed by the empirical sciences, any scientific support for a philosophical opinion is apt to seem to philosophers and public alike a sort of practical vindication of the reputedly over-abstract and unreal philosophic opinion. Long before this, however, past experience should have warned philosophers to beware of scientists before looking carefully over their gifts. The obvious philosophic weakness of various "scientific" arguments for the existence of God has probably done more to make agnostics and atheists out of large numbers of scientists than any other factor. As in that other case, the argument of

1. This is merely a personal opinion, a general impression that I got during the course of my research on Driesch.

Driesch for an "entelechy" rests upon the inadequacy of physical theory to explain a given set of facts, to explain which, therefore, another sort of cause is postulated. We must be sure, therefore, that the impossibility of such a physical or chemical explanation is really an intrinsic impossibility, and not one that is simply a reflection of our present ignorance.

There are three basic points on which disagreement with Driesch might be possible. One point of possible disagreement might be the basic philosophical assumptions that are reflected in his argumentation, another would be his argument against the mechanical interpretation of the actions of the organism, and a final source of difference might be found in his analysis of the relation which exists between the entelechy and the material organism. This chapter will attempt a brief evaluation of each of these questions.

Driesch's principal philosophic presupposition is concerned with the nature of causality. And here we can distinguish three elements within his treatment:

First, Driesch accounts for the origin of the idea of causality by claiming that the notion has its beginning in our experience of the relation between ideas rather than in our experience of the relation between things. Thus the necessary implication of the idea of the genus within the notion of the species, e.g. of "animal" in "man," that first gives us the idea of a necessary sequence proper to the definition of causality. This idea of a necessary sequence is then transferred on the

basis of our experience to relations between things existing in the extra-mental world.²

Second, Driesch's definition of causality includes three elements; the notion of sequence in time, the element of dependence, and the trait of real applicability to the empirical world. Hence Driesch shows himself as a realist in matters of knowledge and as an intellectualist in his affirmation of the intelligibility of the real world.³

Third, there are four basic kinds of causality distinguished by Driesch:

1. Singular causality, whereby a spatial system is influenced in its constituents of number, motion, or arrangement by another external spatial system.

2. Matter creating causality, whereby the number of elements within a spatial system is increased by the intervention of a non-spatial system.

3. Motion creating causality, whereby the elements of a spatial system are reduced from rest to motion by a non-spatial cause.

4. Individualizing causality, whereby a spatial system is given a new and more complex arrangement (without the creation of matter or motion) by a non-spatial system.⁴

2. Driesch, Science and Philosophy of the Organism, p. 319.

3. Ibid., p. 317.

4. Ibid., pp. 320-321

Without attempting a detailed examination of Driesch's account of the origin of the idea of causality, we might remark that it is rather dubious whether a concept of an ens rationis, a relation existing between ideas, can be established with any certainty to apply outside the realm of ideas. It is interesting to note that historically it was this very difficulty (about applying to things a concept that refers only to related ideas) which bears a large part of the responsibility for the origin of modern idealism in Berkeley.⁵

Driesch, it is true, considers it as an established fact that the relation of dependency is found in the outside world as well as among ideas, but it is noticeable that the external material world that Driesch discusses later is a mechanical one where causality is reduced to an absolute minimum. And it is equally noticeable that the locus of any causality characteristic of the Organism is moved from the material body to a substance more nearly resembling an idea in its existential status.

Assuming however that the real and universal applicability of causality in becoming can be established, even if not on Driesch's grounds, we must examine the kinds of causality enumerated by Driesch to see what this division will tell us. The first and obvious characteristic of this distinction is that all the kinds of cause enumerated are subdivisions of efficient causality, and this in spite of the fact that the origin of the idea of causality in Driesch is a sort of formal causality. At

5. cf. Etienne Gilson, The Unity of Philosophical Experience, (N.Y.: Scribners, 1950), p. 194.

any rate, Driesch, in dealing with the external world, is concerned principally with extrinsic causes, a factor that influences his treatment of the entelechy later on.

The second observation I would like to make concerning Driesch's division of causality is that even in the genus of efficient causality the distribution can be considered adequate only if we assume a mechanical point of view. The three things assumed by Driesch to need explanation by either an extended or an unextended causal system are precisely the elements that the mechanist finds basic to the material world, namely a multiplicity of particles, motion in those particles from one place to another, and the spatial configuration of those particles. Since Driesch's view of the organism is not primarily a mechanical one, it seems that this is not the place to enter into an extended discussion of mechanism. However in our discussion of the nature of a machine in an earlier chapter,⁶ and in our appraisal of more professedly mechanical systems in the chapter following,⁷ the ontological emptiness of a machine is apparent; the machine as such has no activities and no being, whatever it may seem to have of either it has in virtue of sources external to itself. Driesch's statements throughout his works are not uniformly mechanical, since he speaks of various chemical forces and of various other qualitative forces of light and matter.⁸ Never-

6. cf. supra, Section II, Chapter 3, pp. 183 ff.

7. cf. infra, Section III, Chapter 2.

8. Driesch, Science and Philosophy of the Organism, pp. 97-98.

theless he is explicitly in sympathy with the mechanistic ambition to explain even these forces in terms of extended matter, locomotion, and position.

A third brief observation might be made concerning Driesch's division of causality. Of the three kinds of effects possible to non-spatial causes--number of particles, motion, and position--only the last is considered as being actually realized in the experimental world. It is very difficult to understand, for me personally at least, how such a cause can be the cause of the coming-to-be of that configuration in any way whatever. And since the only way particles can assume a position they have not had before is either by being created there, or by being moved there by something else, it is obvious that according to Driesch the non-spatial system is just such a cause of being but not of becoming.

All of these difficulties in Driesch's theory of causality, it seems to me, are the result of a certain conflict that must inevitably arise between experience and the assumptions necessary to the experimental method, between the philosophic and the empiriological elements in man. The philosophic experience teaches us that there are certain qualities in reality that are distinct from and in a sense superior to any geometrically understandable arrangement of discrete elements, otherwise the geometrical shape itself would be not only unintelligible but completely unknowable. On the other hand, the physicist, being himself incapable of the direct generation of most natural effects, and

observing that the only way for him to produce such an effect is by bringing the proper cause into spatial conjunction with the appropriate matter, in a way is forced to deal with qualitative features in terms of geometrical figures. Driesch almost instinctively recognizes, therefore, that there are aspects of reality that are not intelligible from the point of view of undifferentiated matter in a state of locomotion, but his scientific background seems to coerce him into regarding the material co-efficient of these as a machinelike arrangement of parts. In a way this confusion already implies an entirely immaterial cause of such phenomena and the divorce between being and becoming that we have already noticed. However unlikely his theory may be otherwise, the separated entelechy is the only possible solution to Driesch's epistemological difficulties.

In spite of the criticisms we have made of Driesch's outlook on causality, the necessity of the elements of his definition to a rational and realistic science of the world cannot be too strongly emphasized. Our quarrel is not with the basic concept of causality exhibited by Driesch, but with his too restricted application of that concept to the material world.

In his application of these ideas, Driesch proceeds to show that there must be a non-spatial cause of a spatial configuration of elements within the organism by a process of elimination. Having decided against the normal operation of any matter-creating or motion-creating causality on the basis of the principles of the conservation of matter and of the conservation of energy, Driesch proceeds to show by a series of three argu-

ments that what he calls "singular causality," i.e. the influence of one material system upon another, does not account for phenomena observable in living things.

First, no mechanical cause, either physical or chemical, can account for the element of purposefulness exhibited in an organism when divided as an embryo. Thus a quarter of the embryo of the sea-urchin, separated artificially, developed normally although on a small scale. Obviously then the parts of this embryo are not determined by their nature to produce any one determinate part of the fully developed organism, because a part that develops into one part in the case of the undivided embryo develops into another in the case of the divided one. Nor can it be accounted for on the basis of external causes, most of which are non-directional and the rest of which are known to have no specifying influence in certain kinds of embryonic development. Nor can there be any structural forces, internal to the organism but external to the parts, accountable for the differentiation between what becomes of the part in one case and what happens to it in another. If this structure were purely physical, it would be destroyed by the division; if chemical, its results would be geometrically regular like a crystal, and all parts having a similar composition would be alike in structure. No spatial system, therefore, is capable of accounting for the structure of the adult organism, hence there must be a non-spatial cause.⁹

9. Driesch, Science and Philosophy of the Organism, pp. 88-106.

Second, in a similar way the "complex-equipotential" system of the ovary is made up of numerous cells, all descended from the same parent cell or "Anlage." Moreover, each one of these cells has basically the same potentiality as all of the others, and the same potentiality as the Anlage itself--the power of developing into a complete organism. If, then, the living organism is a machine, it follows that the Anlage and its daughter cells are machines too, and if this is true, then the consequence is that a machine can be divided indefinitely and still retain its nature as the same machine, an obvious impossibility. The only alternative is a non-spatial cause different from the spatial system itself.¹⁰

Third, an analysis of stimulus-response reactions in the learned (as opposed to instinctive) actions of animals also reveals the difference between the animal and a machine. Even if the examination is carried on from a behavioristic standpoint, it remains true that the learned reactions to stimuli differ from modifications in the behavior of machines due to past stimuli (e.g. in a phonograph) in the following particulars: that the reaction of the machine thereafter is fixed and identical with the stimulus that set up the new behavior pattern, whereas the changed reaction of the animal is not necessarily identical with the stimulus that set up the pattern but is governed by a specific end of the animals' behavior, and at any rate the nature of the response is entirely different from that of the stimulus. Moreover the animal responds to the stimulus as a

