THE LOGIC OF LIFE

B. M. Puri Swami, Ph.D.

Modern science generally assumes that the same laws of logic apply to mechanical, chemical and biological entities alike because they are all ultimately material objects. This may seem to be so obvious that there would be no need to validate it -- experimentally or logically.

In this article we would like to critically examine this assumption and show that from an experiential/observational level, as well as from a rational/logical level, it is not valid. This becomes apparent, for instance, when we consider the simple observation in which we distinguish animate from inanimate objects: those objects that seem to spontaneously move themselves and those that move only when impelled by some applied force outside or beyond the object. This distinction may be valid at the macroscopic level more than at the level of theoretical atomic particles. Thus the detailed nature of spontaneous movement must also be understood.

We consider animate objects to be living, and the inanimate ones dead. Yet we consider both as being material objects since they are both composed of atoms and molecules. Even if the composition may be a little different for the two, still the living objects can die and thus become the same as the dead objects. Thus the difference does not seem to be specifiable within the material aspect of the object.

This means we are left with the question: what automates the animate living objects that does not seem to be present in the dead ones. At first we may try to answer this question by claiming that it is the chemical reactions going on in the animate object that are causing it to move. After all, chemical reactions can occur on their own in any laboratory by a process as simple as mixing two reactive chemicals together.

Of course there is a serious problem with that explanation. Chemical reactions generally produce a stable product - just like acid and alkali when added together produce a salt. The reaction seems to occur spontaneously, but it does not go on and on for many years. It does not sustain itself. In the living object or living organism there occurs sustainable chemical activity of a special type called biological activity. That activity can become very complex, even defying all explanation at a simple chemical level because of the intricacy involved.

But living organisms exhibit further peculiar traits that we call behavioral symptoms that are not found in inanimate objects. That is, organisms exhibit growth, irritability, reproduction, metabolism, etc. The point is that animate and inanimate objects, even at the simple level of observation do exhibit important differences. Objects that participate in chemical reactions are different from objects that do not react with each other. And animate objects or organisms behave in manners that chemical objects do not exhibit.

Over two millennia ago, Aristotle made an attempt to explain by philosophical analysis the peculiar nature of living organisms. He considered dead matter to be what he called *dunamis* or potentiality, and matter in action *energia* or actuality. The word "actuality" implies "act." And the Greek word *energia* means "energy." According to scientists, the concept energy means "the ability to do work." A certain amount of energy can do a certain amount of work. This is how energy is determined and measured.

Yet what is it that moves dead matter (*dunamis* or potentiality) into action (*energia*, act-uality). Aristotlte called that actualizing force *enetelechia* or entelechy. This peculiar word comes from *teleos* or teleology, and specifically it refers to inner (*en*) teleology. It means purpose or end in the sense of aim.

We may at first think of teleology as external purpose, as is the case when a carpenter builds a chair from wood. The wood is the original matter, and the chair is the end product - the idea of the chair in the carpenter's mind is actualized in the form of the wood as a chair. Any artifact can be viewed from this perspective of external teleology.

But inner teleology is quite different. According to Aristotle there are many types or kinds of being or matter. For instance, the being of an animal is different from the being of a bird or of a man. Thus the *dunamis* or potentiality has different potencies depending on the kind or species of creature that it is. For example, the seed of an oak tree, or the egg of a chicken have certain potencies within them characterizing the type of matter they are. When their potency is awakened their entelechy will drive them to actualize as a tree or chick.

If we consider Aristotle's ideas from the modern viewpoint, we find a similar concept is utilized in biology. The specific genetic and phylogenetic material of each type of organism is unique due to the different arrangements of the amino acids in the DNA code and other specific proteins, enzymes, mitochondria, etc. that are part of the makeup of the various kinds or species of life. The specific type of matter will therefore determine what kind of creature will develop from it. So it is a tribute to the brilliant intelligence of Aristotle that his conceptions, in its general principle, is still quite valid even today.

Of course, modern science has not found out what corresponds to the entelechy, the mysterious force that causes a particular glob of protoplasm to differentiate and almost magically develop into whatever life form it eventually becomes. It is much too complex and specific to be understood as the result of a series of

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standard chemical reactions. Various experiments have been done on the zygote (fertilized egg) to show that there is a definite directive process involved that continues despite severe modification of the basic structure at an early stage of development. [1]

It is almost as if there were an invisible pattern, concept or idea that was imprinted in the specific type of matter that directed it toward development into the specific creature that it becomes. Aristotle considered the situation from this point of view and concluded that there is a soul that was responsible for this. [2] A couple of thousand years latter G.W. F. Hegel also demonstrated in his *Science of Logic* [3] that there is a Concept involved in the determination of its corresponding content. In between these two towering figures of philosophy, Immanuel Kant also developed the same themes in his philosophical analysis of the scientific understanding of organisms. [4]

I think it will be very useful to look at the way Hegel organized the various types of objects that we observe in Nature, viz. the mechanical, chemical and biological, according to what he called the Concept (*Begriff*). The Concept, for Hegel, is basically a dynamic or organic unity of the different moments or parts that make up the Concept and its content. We will start with his application of this idea to the mechanical object.