10. Ibid., pp. 147-150.

meaningful whole, whereas the reaction of the machine varies in exact accordance with the variation of the parts of the stimulus. Thus it is obvious that these learned actions of animals differ essentially from anything that is produced by a spatially organized system, (a machine), and must, by elimination be caused by a non-spatial cause.¹¹

Insofar as a scientific proof of the differing natures of the living and the non-living is possible, Driesch's work is certainly such a proof. However no proof of the nature of a thing can be based entirely upon experimental science alone, inasmuch as these sciences deal with the inter-connections of the observable. If therefore, a really apodictic proof of the non-mechanical nature of the organism is to be achieved, it seems to me that it depends upon a philosophical analysis of the machine, an analysis that will reveal some facet of mechanical operation that is completely incompatible with the behavior of living things.¹² Obviously Driesch tries to perform just some such analysis. Furthermore, if we are speaking of a purely physical machine, i.e. one in which the differentiation between the parts is solely a differentiation of position and shape, then it seems quite clear that Driesch succeeds in his analysis, for it is just such an organization, e.g. in a printing press, that cannot be divided without being destroyed. However, if the organization under discussion be an organization of chemical

11. Ibid., pp. 202-214.

12. cf. supra, Section II, Chapter I, p. 140.

substance, Driesch's case is not quite so clear. The difference between the chemical and the physical machine is this: that a shape, when it is divided is no longer the same shape, but a chemical substance can be divided into extremely small parts without altering its nature or its basic activities. In short, a division of the extension of a thing certainly changes the extension, but it does not necessarily change anything else. Supposing, therefore, a polar chemical organization within a living cell, it is conceivable that very many divisions could take place along a certain axis without destroying the basic organization, and consequently without destroying the chemical machine. In this case, therefore, Driesch supplies the lack of intelligible necessity, with certain observable consequences of chemical organization within inanimate things, viz. that chemical organizations always have a regular, geometrical form, as in crystals, and that parts with chemically identical natures should have the same shape. Now both of these consequences may seem highly probable to us, and indeed it may be that in nature they are absolutely necessary, but their necessity is by no means obvious to us. Indeed, in the second case, since the varying physical structures of the organism are presumably produced by the interaction of various chemicals within our presumed machine, varying interactions would tend to produce differing structures, even though the basic chemical substance out of which the structures were formed were the same. In any case, these observed differences may be enough to force Driesch to conclude that the organism differs from the physical and chemical machines found in inanimate

nature, but it is not enough to show that they are and must be essentially different. An indication it may be, even a proof to the degree that scientific proof of this problem is possible, but since certain of the impossibilities found by Driesch as resulting from the supposition that the organism is a machine are merely statements that spatial systems do not produce such results, and not really demonstrations that they cannot, the certainty produced by this proof is not of a philosophical level.

Pretty much the same thing could be said of Driesch's third proof for the existence of an entelechy. It is quite obvious that the behavior of animals in response to external stimuli differs considerably from anything found in the non-living world. It is equally clear that Driesch has with considerable skill selected and pointed out some of the differences observable between the two classes. Unfortunately it is not equally obvious, at least not from Driesch's analysis, that the differences discussed by Driesch are of an essential nature. They are simply disparities of operation that do, de facto, exist between mechanical and living beings. I do not say that a case could not be made out that some of the differences mentioned by Driesch really are essential; I think that this is particularly quite possible in the case of the response on the part of the animal organism to the wholeness of the stimulus. What I do say is that Driesch, unhappily, does not carry the proof through. The point of the reaction to the wholeness of the stimulus on the part of the organism is that from a purely mechanical point of view, or from any material standpoint at all for that matter,

this wholeness does not even exist; the unity, e.g. of a sign, is a meaningful unity and can only exist on an intentional level. What Driesch succeeds in proving, therefore, is that animals act by means of knowledge, a conclusion that is so obvious that even many materialists, like Haldane, admit its validity.¹³ What Driesch needs to do, therefore, is to show that knowledge can in no way be considered a mechanical or a non-vital action. However, Driesch himself makes this approach impossible by what seems to be a purely gratuitous assumption of the behavioristic methodology.¹⁴ It must seem slightly inconsistent to a Behaviorist that Driesch brings into evidence a conscious unity while throwing out consciousness. In short, Driesch is once again working on the periphery of a truly apodictic proof, and is working with what are really essential differences in behavior without showing clearly that the disparity is really specific. Once again, therefore, we might say that Driesch really proves his point, but that the proof as it stands is lacking in certainty.

In a way, Driesch's proofs for the existence of the entelechy, as well as his rather mechanistic view of the nature of material reality, are responsible for the development of his views concerning the nature of the relation of entelechy to material organism and the nature of the entelechy itself. Of

13. J.B.S. Haldane, Marxist Philosophy and the Sciences, pp. 153-154.

14. As we noticed in the exposition of this argument in Section I, Chapter 2, Driesch is not himself able to resist the temptation of explaining how we are able to understand the behavioristic proof by smuggling in a little introspective psychology. cf. his Science and Philosophy of the Organism, p. 204.

these conclusions, the most important are those having to do with the nature of the entelechy considered in itself.

First of these conclusions is the unextended character of the entelechy. This follows from the fact that a division of the organism does not destroy the wholeness of the entelechy, as such a division would do if it were extended.¹⁵

Second, the entelechy is not dependent for its existence upon any body. This Driesch proves indirectly by a reductio ad absurdum. If the entelechy did not exist independently, then the body would be the cause of the entelechy, and this would in turn involve three results contrary to fact and reason:

a.) The entelechy would be itself extended and hence divisible. But we have seen that this is not true.¹⁶

b.) There would have to be a kind of "living substance" to bear the entelechy. But the "living substance" turns out to be simply a mixture of highly complex but quite obviously inanimate chemicals.¹⁷

c.) The entelechy, as the result of a material thing, would be material and subject to alteration by material forces. This, however, is not true.¹⁸

Pretty much the same objections are valid if we consider the entelechy as the result of a constellation of elements--at any rate the first and third impossibilities still hold.

15. Ibid., p. 293

16. Ibid., p. 293

17. Ibid., p. 293

18. Ibid., p. 293.

As against the Aristotelian position that there must be some sort of activity independent of matter before an existence independent of matter can be postulated, Driesch objects that this principle is not universally true. For instance, the architect does not depend for his existence upon bricks, though he could not act if it were not for the existence of these same bricks.¹⁹

Third, the entelechy is an "intensive manifold" since it produces a spatially complex result without being extended itself.²⁰

Fourth, it is not "located" in any one part of the body. This is once again the result of its lack of extension.²¹

Fifth, Driesch embraces a somewhat neo-Platonic view of the unity of the entelechy. The impossibility of dividing the entelechy when the organism reproduces, and the obvious fact of unity within the universe lead Driesch toward an assertion of a sort of world entelechy--a super-personal source of unity for the universe. On the other hand, the multiplicity of organisms, and the multiplicity of levels of functions even within one and the same organism coax an admission of a multiplicity of modes within this unified entelechy.²²

It takes Driesch the whole of a two-volume work to establish his proofs of these points, and it seems a little presumptuous to pass judgment upon his conclusions on the basis of a

19. Ibid., p. 296.

20. Ibid., pp. 245-247

21. Ibid., p. 299.

22. Ibid., pp. 331-332

brief discussion. I would like, so far as is possible, to limit my comments to the second point, the independence of the entelechy.

One point that immediately strikes us in connection with Driesch's discussion on this subject is a peculiarity in Driesch's idea of substance. His speaking of the impossibility of buying lion-substance, as distinct from the composite that is lion-meat, in the market place manifests an underlying supposition that the unified substance must be qualitatively homogeneous. Within a particular philosophic system, such an assumption might be consistent, e.g. within the mechanistic system where qualities are regarded as functions of extension. To make this assumption even within that system, however, is to assume that we know the nature of the substance before we know the nature of its effects, a supposition that is contrary to all of our experience. The one thing that can be reasoned to with certainty concerning substance is that it exists in itself, and if our preceding analysis was correct, the one substance of which we have a direct experience, the Ego, is not homogeneous in either its spatial or its temporal extension.²³ A philosophy that makes any such presuppositions about the nature of reality does not wait for the evidence of the facts to decide whether or not there is any difference in the organism considered as a body and the corporeal substances of the inanimate world; the question is pre-judged in the principle. For either a substance is homogeneous and thus quite dead, or else the organized body is not a substance and can be only a

23. cf. supra, Section II, chapter 3, pp. 176 ff.

machine. The question in that case is not, "Is or is not this organism a machine?" but, "Where did this organic machine come from?" And even this question presents an already settled pair of alternatives, for the ontological emptiness of the machine as such is bound eventually to drive causal explanations of such systems back to some non-spatial cause. The same relentless logic that so often drives a basically mechanical philosophy into idealism is operative here too.

In a way the same basic supposition is visible in Driesch's arguments that if the entelechy were dependent for its existence upon the body, it would be material and extended, a result that is impossible on the basis of his experiments. Here the immediate difficulty seems to be in a univocal use of the terms "material" and "extended," as being synonyms for the word "body." Hence when Driesch says the entelechy cannot be material or extended, what he means is that the entelechy cannot be a body like the body it produces. It is not perfectly obvious that we should use the words only in that restricted sense. We might easily refer to the art of a painter as being a material, extended art, not only insofar as the painter is an extended thing, but insofar as the exercise of the skill involves the use of several spatially separated parts of the body. It would be ridiculous, however, to talk of the skill itself as a body that inhabits the body of the painter, or to say that when we guillotine the painter we chop off a piece of his art at the same time. The art is material and extended because it depends upon the existence of a material man, but not because it is a body of determined size

and shape itself. Similarly the art is divided when it is possessed by several painters, although there is no way of drawing a diagram of how the art is to be cut up when it is apportioned among the many artists. The art in this case would be said by Aristotle to be material and extended and divisible accidentally, as opposed to the body of the painter which is said to have these characteristics by its very nature.²⁴

Such an alternative seems not even to have occurred to Driesch, and it is worth while seeing why. The argument he gives is that an effect produced by the body must be of the same nature as the body, hence material, extended, divisible in precisely the same way as the body is itself. Clearly it is true of the efficient cause that it cannot produce a being of a higher order than itself, and it seems to be this fact that leads Driesch astray. For as we have already seen, Driesch in his preliminary treatment of causality analyzes only extrinsic causality. Consequently the sort of accidental materiality that might arise in a being from dependence upon a cause that remains in the effect (in this case, from a material cause) could not possibly occur to Driesch in view of his somewhat truncated view of causality. And this abbreviated outlook on the possibilities of dependence in existence might be traced (although, of course, Driesch himself does not trace the thought through these channels) to his mechanistic basic outlook, an outlook that begins by searching for being and action in something outside the being and agent.

24. Aristotle, Physics, II, ch. 3, 195 a 34-36.

Digressing a moment from the nature of the entelechy as it is related to individual entelechies, we can notice a similar bias arising in Driesch's opinion concerning the universal entelechy. In some fashion this affirmation of a universal entelechy is merely a recognition of the fact that the presence of unity and determinate action in a world marked by potentiality and imperfection demands the presence of an efficient cause, actual and perfect, distinct from the corporeal world. But Driesch carries the argument to the point of identifying the unity of the physical universe with that of the immaterial cause, of reducing the actions of material beings to the actions of the entelechy. In this way, Driesch robs the whole material world of any claim to agency, to intelligibility, and eventually to being.²⁵ At least we might say that Driesch so pilfers reality from the corporeal universe in his conclusions, were it not for the fact that the mechanistic approximation adopted for practical purposes by the physical scientist assumes, when used as a practical philosophical principle, the ontal vacuity of matter at the level of the first principle of thought.

To return to our discussion of the entelechy of the organism, we have seen that Driesch's argument is a negative one that suffers from the fact that it overlooks one of the possible alternatives; however the question still arises as to whether or not the conclusion is correct, even if the argument is

25. This fact is even recognized by some of Driesch's fellow vitalists. cf. J. Arthur Thomson, The System of Animate Nature, (N.Y.: Henry Holt, 1924) p. 170.

not totally adequate to establish that correctness. We have discussed in another chapter the Aristotelian position that the existential status of a being is reflected in its operational independence; a renewal of that discussion here would be superfluous.²⁶ Actually the truth of this principle is based upon a state of affairs recognized by Driesch himself; the fact that whatever is in the cause can be reflected in its effect, but that nothing else besides what is actually present in the cause can appear in the effect. The principle does not claim that every action of an independently existing being will be independent, but simply that some of them are, and that it is by means of the independent acts that we can know about the independent existence. In Driesch's own example of the architect whose activity depends on bricks, but whose existence does not, it is quite clear that the architect is a complex-being who has certain activities that have nothing whatever to do with bricks, and even has certain activities as an architect that do not involve the actual, as opposed to the intentional, existence of bricks. If it were not for the existence on either the intentional or actual level of some sort of building materials, the existence of the architect qua architect is impossible. Furthermore, the only way the Driesch knows that the architect goes on existing with or without bricks is that the man goes on acting with or without them.

Applied to the problem of the organism, this principle insists that not merely the effect but the operation by which

26. cf. supra, Section II, Chapter 3, p. 182, note 11.

the effect is produced is material, insofar as the operation involves the transportation and qualitative change in food and the spatial disposition of the qualitatively differing parts. There is simply no activity in the case of most living things that bears witness to an independent existence of an entelechy different from the organism itself.

It is possible to make out a case for the immateriality of thought as an operation,²⁷ although it is not within the compass of the present treatment to do so. On this supposition, however, Aristotle points out that the soul that possesses such an activity is separable in existence from the body. Even on this basis, it is simply impossible to account for men as spiritual beings that happen to be related to a body as its efficient cause. Even if it were not for the fact that certain operations that belong to the ego are operations that involve the body (i.e. the sensitive powers), it would still be the case that the union between an independently existing soul and its machinelike body would be contrary to the proper order of being.²⁸

"This position," says Thomas Aquinas, "is untenable.... Inasmuch as the human soul has an operation transcending the material order its act of existing transcends the body and does not depend on the body. But inasmuch as the soul is naturally capable of acquiring immaterial knowledge from material things, evidently its species can be complete only when it is united to a body. For a thing's species is complete only if it has the things necessary for the proper operation of its species."

St. Thomas explains this necessity of the body for the sake of knowledge more fully in another passage dealing with

28. St. Thomas Aquinas, De Anima, art. 1, trans. by Dr. Rowan.

the Platonic theory of knowledge:²⁹

"Now according to this theory, it appears that no explanation can be offered as to why the soul is united to the body. For (if the body does not contribute to the knowledge of the soul) this union is not for the sake of the soul, because the soul when it is not united to the body can still exercise its own proper operation, whereas its proper operation is impeded by its union with the body. Similarly, according to this view, it cannot be argued that the union of soul and body exists for the sake of the body, for the soul does not exist for the sake of the body, but rather the body for the soul, because the soul is nobler than the body."

The question of the living substance, therefore, eventually depends upon the being that is the final end of the agent's action, in the sense of that for the benefit of which the agent acts, since that end is the agent itself. In the case of those living things that manifest the vegetative and sensitive operations only, the beneficiary is obviously the organism as a material being. In the supposition that the immaterial mind has an end that is not the end of a material thing, the "entelechy" or soul of an intelligent being could be considered as an independent agent, but de facto in the case of the material intelligent beings of our experience, i.e. human beings, it is necessary for them to operate as material beings in order to attain the immaterial end that is the completion of their nature.

Nevertheless, it remains true that if there is any validity in the arguments for an entelechy or soul distinct from the spatial arrangement of parts within the material organism, that life principle is the actuality in virtue of which the organism is able to act. In this sense, then, the entelechy is

29. Ibid., art. 15.

The efficient cause of the living operations, and is even the efficient cause of the developed organism itself, insofar as the mature body is the result of those vital activities. There is not, therefore, so much a question of disagreeing with Driesch, at least with regard to the positive results he has come to, as there is a problem of seeing how he could have arrived at those results without seeing that the further implications of the scientific approach itself point in the direction of the Aristotelian solution. The biological science sets out to study the nature of the organism as a given fact in the material world; Driesch's vitalism in the long run abdicates this task in favor of studying the activities of a being of another order entirely. Yet it seems to me that it is perhaps the fault of the science itself that this result comes about, for by dealing with the activities of the organism on a phenomenal level and only in their interconnections with other phenomena, by explaining those operations in terms of causes that are extrinsic and not intrinsic, the biological science, like all its experimental brothers, tends to breed a philosophic forgetfulness that there is more than one type of dependence, and that a causal interaction may be mutual rather than simply one-sided.

SECTION III

CHAPTER II

AN EVALUATION OF THE MATERIALISTIC LIFE THEORY OF J. B. S. HALDANE

It is one of the favorite theses of mechanistic theorists concerning the nature of life that the reason the vitalistic interpretations of life arose in the first place was the lack of knowledge of machines. The mechanical age is the modern age, and it was not until shortly before the time of Descartes that such devices had reached a sufficient degree of perfection to exhibit any resemblance to a living being.¹ Perhaps a little more profound explanation of the reason for the comparatively modern trend to mechanistic explanations of life lies in the relative novelty of the emphasis on mathematical explanations in natural science--an emphasis that by its very nature tends to produce mechanistic rather than non-mechanistic views of reality. Whatever the explanation, it is important for us to examine the pre-suppositions and contributions of the mechanistic view of the nature of life to discover whether or not this outlook does add some new dimension to the problem that was not accounted for by the earlier animistic or vitalistic analyses, whether or not it

1. cf. J. B. S. Haldane, "What is Life?" in Adventures of a Biologist, p. 50.

raises some difficulty insoluble on other grounds or perhaps offers a solution more simple and more satisfying than any others.

The principal vehicle here chosen for this discussion is a re-evaluation of the materialistic position taken by J.B.S. Haldane. In large measure, Haldane's arguments for his position are representative of those used by all theorists propounding a specific sameness between the world of the living and the world of the non-living. However, as we pointed out in our earlier treatment of Haldane's theory, the results of Haldane's analysis show certain atypical features. For this reason, in order to give as complete an understanding of the value of mechanism as a whole in dealing with the problems of life, it will from time to time be necessary to deal with aspects of mechanistic theory that are neglected or even frowned upon by Haldane himself.

Moreover, I do not intend to undertake a point by point evaluation of each of the arguments advanced by mechanists. Many such arguments differ merely in the factual matter to which they apply a uniform interpretation, and since it is the interpretation rather than the facts that is in question here, individual examination of each argument would be needlessly repetitious. For this reason, the arguments of the mechanists will be grouped under a few main headings which will then be evaluated as a whole. First, then, we will treat of the philosophic presuppositions common to mechanistic systems as a whole, with special attention to the particular brand of Materialism espoused by Haldane. Next we will discuss the insights given by Mechanism into the solution of the problem of the nature of life.