Mechanical Objects

Mechanical objects do not have an internal relationship of parts. Thus you can divide a rock and it becomes two rocks, but the basic nature of the rock does not change. What lacks internal relation like this, is said to have merely an external relation to what is other than itself. Thus rocks are related to other rocks by the external force of gravity, or other causal factors. Objects that lack internal relatedness possess merely external relatedness. Planets relate to each other externally, as in the solar system,

explicable by the laws of gravity and motion. Newtonian gravity depends upon mass, but the internal composition of that mass does not play any role in determining their attraction to other planets. Thus gravity acts in a purely external way to unite the planets into the solar system.

In mechanistic objects, the unifying Concept (in this case, gravitational force) exists only implicitly, and therefore only explicitly or externally to the object. Mechanics views a system as having separable, independent parts that are fully understandable outside their connection within the system of which they are parts. When the parts of a system retain the same identity when isolated from the system as when connected within it, it is called a mechanical system. This is the particular logical character or nature that is implied when we refer to a system as being mechanical.

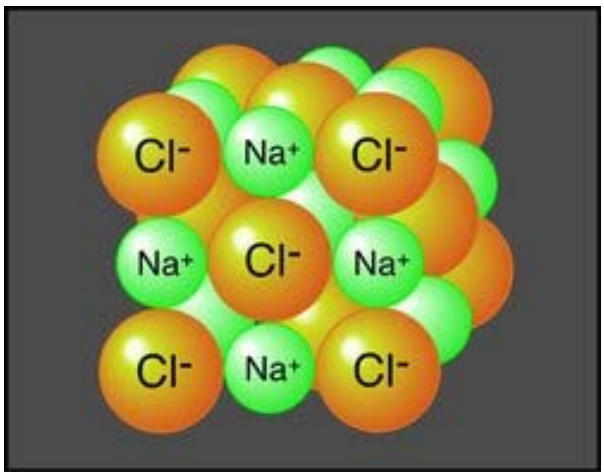
Chemical Objects

Now, those entities that show an intrinsic affinity toward other entities leads to the next type of object - the chemical object.

Chemical objects have parts that are internally related. They are not the same when isolated from each other as when they are connected or united with each other. Thus, for example, a salt crystal cannot maintain its identity when divided at its most fundamental molecular level since sodium and chloride atoms when divided would form two distinct substances - sodium and chlorine. External relations are formed due to the intrinsic properties of the individual parts of a chemical reaction. Thus an acid is intrinsically related to an alkali, which combine to form a neutral salt. Their unity, the neutral salt, is a completely different substance compared to the distinct parts in their isolation.

Furthermore, to speak of nascent acid would be a misnomer. A substance is acidic only in relation to alkaline substances. Its identity or definition as an isolated entity is incomplete and can only be understood in its relation with another object. On the other hand, mechanical objects possess an individuality that is complete in itself without reference to another object.

The unity of a mechanical system, like the solar system, made

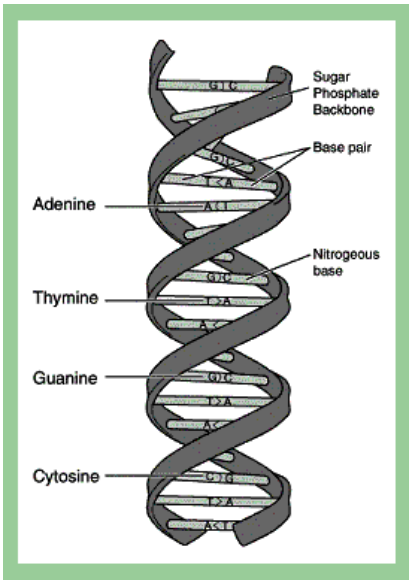


up of mechanical objects, is established externally in the form of a law, which reigns outside of and over the parts and by which the parts of the system are regulated. On the other hand, the unity of the chemical system is intrinsic to the parts, arising from their intrinsic natures. The ordered structure of a crystal is based on the nature of the constituent parts of a chemical system. Still, the parts of a chemical system retain their identity even apart from the interactive system, so that their initial and final states can be differentiated. In this sense the parts are both independent as well as dependent. For example, an acid and alkali can be isolated in different bottles and then added together to form a third substance - a neutral salt.