In an absolutely pure form, mechanism or atomism has very seldom appeared on the philosophical horizon. The common elements of all philosophic mechanisms is the emphasis upon quantity as the principal attribute of matter. The qualities that we perceive in material things are ordinarily de-emphasized, their number reduced to an absolute minimum, and the vast majority of them regarded as subjectively differing interpretations of what is objectively one. The uttermost limit of this tendency is reached in the absolute denial to matter of any qualitative attributes at all. Such, for example, is the mechanistic view of matter taken by Descartes--the essence of matter is extension, wherefore the only difference between one material substance and another is a difference in shape, and the only kind of material change is locomotion.²

At least in its extreme form, such an analysis of the material world is entirely unsatisfactory, and for this reason the mechanical view of the world has long since ceased to exercise any philosophical fascination. The principal objection to such a pure mechanism is that it actually removes from matter any possibility of any proper activity. To remove the qualitative attributes from matter, as Geulincx and Malebranche clearly saw, is to remove from them any sort of causal efficacy; extensions alone cannot react on each other unless in virtue of some mutual resistance, temperature, cohesiveness, or some other characteristic;

2. René Descartes, Les Principes de la Philosophie, in Oeuvres de Descartes, (Paris: J. Gilbert, 1950), Pars I, n. 53, and Pars IV, n. 198. pp. 119 and 398-400.

a triangle is invisible unless there exists some material mode that corresponds to color, intangible unless there is some hardness or heat in its makeup. In short, a really consistent mechanism reduces material reality to a machine, and in a machine, as we saw in the second section of this work, the principle of motion and rest is entirely extrinsic. And because being and causality are correlative activities, the denial of causal efficacy is at the same time the denial of existence. It was the realization of this very patent corollary that constituted the original insight characteristic of Berkeley's idealism: if extended reality does not operate, there is no particular reason for believing that it exists either.³

In spite of these shortcomings, the mechanical view of nature has certain advantages from a practical point of view, advantages that are reflected in the continuing mechanistic presumptions underlying modern scientific practice. There is a certain truth to the Newtonian complaint that the qualities in terms of which the Aristotelian explanation of material events is given are "occult."⁴ It is a matter of experience that any sort of science of the reasoned fact (propter quid) in terms of the substantial forms of material beings is possible only on the most widely generalized basis--the specific natures of material things remain hidden from our eyes, intellectually speaking, although we may be able to analyze them generically. If any

3. Etienne Gilson, The Unity of Philosophical Experience, pp. 187-206.

4. Isaac Newton, Principia Mathematica, p. xvii.

understanding of the facts proper to the species of material things is to be acquired, this can only be through another approach. Though the substantial nature of mobile beings may be mysterious as being deeply immersed in matter, the quantitative aspect, which is also basic for the existence of material qualities, is the subject of a science that from the human point of view possesses the highest degree of intelligibility, i.e. mathematics. A science not only can be but has been constructed that permits the deduction of certain qualitative aspects of material species on the basis of mathematical, i.e. mechanical, study. Ultimately, for the reasons given above, such a treatment must fail in giving complete understanding since it treats only of causes extrinsic to the substantial nature itself, but from both a theoretical and a practical standpoint, this mechanical approach is the most satisfactory one available for the analysis of the particular factual material with which it deals.⁵

It is precisely because the basic truth perceived by mechanism, viz. the truth that every qualitative change depends upon and accompanies a quantitative one, is the truth at the basis of the success of modern experimental science that modern philosophy continues to hold to variations of the mechanical hypothesis, variations designed to supply the shortcomings of the theory in its pure form. One of the results of this compromising process has been a sort of atomistic dualism, a charac-

5. cf. Maritain, Degrés d' Savoir, pp. 83-91

teristic representative of which is the Dialectical Materialism espoused by Haldane.

These apparently radically opposed theories are thus closely related in the fact that they proceed from a common way of looking at the world. The differences between the Mechanistic and the Dynamistic view of the world include not only their divergency on the matter of the existence of activities, but an equally basic disagreement on the question of the existence of substance; Mechanism affirms such an existence, whereas Dynamism denies it. If substance is understood in the inert and changeless sense understood by the Mechanists, it is easy to comprehend why the Dynamist feels compelled to deny its existence. Actually, however, the difficulty faced today by these two schools is one that they have in common, and one, for that matter, that they share with the earliest proponents of their views, the Eleatics and the Heracliteans. The problem is how to stuff a diverse and analogical reality into a univocal concept of being--in the case of the moderns into the ens quantum characteristically studied on the second degree of abstraction--and into an analysis in terms of one uniform scientific method--presently the mathematical method. In the present day dispute the divergency of opinion results from an attempt to analyze substance in terms of its quantitative modification, to understand being in itself as though it were being in another. The result is a perfectly legitimate science as long as it abjures all philosophical pretensions, but when an attempt is made to transfer the results, as is, to the philosophic sphere, the inadequacy of the method

as a philosophic mode of procedure becomes clear in the opposing tendencies mentioned above. Approaching substantial change from the point of view of the science of the immobile, the philosophic result is a denial of substantial change, in one case by affirming substance but denying change, in the other by affirming change at the expense of substance.⁶

Without going into a detailed refutation of the dialectical materialism professed by Haldane, we can easily understand how the philosophical position at its basis came into being. Admittedly, the philosophic side of Marxism results from the attempt to gather all human knowledge under the scientific method proper to physics.⁷ In the case of the Marxian philosophy, the motive for this straight-jacketing of reality within a single methodology seems to lie in the practical applicability of the method, an applicability that has led some observers to classify experimental physics as an art rather than as a science,⁸ an applicability that is regarded by some of the outstanding apologists of modern science as its chief characteristic, e.g. by Comte in his famous "Savoir pour prévoir afin de pouvoir." Thus, whether or not we can accuse the experimental sciences as a whole of being art, it is obvious that in the Marxist understanding of them they can be

6. Maritain, Philosophy of Nature, (N.Y.: Philosophical Library, 1951) pp. 41-44.

7. J.B.S. Haldane, Marxist Philosophy and the Sciences, p. 5.

8. cf. Vincent Smith, Philosophical Physics, pp. 162-169.

so characterized.⁹ This fact has important consequences in the rest of the theory.

The result of the scientific logic, based as it is upon mathematical method, to the whole of reality is a monistic and phenomenological understanding of reality. Since the method is by its very nature adequate for the understanding of the category of quantity alone--and of quantity as it exists in the imagination at that--the assumption that the method can be imposed as the only valid one upon the whole range of human knowledge involves from the very beginning that the whole of reality can somehow be reduced to that category. What Haldane means when he claims that monism is superior to dualism as a practical program for research is precisely that dualism does not demand the explanation in terms of this single formal causal factor that is demanded by a monistic philosophy.¹⁰ As we have seen, the complaint is not entirely without justification, inasmuch as specific explanations in terms of a philosophic dualism of any sort are impossible in view of the obscurity of the beings involved; it is only on the most general level that this sort of exposition aids understanding. Ultimately, however, in terms of intelligibility, the mathematical or scientific type of explanation is really no improvement over the philosophic, even

9. J.B.S. Haldane, The Causes of Evolution, p. 155. "For a scientific man, a philosophy is a program rather than a creed."

10. Ibid., p. 155. "Over against these stand various pluralistic systems which hold that the distinction between different minds, or between mind and matter is irreducible. My objection to them is just that they proclaim certain problems to be insoluble merely because three thousand years of thought by a few members of a species which may have many thousand million years ahead of it has not yet solved them."

on the level of specific nature; scientific reasoning from the very beginning has abjured the task of understanding motion since it deals with this activity by means of the methodology of the completely inert. It is perhaps a paradox, but not an obscure one that the scientific method which began by denouncing the mystery of qualitative and substantial forms and by seeking to replace them with explanations in terms of more clearly understood extrinsic causes has ended in its later philosophic manifestations by denying even the possibility of extrinsic causes and by making a public renunciation of any aspirations to understanding anything at all. Because, as we have seen, the later philosophy of science has found it necessary to reject the inert Cartesian substance, it has aspired, at any rate, to confine its attentions to the phenomena and their inter-connections.¹¹ Using the same basic assumption, therefore, that the human reason, conceived as operating on the mathematical level of abstraction, is capable of knowing whatever we will ever know, the seventeenth century Rationalists and the modern scientific philosopher have ended in contrary positions in the epistemological dilemma concerning the power of the human mind; Descartes and Spinoza had a great vision of the mind as achieving an exhaustive knowledge of the whole of reality, the modern has come to the point of insisting that the only thing certain is the method itself of gaining knowledge, but never its content.¹² There is really no

11. Maritain, Philosophy of Nature, p. 47.

12. V. Smith, Philosophical Physics, pp. 159-160

great mystery about this evolution in philosophic outlook. Long ago old Parmenides settled the point that the explanation of motion could not take place on a monistic basis. Committed to a single causal factor by their method, therefore, those who regard empirical science as a philosophy can only save their monistic preconceptions and the reality of motion by throwing out being and intelligibility altogether.

Under these conditions, the monist has a choice of two possible alternatives: he can try to restore a semblance of intelligibility to the change of the material world by identifying it with the evolution of mind, which is the seat of intelligibility, or else he can abandon the whole of the intelligibility and identify even the mind with material becoming. The first alternative is doomed from the start, at any rate if its purpose is to render the basically irrational understandable, for all that this alternative accomplishes is to remove the basic impossibility of the explanation of motion from the material world and place it in the mind. If development without cause is senseless in the extra-mental world, it is no more understandable in the mental, and the total result of the attempt is simply to make the reason the very locus of the unreasonable. I think that it is precisely this failure of Idealism, at least of Hegelian Idealism, that led Marx and his followers to despair of the mind as a speculative instrument, and led them to think of it as a practical faculty that is subsequent to something else and meaningful only in relation to something else. At least

this position has a slight advantage in consistency, if scarcely in logic, over the idealistic version of monistic evolutionism. It is questionable whether the resulting set of opinions can adequately be called a philosophy, (although this objection may be only a personal prejudice). But philosophy or not, the set of opinions comprised under the head of the Marxist philosophy, or any other evolutionary materialism for that matter, has the advantage of rendering itself completely immune from criticism on its own ground by flatly denying the validity of the reason that is the only conceivable means of assessing its value.

This denial of reason takes the form in Marxism, as in other similar philosophies from the time of Heraclitus, in a denial of the principle of non-contradiction, that is in the affirmation of contradictories of the same subject. Of course, every philosopher must realize that change involves opposites, but the attempt to cram a multiple reality into the straight-jacket of a monistic system involves a refusal to subject the opposition of change to any sort of meaningful analysis. If everything is identified in the unity of matter, then the opposites are not only unified, they are identical.¹³ Since rational logic is based upon the impossibility of any such identity, then, Dialectical Materialism is able to dispense with this instrument and to replace it by a purely historical description of progress through opposites.

13. J.B.S. Haldane, "The Marxist Philosophy," in Adventures of a Biologist, p. 261. "I do not think that there is any choice between denying the reality of matter and admitting the unity of opposites."

Now it is possible to show, as Aristotle showed over two thousand years ago, that any position that attacks the basic principle of thought is self-destructive. It is possible to show that anyone upholding such an opinion is by that very fact destroying his own claim to be more nearly correct than his opponent, and that, as opposites are true, any statement that they make is meaningless, since it might just as well be expressed by the contrary expression. Of course, Haldane and the other Marxists attempt a retreat from the absolute denial of the principle of non-contradiction by appealing to the ultimate resolution of all contradictions in the infinity of matter, and to a corresponding infinite truth which can be approached, though never attained, and is sufficient to guarantee the greater relative truths of one set of doctrines over another.¹⁴ This retreat, however, plausible as it may sound, must eventually fall back upon the irrationality that is at the root of the whole system, for any attempt to analyze the sense in which the matter of the world is said to be infinite would show either that the opposites so contained in infinity (i.e. in an absolute, actual infinity) cannot make an appearance except in a limiting principle diverse from the infinite,¹⁵ or that a purely potential infinity (the sense in which an infinite becoming would really have to be infinite) would be homogeneous chaos without a diverse principle to make the opposition actual.¹⁶

14. Ibid., p. 230

15. Aristotle, Physics, I, ch. 6, 189 a 29-33.

16. cf. Section II, Chapter 2, p171.

The Marxist philosophy, vulnerable as it is on the score of its denial of the basic principle of thought, does not need refutation so much as it needs understanding. Haldane claims, as we have seen, that Marxism is the logical outcome of the universal application of the method of empiriological sciences to the whole realm of human knowledge. Historically, therefore, Marxism depends upon the assumption that the whole of diverse reality can be adequately comprehended by a method commensurate with one particular aspect of reality. Instead of allowing science to be flexible and responsive to the demands of a seemingly multiple reality, marxism attempts to encompass this reality within a sort of scientific corset which distorts reality when too much of the world is stuffed within its narrow bounds. Once this entirely a priori and unwarranted assumption is understood, the whole of the Marxist philosophy--its practical aim, its dialectical and anti-rational logic, its evolutionary character, and its monistic materialism--becomes clear. Haldane reveals this methodological prejudice in his argument against pluralistic systems. It is not really in terms of an explanation, but in terms of a specific kind of explanation that Haldane calls pluralism lacking.

As for the particular arguments by which Haldane attempts to defend his choice of the materialistic as opposed to the idealistic variety of monism, none of them seem to mean much in the absence of the epistemological suppositions seen above. The question of the physiological explanations of consciousness we will take up later in the chapter. As for the argument that

matter must have preceded mind because the fossil record establishes this priority, it is a little difficult to see how the fossil record could contain any record of the remains of a mind that preceded the body. This is simply a variation of the cheap ancient argument against the human soul that no surgeon had ever discovered it in dissecting the body.

In discussing the specific problem of the nature of the living organism, the community of outlook induced by dependence upon a unified method is obvious between the modern Dynamistic descendant and its seventeenth-century mechanistic ancestor. Thus, although there are the differences in detail we might expect between Haldane and the earlier proponents of the specific sameness between living and non-living, they exhibit a remarkable sameness in underlying conception and plan of argumentation. As a matter of fact, if we but substitute some modern scientific terms for those of Greek physical theory, e.g. enzyme for fire or heliotropism for the theory of absolute natural place, we can recognize most of the modern arguments in the De Anima. Most of the arguments, ancient or present-day, are mentioned at least in passing by Haldane, so we will use his arguments as the principal focus of our discussion of the value of the anti-vitalistic theories of life. Furthermore, it will be convenient to treat these arguments from the viewpoint of their bearing upon the unity of the organism and upon the exteriority or interiority of the mover.

The arguments for the substantial multiplicity of the organism may be summarized under the following headings:

1. There is obviously some diversity about the organism. As a matter of fact there is nowhere found in nature a homogeneous living substance distinct in its chemical or physical characteristics from the substances found in inanimate nature. Thus as Driesch points out¹⁷ there is no determinate moment when you can say that digested food becomes "alive."

2. These qualitatively different parts show a remarkable independence of action. When separated from the organism, they continue to turn out the same products that they do within the organism, although perhaps not with the same degree of efficiency, nor, in many instances, for any protracted period of time. Not all such substances have been isolated but there is no reason to suppose that any substance within the organism performs a function that it does not or might not perform outside its organic environment. Under the circumstances no one of the constituents out of which the organism is made can be said to be alive in or out of the organism itself, since it performs basically the same activities under both circumstances.¹⁸

3. Arguing in the same fashion, we can point out that the multicellular organisms are composed of smaller organisms, i.e. cells, that live their own lives and under proper conditions can continue to do so after the death of the larger organism. This is true, for instance, of the chicken heart that was kept alive and continued to function long after the death of

17. Driesch, Science and Philosophy of the Organism, p. 291.

18. J.B.S. Haldane, "What is Life?" in Adventures of a Biologist, p. 66.

the chicken. Hence the major organism, at least, is simply the functional total of activities that are performed primarily on a cellular level.¹⁹

4. Similarly evidence is adduced to prove that the unity of consciousness, so often brought forth as a proof for the unity of the organism, is actually reducible to meristic elements. The proof adduced by Haldane for this fact are the gradual deterioration consciousness due to the disorganization of the brain at death or under brain surgery. As a matter of fact, Haldane compares thought to a symphony orchestra made up of an astronomical number of instruments. The compositions played by the orchestra, like consciousness, possess a unity, and the absence of one or two violins among a multitude would make little or no difference. Nevertheless, the unified musical opus is made up of a number of distinct sounds produced by distinct instruments, and the result is that the removal of the entire violin section has a noticeable effect upon the unity of the symphony, just as the death of a major section of the brain affects the consciousness.²⁰

In the system of mechanism advocated during the seventeenth century, the explanation given of this set of facts (with the exception of the last) was that the body was made up of a multitude of substances which functioned together with the kind of unity characteristic of a printing press. On the basis of this theory, it should be possible to predict in some detail the

19. J.B.S. Haldane, "What is Death?" in Adventures of a Biologist, p. 66.

20. Ibid., pp. 67-68.

behavior of such a system through a mathematical deduction. The total failure of science to carry out such predictions in any detail on the organic level, and even, for that matter, on the chemical level, has led to various systems of holism, e.g. the Emergent Evolution of Morgan, and the currently popular Gestalt school in psychology. These theories admit the appearance in composites of characteristics, especially of unity, that have no adequate explanation in the parts out of which the whole is constituted. The basic principle of knowledge in these schools is that "The whole is greater than the sum of its parts." Unfortunately these specifically modern types of holism assume with mechanism that an explanation in terms of parts is the only type of explanation possible, and so, ordinarily, they regard the appearance of novelty as a more or less irrational element, the existence of which science must recognize as an inexplicable datum.