Biological Systems

Those parts that can not be separated from a system without destroying it as a working system, can no longer be called parts but are participants or members of a dynamic whole. The participants are as essential to the whole as the whole is to the participants - this is the biological system or organism. Here we are removed from the stasis of fixed objects and are in the milieu of pure dynamical activity. Participants cannot be isolated from the whole in which they are participants and remain what they are. A DNA molecule can no more be what it is as a producer of protein molecules, than the protein molecules can be what they are as produced from the action of DNA, and producing the DNA. Each participant is cause and effect of every other participant, as Kant defined organism. Therefore nothing in an organism is without purpose, nor is the organism as a whole without purpose in the environment. Thus everything in the organism is both purpose [end] and means.

Life is a unity in multiplicity. It is a process as a united flow, but it consists of many instantaneous moments - like the frames of a movie. The tendency of abstract understanding is to either think of a unity OR a multiplicity. Pure multiplicity is indicative of the atomic thinking of material reductionism. Pure unity is the indeterminateness of abstract monism. Unity in multiplicity is the comprehensive thinking of dialectical reason. Life has to be



comprehended as a process in which its participants are simultaneously both ends and means to one another.

The living organism internally assimilates itself and produces itself. This self-consumption and self-production is its metabolism, by which it anabolizes and catabolizes, creates and destroys its own cellular substructure in order to maintain its own superstructural integrity. Likewise, the superstructural system assimilates the outer environment of which it is an integral participant. It both consumes and produces the environment in which it lives, but on a localized scale, unlike the totality of its destructive and constructive activity that occurs within itself. Reproduction is a production of itself as a totality but in a localized portion of the environment. It is a process of preservation of the species.

Its inner metabolic process is the preservation of its particularity. Its assimilation and defense against the environment is the preservation of its individuality. And the reproduction of itself as a species is the preservation of its universality. The particular, individual and universal aspects of the living process are characteristic of what is called a Concept. A Concept has three aspects: universal, particular and individual. For example, in biology we speak of genus, species and specimen. Mammal is a genus (general or universal), whereas tiger is a particular species or kind of mammal, and the individual tiger that we meet in the jungle is a specimen. All three of these aspects are required in order to completely specify the individual identity of whatever is experienced.

The living organism, therefore, ultimately has the Concept as its substance when it is comprehended completely. Thus, the categories of understanding that seek to fix identities in their identity (e.g. A=A, B=B, etc.) cease to be applicable to the living

organism whose participants do not possess isolated identities but are identified only in their mutual relations. Unlike chemical objects, the participants of a biological system are produced by as well as productive of the other participants.

The proper understanding of inner teleology requires that we grasp that there is not one thing being driven by another outside of it or beyond it, but a single nature actualizing itself, sustaining its own reality. Teleology is in the organism in the same way that reason is in the thing studied. The self-differentiating unity of organic teleology is not observationally but conceptually grasped. In other words, in the same way that gravity can not be directly observed but is deduced from the behavior of bodies, we cannot observe teleology but it must be logically concluded because the behavior of the participants cannot be explained by either mechanical or chemical principles. As previously explained, that which is logically concluded involves thought, and thought when developed in form is called a Concept.

The objectivity of the organism

Hegel briefly summarizes what has been explained above in his *Science of Logic*: [3]

In the first stage of comprehending the objectivity of the organism, when the Concept is not explicitly known, and is thus only implicit or potential for knowledge as inner unity, we determine only the purely external relationship of parts known as mechanism. Here the totality of the determinations of the Concept appear merely as the external immediacy of its self-subsistent, independent parts, in other words, as an ordered aggregate.

In the second stage of comprehending the organism as an object the immanent law of the parts is established so that particular relationships between the parts is revealed. This is chemism.

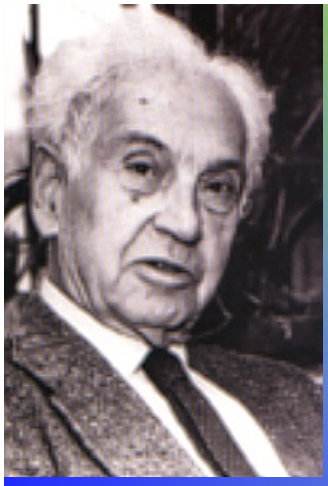
In the third stage, the essential unity of the object is comprehended as distinct from the self-dependence of the parts, and posited as a subjective end which is opposed to the objectivity that it utilizes as means to fulfill its purpose. This is teleology or the biological object.