Haldane accepts the appearance of such novelties, and of unity, as a fact because as a Marxist he is committed to an evolutionary theory of becoming, and also, of course, in obedience to the facts of reality. He is not completely committed to the irrationalism of the Emergent Evolutionists, however, for while he admits the appearance of qualitative characteristics in the composite that do not appear in the parts, he usually insists, as a scientist, upon the fact that these qualities must in some fashion be already present in the parts. He does not then find it necessary to account intelligibly for the co-existence of this quality of the composite with its opposite quality, the one that actually appears in the part--in this respect he can fall back

upon the basic irrationalism of the Marxist philosophy that proclaims the unity of opposites as the fundamental constituent of reality. Although, as I say, Haldane ordinarily insists upon pushing this irrationality back as far as the part, he does not seem to try to account for the supra-functional unity of the organism on the basis of its parts. While the operative oneness of living beings can be accounted for on the basis of the parts, the individuality of the organism must be attributed to the unity of opposites. As a matter of fact, Haldane claims that the Marxist philosophy has enabled him to recognize the problem of reconciling the meristic features of the organism with its individuality as a false problem--we should have expected nothing else as Dialectical Materialists. The problem, therefore, is not to account for the "why" of this apparent conflict, but simply to describe the operations in which the organism manifests each of these characteristics.²¹

Whatever explanation be given of its multiplicity, the fact of distinction within the organism remains, and it is this fact that is directly demonstrated by the arguments mentioned above. Although it is clear that the philosophic presuppositions of the various proponents of the substantial diversity within the organism render their ultimate interpretations of the fact of multiplicity inevitable, and in this sense it might be said that the whole question has been settled before it ever arises, nevertheless these arguments do have the appearance of establish-

21. J.B. S. Haldane, Marxist Philosophy and the Sciences, p. 109.

ing the substantial multiplicity of the organism. If, as Thomas Aquinas shows, a thing's operation is proportioned to its being, and if, as modern biology seems to show, the parts of the organism produce exactly the same effect within the organism as they do when they obviously exist as independent beings, there seems to be no reason to suppose that they do not exist as independent beings within the plant or animal.

The question we must ask, therefore, in order to decide this problem is whether the effect in the two instances is in truth exactly the same. Here we must take account of the fact that a qualitative similarity of effects does not definitively prove their substantial identity except when the characteristics in question have a demonstrable connection with an essence as a necessary and unique effect thereof. To draw a comparison with mathematics, we could never know whether or not two triangles were congruent from the fact that both were the same shade of white or measured the same degree of heat, for such characteristics are accidental to the nature of the triangle; but we could establish their congruency if we could show that two sides and the included angle of one were equal to two sides and the included angle of the other. In the same way we must now look for specifying characteristics of these effects as they are produced within or outside of the organism to see whether they are really the same or not.

Now the primary effect through which we can identify the substantial agent responsible for any given operation is really only the ultimate end of the operation, for this is the end that

finally and completely determines what the agent will do, including whatever means are chosen as stepping stones to that goal. Since therefore a given intermediate effect is not completely specificative of the agent's action, it is conceivable that several different principal agents could, especially by use of an identical instrumental cause, produce similar or specifically identical mediate effects on the way, however, to entirely different ultimate effects. Thus the ultimate use to which a Chinese hog and a house-painter put the absorptive power of the hog's bristles is entirely different, although, of course, the absorptive action of the bristles themselves is the same in both cases. And even among ultimate ends, we must differentiate between the effect to achieve which and the being in whose interest the effect is achieved.²² The reason for making this distinction here is that, although the final cause in the sense of the end of the deed may be analyzed to show its proper cause only on the condition of knowing the nature of the effect itself--a condition rarely satisfied in dealing with natural things--the principal agent, i.e. the proper cause of the effect, can be identified easily if we know the being for the sake of which the effect is produced, because in this sense, as we saw earlier in this work, the end of the principal agent is itself.²³

Now whatever the particular process being considered within the organism, and whatever the intermediate steps by which it

22. Aristotle, De Anima, II, ch. 4, 415 a 3; St. Thomas Aquinas, In II Librum Sententiarum, dist. 1, c. 11, art. 1

23. St. Thomas Aquinas, Summa Contra Gentiles, III, 17.

is reached, the principal beneficiary of all operations within a normal organism is the whole organism. This, then, is the ultimate end of the agent, and since this end is the agent itself, it follows that the principal agent is the organism. The parts which produce particular effects within the organism, therefore, are productive of intermediate ends only, hence they are related to the ultimate end of the operation as instrumental causes. Although the organism, therefore, is and must be composed of parts, it is nevertheless an independent substance, and the parts themselves cannot be substances, whether they be molecules or cells, otherwise there would be substances existing in the subject of other substances, a state of affairs that involves a contradiction.

Of course it is not necessary to believe that everything within the organism is a part of the substance itself. It is perfectly conceivable that these parts are substances produced by the organism and merely extrinsically united to it as a tool is united to a carpenter and used by him for his own purposes. In the strict sense of the term, an instrumental cause is just such an independent substance, for it is an agent that produces a proper effect different from the ultimate end, and thus, as an agent, is a substance as well.²⁴

It seems to me, however, that there is no real reason to insist upon the exteriority of these instruments to the organism. In fact if we allow ourselves to think of everything

24. e.g. Barthelemy distinguishes between the living and non-living parts of the body in something like this basis: cf. "Notes sur la fonction de Nutrition," in Revue Thomiste, XLIII, no. 2, p. 264.

that is used as an instrumentality by the organism as being exterior to the substantial composition of the organism, we will find ourselves in the ridiculous position of maintaining that the whole material part of the organism is outside itself, or in some sort of Platonic-Cartesian position of identifying any really living being with its soul. The untenability of the latter theory we discussed in the last chapter; the hypothesis that the living thing is something else besides itself is not even intelligible.

To understand, then, how the parts can be related to the whole as its instruments and still not be substantially distinct from it, we must consider how natural substances produce their effects. The important point for us to consider in this place is that such a substance can not produce any effect at all directly, because if it did the effect would have to be, according to our principle that the effect and cause must be similar, another substance of the same kind as itself. Now although this requirement may seem to involve no impossibility, when we consider that being the cause of the specific nature of such an effect would involve being the cause of oneself as well, inasmuch as the cause also has that specific nature itself. Insofar as this is true, therefore, a natural agent is not the cause of either of the elements, matter or form, that go to make up the substantial nature, but merely for the individual union between them existing here and now.²⁵ This the agent does by altering the accidental characteristics of an already existing material substance in

25. St. Thomas Aquinas, Summa Th., I, q. 104, art. 1.

such a way as to "drive out" one substantial form and prepare the way for the union with another.²⁶ Since the immediate effect of a natural agent's action, therefore, is on the accidental level, the principles whereby the agent acts must be qualitative modifications of the substance, although the agent itself, to be sure, must be the substance. In this sense, therefore, the qualities are related to the substances as instruments to a principal agent.

Insofar as its actions and reactions with the material world are concerned, and also in the interactions of its parts upon each other, the living organism displays the same qualities as are found in non-living bodies: resistance, heat and so on. Since the effects produced by the organism in these reactions are generically no different from the effects produced by inanimate substances, i.e. changes in size, place, temperature, and eventually in substance, there is no real reason to suppose that there should be any qualities present in organisms in virtue of which alterations take place which are not present in non-living things.²⁷ The basic difference in the final end of the living thing as opposed to that of non-living substances is not in the kind of effect produced by the vegetative activities, but rather in the relation of that end to the agent itself.

Consequently, as long as the part of an organism shows the same qualitative determinations as those possessed by other, non-living agents, there is no reason to wonder that it produces

26. St. Thomas Aquinas, De Anima, art. 12.

27. That is, qualities of the third species, cf. Aristotle, Categories, in Basic Works of Aristotle, trans. by Edghill, ch. I, 9 a 28 ff.

effects as intermediate ends that are qualitatively the same as those produced by the inanimate substance, and even that a chemical, substantial change produced through these accidental dispositions might be the same. What could not be the same is the specifically proper effect of the principal agent. Thus, if a part of the organism, on being separated from the organism, retain qualities similar to those it had in the organism, there is every reason to expect that to happen that does actually happen; that the immediate result of the action of these qualities will appear, but that the proper effect of the substance of which it, the separated substance, was formerly a part will certainly not. This understanding can be applied to the parts both chemical and cellular.

A similar distinction can be applied to the objections attempting to show the divisibility of consciousness. There is no doubt about the fact that consciousness embraces a good many sharply differing activities. Neither is there any serious quarrel that these conscious activities involve modifications of material organs, at least as pre-requisites of the psychic activities. The destruction of parts of consciousness by the destruction of parts of the brain or nervous tissue proves no more than this: that the activities of the conscious faculties are different and depend upon different organs. The unity found in consciousness, as we showed above, has to be the unity of the subject underlying the activities, and this is not destroyed by the destruction of the nervous tissue. Once again, the difference is on the qualitative level, the unity on the substantial.

Thus the modern holistic outlook on the problem of the unity of the organism comes closer than mechanism to a recognition of the fact that there is a oneness about the organism that cannot be explained by anything among the quantitatively separable parts of the plant or animal. Insofar as Haldane's theory of life contains elements that resemble holism, it is true that Haldane himself recognizes that the organism's unity cannot be explained on the basis of its divisions. Both, however, fall short in failing to find another intelligible explanation when the mechanistic one had shown itself to be deficient.

The second group of arguments advanced by the proponents of the specific sameness of living and non-living are designed to show that these two classes do not really differ in respect to the exteriority of their movers. And these arguments, in turn, can be divided into two groups, the first attempting to show that the mover of the organism is really not intrinsic to the organism at all, the other pointing out certain cases in which non-living substances appear to move themselves.

Characteristic of the arguments designed to prove that the mover of a living being is extrinsic is the reasoning first advanced by Helmholtz based upon the principle of the conservation of energy. If there is a mover intrinsic to a living being, runs this dialectic, then there should be energy produced by the plant or animal itself which does not come to it from without. But this would mean that the organism created energy, a situation that would violate the principle of the conservation of energy. Experimental evidence shows that, applying the same formulae for

for the conversion of energy from one form to another, biologists can trace with considerable accuracy the energy output of the living body back to the energy absorbed by the organism out of its food and from other external sources.

Other arguments to prove the same point are largely defensive proofs, designed to show how some particular aspect of the organism's activity can be explained by agencies in some sense extrinsic to the organism itself. Thus it was the early success of a mechanical explanation of the fact of locomotion--an explanation in terms of the action of the muscles upon the bones, and the function of the latter as levers--that gave the first great impetus to modern mechanism. Similarly biologists have recently been able to give more and more detailed accounts of the physico-chemical agencies involved in other vital activities, nutrition, reproduction, growth, and even sensation. Typical is the mechanical explanation envisaged by Haldane that would account for the whole of the nutritional process, even within the cells, as a function of the purely chemical action of enzymes.²⁸ Another such explanation is that given by Haldane which describes sensation as being due to the action of the external object that is perceived in sensation; the wave structure of the external object, it seems, has the power of setting up proportionate, although slower, waves in the nervous structure of the perceiving organism.²⁹ Some of the most remarkable work

28. J.B.S. Haldane, "What is Life?", in Adventures of a Biologist, pp. 57-58.

29. J.B.S. Haldane, Marxist Philosophy and the Sciences, p. 165.

in this field has been done by that outstanding proponent of mechanism, Jacques Loeb. His work in establishing the influence of various outside forces, the earth, for instance, or the sun, in establishing the direction of growth and movement in plants and some of the simpler animals is especially famous;³⁰ and almost equally penetrating is his study of the purely chemical stimulation of the sperm in causing the development of the ovum in the process of reproduction.³¹ The technical detail of these explanations are too complex to reproduce here; although the universal applicability of the observed facts on which these theories depend is rather dubious, and although the theoretical interpretation of these facts may prove eventually to be insufficient to cover the whole of the observable facts, nevertheless these are objections that may be urged against any theory of physical science, and we may provisionally, I think, accept the facts of the case and the theory as being basically correct.

All of these objections share one common viewpoint: in dealing with causes, every one of the above arguments adopts the scientific point of view that whatever uniformly precedes an effect and is absent when the effect is absent is the cause of that effect whether or not the effect is explicable in terms of that cause. In this way there is frequently a failure to distinguish between the causes of the various aspects of a particular effect; and this failure is particularly noticeable, because these em-

28. Jacques Loeb, The Mechanistic Conception of Life, (Chicago: U. of Chicago Press, 1912) pp. 26-27.

29. Jacques Loeb, Artificial Parthenogenesis and Fertilization, trans. by Nathan King, (Chicago; U. of Chicago, 1913)

irical sciences are concerned with the phenomena alone, in the cases where the cause of the ontal status of a given effect is in question. The failure to make this distinction is nothing new in the history of attempts to explain the nature of the organism. Aristotle found himself under the necessity of explaining Empedocles' shortcomings in accounting for the operations of the plant by making a similar distinction:³²

"Empedocles is wrong in adding that growth in plants is to be explained, the downward rooting by the natural tendency of earth to travel downwards, and the upward branching by the similar natural tendency of fire to travel upwards. For he misinterprets up and down; up and down are not for all things what they are for the whole Cosmos: if we are to distinguish and identify organs according to their functions, the roots of plants are analogous to the head in animals. Further, we must ask what is the force that holds together the earth and the fire which tend to travel in contrary directions; if there is no counteracting force, they will be torn asunder; if there is, this must be the soul and the cause of nutrition and growth."

This tendency to lump all aspects of causality together is especially evident in the case of the argument from the principle of the conservation of energy. Aside from a rather questionable tendency to reify causality, and to regard motion as a substance that can be passed along from one location to another by means of a "push" that robs the cause to enrich the effect, the argument shows an unfortunate confusion between what happens and the fact that it happens. Thus we saw that an organism in nourishing itself uses food both for the purpose of replenishing its own substance and for the purpose of providing by oxidizing the food the energy necessary to carry on its activities; the

32. Aristotle, De Anima, I, ch. 4, 415 b 29--416 a 8.

food, however, cannot be considered as the principal determinant of either the living substance or the living activities, since these are specific and differ from one organism to another, whereas the food is relatively speaking indeterminate. Similarly, if energy is regarded as something common to all material things that can be passed from one being to another, it must of its nature be indeterminate and amenable to being used indiscriminately in many different ways. What is done with the energy, therefore, cannot be due to the energy itself but must be determined by something outside the energy itself, i.e. by the being that is the principal cause of the effect. Thus "energy" can never be regarded as anything more than an instrumental cause, since it does not explain the intelligible aspect of the effect as a being, that is, as actual or determined.³³

Basically the same limitation can be discerned in all attempts to reduce the operation of mechanical forces. In the nutritive activities, it is true, the effects produced are the same in kind as in the operation of non-living substances--this fact we have called attention to on several occasions--and insofar as this is true we do not necessarily have to suppose any new means of moving or disposing matter than appear in non-living agents, nor do we have to suppose any of these means produce effects contrary to their operation in the world of the inanimate. Thus St. Thomas observes concerning the powers observed on the plant level:

33. Henri Renard, The Philosophy of Being, (Milwaukee: Bruce, 1950), p. 139.

"Such powers are called natural, both because they produce an effect like that of nature, which also gives being, quantity, and preservation (although the organic powers accomplish these things in a more perfect way); and because these powers perform their actions instrumentally, through the active and passive qualities, which are the principles of natural actions."³⁴

The "more perfect way" that St. Thomas describes as characteristic of organisms in producing their effects, is, of course, the auto-perfection found in living as opposed to inanimate substances. These mechanical causalities common to both orders are responsible only for a certain aspect of the effect and that an accidental one. It may be possible to explain the division of a cell on mechanical grounds, but it is scarcely explicable on these grounds that what is produced as a result of the division is a new organism having the same functions as the parent;; it may be conceivable that growth, and, to some extent, locomotion may acquire a certain direction from heliotropism or geotropism or from other tropisms, (notice the similarity to Empedocles' theory), but what is it that is responsible for the nature and function of the part that grows and moves upward toward the sun? Of course the problem of dealing with these mechanical agencies as external to the organism can arise only upon the supposition that the organism is a substantial multiplicity; if the living being be considered as a substantial unity, as we have seen that it must be, then the idea of the

34. "Huiusmodi vires dicuntur naturales tum quia habent effectum similem naturae, quae etiam dat esse et quantitatem et conservationem (licet hae vires habeant hoc altiori modo); tum quia hae vires exercent suas actiones instrumentaliter per qualitates activas et passivas, quae sunt naturalium actionum principia." Summa Th., I, c. 78, art. 2, ad 1^m.

organism as a self-perfecting being follows from the mechanist's own statements, since no one denied the fact that the sources of motion are within the organism as parts.³⁵

The shortcomings of the mechanistic explanation are especially obvious in the case of Haldane's attempted explanation of sensation on the basis of the power of external objects to set up proportionate wave structures in the nerve structures of the perceiving animal. Such an explanation may be considered as an indication against the idealistic point of view that sense knowledge is originated in the sensing being itself, although there is no really new difficulty for even idealism to explain here. But the fact that an external cause produces effects similar to itself in an animal is no explanation at all of how the animal happens to have knowledge as a result of that causality. A hot toaster produces hot toast, but that does not make the toast conscious of heat. Sense knowledge, as we have already seen, is passive in a certain respect, and in this respect it is acted upon by the external world, but the fact of knowing itself is different in kind from anything produced by such causality, and must be an immaterial and immanent act of the knower itself.

A last set of arguments to establish the specific sameness of the living and non-living is based upon certain similarities observed in the inanimate universe to the self-moving activities of the organism. In a way the effect of these arguments is just the opposite of the result of those we have

35. Maritain, "Notes sur la fonction de Nutrition," in Revue Thomiste, XLIII, no. 2, pp. 269-270.

been considering, for where as the former arguments were designed to show that the agent cause of the organisms activities is distinct from the organism, the end of these arguments is to show that the cause of certain perfections exhibited by non-living things is found in the inanimate substances themselves.

Thus on the atomic level there are discerned certain remarkable likenesses to organic functions. Not least among these likenesses is the continuous motion that apparently takes place within the atom among its constituent parts--a motion that seems to be exempt from the law of entropy. Perhaps more striking, however, is the self-repairing power of the atom--the power to rearrange its parts in their proper structure when disturbed by outside forces, and even to capture and absorb free electrons when it is necessary to restore the electrical balance of the whole. The obvious resemblance between this power and the nutritional power of plants needs no emphasizing. Moreover, it is even claimed that there is a resemblance in atoms to such peculiarly mental phenomena as freedom. This rather startling likeness is claimed for atomic particles because it is impossible to predict with accuracy what they are going to do next, since the position and velocity of such a particle cannot be ascertained simultaneously. The impossibility of making such simultaneous measurements was enunciated as the principle of indeterminism by Heisenberg in 1927. The determinism noticeable in larger aggregations of particles, according to this view, is wholly a matter of statistical probability.³⁶

36. A.S. Eddington, The Nature of the Physical World, (N.Y.: Macmillan, 1946), pp. 220-229.

Other resemblances above the atomic level can be found in the seeming reproductive power of the so-called auto-catalysts. These are chemical compounds that, when placed in the proper environment, have the property of causing more of the same compound to be formed, and at a rate that constantly accelerates in proportion as more and more of the substance is formed. Now in both of these properties (ie. the fact that the produced substance is like the catalyst and the additional fact that the speed of the reaction increases as it progresses) are found as well in living things in the process of cell division. The case of the tobacco mosaic, of which Haldane makes so much in his argument, is regarded as a transitional case exhibiting many of the additional features found in living things in reproduction. It is upon the existence of such chemical substances that Haldane bases his early theory of the living things as a series of such self-producing chemicals, each one of which requires the presence of all the others as the only suitable environment for its self-production.³⁷

Another striking resemblance to living operations in the world of the inanimate is the likeness, long recognized, between the growth of living things and the structured growth of crystals in a supersaturated solution of certain chemicals. The superficial nature of this particular resemblance has long been recognized by even the most outspoken proponents of mechanism; however the likeness is still mentioned in passing by many mechanists,

37. J.B.S. Haldane, "The Origin of Life," in Possible Worlds, pp. 151-154.

including Haldane, as an indication if not a proof of the essential likeness between the living and the non-living.³⁸

Analogous to these problems in the analysis of the nature of life were similar difficulties for Aristotle and Thomas Aquinas in accounting for the difference between fire and a living thing, and also for the apparently self-moving characteristics of bodies that move toward the center of the earth and of the lighter bodies that move away from that center. It may be said that the behavior of fire, which was regarded by the ancients as a substance, is almost exactly that of the auto-catalysts that we mentioned earlier. And the behavior of a body that, having been at rest, begins to fall after the removal of some obstacle is quite similar in its essentials to the behavior of atoms. Let us examine these earlier analyses of these problems to see how adequately they account for our present difficulties.