This end or purpose is actually the Concept which is related to objectivity for the purpose of removing its defect as being merely subjective. As actualized end it is the return of the Concept to itself from its externally posited being and in this internal unity with itself is called the Idea.

Conclusion

In his book "This is Biology," [5] leading biologist Ernst Mayr wrote, “It is a little difficult to understand why the machine concept of organism could have had such long lasting popularity. After all, no machine has ever built itself, replicated itself, programmed itself, or been able to procure its own energy. The similarity between an organism and a machine is exceedingly superficial.”

Immanuel Kant, like Aristotle before him and Hegel after him, understood that an organism had to be distinct from both mechanical and chemical systems, and could only be understood within a teleological framework. For Kant, teleology exists when two criteria are met:



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– Ernst Mayr, 20th century's leading evolutionary biologists

1. The parts of a whole are possible only through their relation to the whole.

and

2. The parts are combined into a whole by being reciprocally the cause and effect of their form.

He therefore proclaimed that "There will never be a Newton of a blade of grass." [4] This is because there is no regulative law that can be formulated for a teleological system. As previously explained, law applies only externally to mechanical systems, whereas teleology is an effect that is internal to the unity of the system.

What Hegel called the Concept, Aristotle called the soul. This additional element is needed to describe the living organism, and it cannot be completely explained without it. This is the conclusion of some of the greatest philosophers of Western culture. And it has its counterpart in Eastern philosophy as well. In fact, it is the teaching of all the great religions of the world.

Only modern science has insisted on trying to explain life on a purely mechanical-chemical level, and has failed repeatedly to even come up with a definition of life on that basis, as it must since life and matter are inherently understood as being distinct principles. Reason is one, thus modern science, as the honest study of reality, must eventually concur with the same truths that human reason has established in our philosophical and spiritual

traditions. It is due to the progress of science that we are led to acknowledge the limits of science and the importance of recognizing life as a distinct principle beyond the mere material or naturalistic conception of Nature. The whole concept of Nature, itself, cannot be encompassed simply in terms of atoms, molecules and their physical and chemical reactions. A deeper truth has to be sought in the corresponding reality of thought and spirit. It is hoped that this brief introduction to the logic of life will inspire further study into this deeper reality.

References

[1] Cecie Starr, *Biology: Concepts and Applications,* Thomson Brooks/Cole, 2005, p. 650.

[2] Aristotle, De Anima, (On the Soul) trans. R.D. Hicks, Prometheus Books, 1991.

[3] G.W.F. Hegel, Science of Logic, trans. A.V. Miller, George Allen and Unwin, Ltd., 1969, p. 710.

[4] Immanuel Kant, Dreams of a Spirit-Seer (1766); Critique of Judgment, 1790, trans. W. Pluhar, Indianapolis: Hackett, 1987. §§ 75, pp. 282-283.

[5] Mayr, Ernst, This is Biology: the Science of the Living World, Belknap Press of Harvard University Press, Cambridge, 1997.

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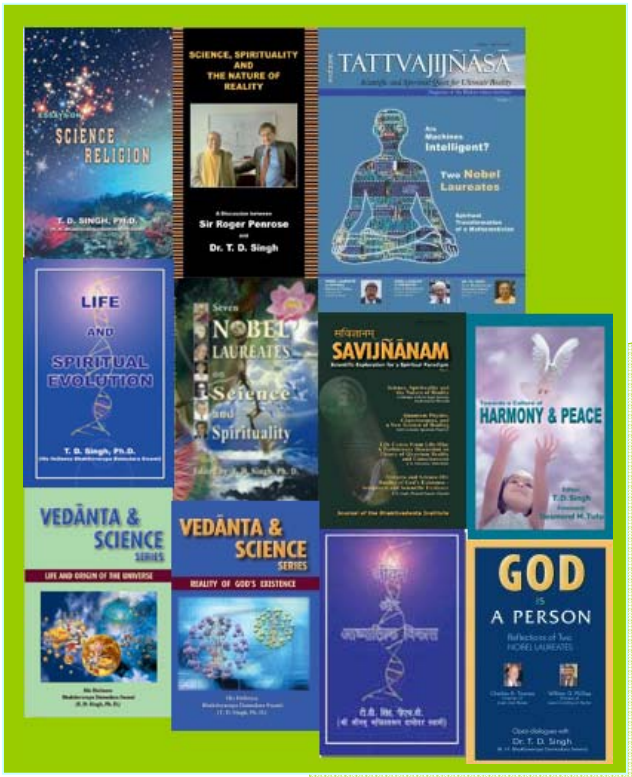

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