The Aristotelian explanation of the upward and downward motion of unpropelled bodies is based, as is well known, upon his idea of the natural place of bodies. Each of the four elements recognized by the ancients was supposed to have a place within the geo-centric universe that was most fitting to its specific nature, earth near the center, water next, then air, and finally, at the outermost extremity of the terrestrial sphere, fire. Like everything else that is natural to a thing, i.e. that is any accidental modification that is characteristic of a certain species because of some formal exigency of that nature, the

#8. Ibid., p. 155

property of being in a specific place was within the power of the agent generating the natural thing, and normally would be generated by the agent along with the specific form. The only circumstance that could prevent this accidental perfection or any other property from being so generated would be the interference of some outside impediment. The removal of the impediment, therefore, merely permits what is essentially the object of the agent's exercise of generating power to take place. In a way, therefore, the motion of fire or earth to its natural place when circumstances permit is merely a continuation of the action of the agent, although accidentally the action is the result of the agent's action that removes the impediment. Similarly, when such a substance is forced out of its natural place, its return to its natural place can be considered as a continuation of the action of the disturbing agent. In both cases, whether we consider the essential cause of a thing's being in a natural place, and therefore of its movement to that place, i.e. the generator, or whether we consider the accidental cause of its being in that place, i.e. the remover of the impediment or the cessation of a disturbing mover, the principle of motion is extrinsic to the moved thing. Contrast this sort of generation, in which the normal result is the completely developed substance with the kind of generation characteristic of living beings in which the term of the substantial generation is an incompletely developed substance in every case. In the first case, then, the apparent self-motion is only an accidental concomitant of some abnormal circumstance as far as the moving

body itself is concerned, but an essential part of the generator's activity; in the second case the motion whereby the plant or animal reaches its full development must belong to the developing body itself, since it is essential to such a body to be generated short of its specific perfection, and this motion is not of the essence of the generating causality of the agent.³⁹

It is agreed, of course, that Aristotle's theory of natural place, at least in the absolute sense meant by its author, died with the geo-centric astronomy on which it was based, but it seems that the general principles involved in the analysis can be applied to any given set of scientific facts or theories with about the same results that Aristotle and St. Thomas reached. It is still true of inanimate substances that they are generated in their full being, both accidental and substantial, whenever circumstances permit, hence essentially the power of perfecting these substances belongs to the generator. The self-regulating power and self-repairing power attributed to the atom, therefore, are essentially actions of the agent that brought the being into existence in the first place, actions that operate, because of some impediment or disturbance, at some temporal distance from the original generation. They are not really nutritive activities at all.

In a similar way, Aristotle claims that fire, in spite of its resemblance to a living being, does not really nourish itself or grow. The proof of this Aristotle himself finds in

39. Aristotle, *Physics*, VIII, ch. 4, 254 b 33-255 a 19.

the fact that the fire does not regulate its own growth, as do living things, but continues to increase in size at the same rate as long as the readily available fuel supply holds out. In contrast, Aristotle points to living things that grow only to a specific size, emphasizing the interiority of the cause that controls the development in size and qualitative complexity of the living organism.⁴⁰ As Maritain points out,⁴¹ this control is more obvious in the animal world than in that of plants, since there are plants that continue to grow at a more or less uniform rate as long as they are alive, as do, for instance, the giant redwoods of California. Even in plants, however, there are observable certain cyclic variations in growth that are related to but not entirely dependent upon variations in the conditions external to the organism, e.g. any gardener knows that certain plants develop and flower and die at certain times of the year, and that keeping a plant that blooms only in the summertime under summertime conditions all the year around does not have the effect of keeping the plant in bloom constantly. It is possible to modify the cycle somewhat, but not to change the fact that the cycle occurs. Also unique in the increase in size of the organism as opposed to that of anything else is the development of a functionally differentiated structure in the living being as opposed to a total lack of structure, or at best of an inert structure in the inanimate cosmos.

40. Aristotle, De Anima, II, ch. 4, 416 a 13-18.

41. Maritain, "Notes sur la fonction de Nutrition," in Revue Thomiste, XLIII, no. 2, p. 274.

In his analysis of the passage from Aristotle referred to above, John of St. Thomas makes the cogent observation that the actual difference between the growth of the living thing and the apparent growth of the non-living thing is that the substance generated by the non-living thing is numerically different from its own substance, and is then extrinsically united to the generating substance as a continuum, whereas in the case of living things, the substance generated is numerically as well as specifically the same as the generator. It is not the characteristic of living things as such to cause effects like themselves; this sort of resemblance is a necessary condition of any kind of causality. What is characteristic of the living things is that the effect is not only like the cause, it is the cause.⁴²

Fire has long since ceased to be regarded as a substance, but certainly the same sort of analysis may be applied to auto-catalysis, to the tobacco mosaic, and other virus molecules, and to crystals. Obviously in the case of auto-catalysts, whether or not they act in the way usually found in chemical reactions, the substance produced is numerically different from that which produces it. The same situation seems to exist in the case of the tobacco mosaic, although the situation here seems to be considerably more complicated. However there is no evidence to show that this substance reproduces as a form of self-perfection that is proper to the living, that is by producing within itself a part of itself which, on being separated, develops into the

⁴². John of St. Thomas, Naturalis Philosophiae, IV, c. 3, art. 2; Cursus Philosophiae, III, p. 95 a 24-36.

fully-perfected representative of the species. In the case of the growth of crystals, as Maritain explains, there are two basic differences between their growth and that of an organism: first that the growth of the crystal takes place only from the outside, by the deposit on the exterior of the crystal of a specifically same part, and second, more importantly, that the organism is a specific unity that moves itself to the growth by nutrition, whereas the parts added to the crystal are specifically independent.⁴³

As for the indetermination of atomic parts, the only fact that is true in this case is that we cannot determine where the parts are and what their velocity is simultaneously, and the reason why we cannot so determine position and velocity at the same time is because of the inadequacy and interfering nature of the measuring instruments. To assume our failure to measure and to predict the future course of atomic particles is due to an indetermination within the particles themselves is to make an epistemological assumption that is by no means justified by any logical proof, the assumption that whatever is can be known by mathematical method. Actually this assumption leads to the complete unintelligibility of the world, as we have seen earlier in this chapter. If there is any possibility of real knowledge, the cognoscibility of things must be found within them, and not in something external to things, i.e. in a measuring instrument. Consequently this vital "freedom" in electrons turns out to be a

43. Maritain, "Notes sur la fonction de Nutrition," in Revue Thomiste, XLIII, no. 2, p. 267.

shortcoming in the human mind, not a real liberty on the part of the object known.⁴⁴

In spite of the shortcomings of the mechanistic view of the living world, we must, I think, allow to this theory a larger measure of truth than is sometimes credited to ~~them~~^{it}, what we must insist upon is not that the organism is not a machine, but that it is not merely a machine. Insofar as the organism is an extended substance it is subject to the same laws and restrictions that affect all other material things in virtue of their extension. Insofar as the parts of the organism act upon the non-living world and upon each other, it is obvious that it does so by the same physical and chemical powers that are found in the world of the inanimate. Within the context of a science that seeks to find the inter-connections of phenomena as such, and that is willing, as a result, to lay aside the quest after basic intelligibility for the sake of laws that govern the observable elements and their interactions, it is clear that the mechanistic assumption is the only possible one. It is perfectly possible that there are material reactions that do not have instrumental causes in the form of what Thomas Aquinas called the active and passive qualities of matter, but there is no a priori reason for thinking so, and the only way of finding out under the circumstances of human knowledge is by means of continuous experimentation. There is no reason, therefore, why the insistence of the philosopher upon the existence of the soul as an explanation

44. cf. Vincent Smith, op. cit., p. 277.

of the living activities in the intelligible and therefore non-mechanical realm should be mistaken as a deterrent to a search after an entirely different type of explanation. To know what causes a given phenomenon is no substitute for knowing how, especially if reference is had to the practical control of the organism. The ideal situation would be for scientists of both sorts to recognize the limitations of their own particular sorts of explanation, and, while taking cognizance of the accomplishments of the other, to refuse to enter unnecessary conflicts over different but supplementary explanations of the same fact.

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