University of Alberta
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Ludwig von Bertalanffy (1901-1972):

A Pioneer of General Systems Theory

Thaddus E. Weckowicz † 2000 [2]

Professor Emeritus of Psychiatry, Psychology, and Theoretical Psychology
and
Research Associate, Center for Systems Research, University of Alberta
5-21 Tory, Edmonton AB, Canada T6G 2H4; CSR3@UALTAMTS

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1 A successor to the University of Alberta Center for Systems Research is the Center for Systems Research, Kouřimská 24, CZ - 284 01 Kutná Hora, Czech Republic;
Tel: +420 (327) 512-197, *Fax/Voice:* +1 (212) 208-3032,
E-mail: richard.jung@post.harvard.edu, *URL:* http://www.pvtnet.cz/www/jung

2 MUDr. Thaddus E. Weckowicz, by his friends and acquaintances affectionately called Teddy, has died in the summer of 2000. He has been my dear friend and esteemed colleague at the Center for Advanced Study of Theoretical Psychology at the University of Alberta for 22 years. When I established the University of Alberta Center for Systems Research, which was also to be a realization of Ludwig von Bertalanffy's dream, I invited him to join. The present paper was one of his many valuable contributions. *Richard Jung.*

3 This footnote quotes the text, no longer relevant, as it appeared in the original 1989 publication of Teddy's paper: „CSR Working Papers are distributed to CSR members and affiliates only as background material for CSR projects. Copies of this CSR Working Paper may be downloaded from CSR-L@UALTAVM in several formats by registered users (see back cover). Requests for hard copies should be addressed to the author.
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1. INTRODUCTION

Ludwig von Bertalanffy, a distinguished biologist, occupies an important position in the intellectual history of the twentieth century. His contributions went beyond biology, and extended to psychology, psychiatry, sociology, cybernetics, history and philosophy. Some of his admirers even believe that von Bertalanffy's general systems theory could provide a conceptual framework for all these disciplines.

There are two kinds of thinkers, scholars and scientists. The first are the 'trail blazers' who propose new revolutionary ideas, point to new directions for scientific and intellectual developments, create new paradigms of science and scholarship, but leave the details to others. The second are those who follow the new trail, carry out careful experimentation and research within the established paradigm, and work out the precise formulations of theories in a particular domain of knowledge.[4]

Ludwig von Bertalanffy, who was both a scientist and a scholar, represented the first kind, he was a 'trail blazer.' He was critical of the 'Cartesian' cult of analytical thinking which prevailed in modern science and philosophy. He suggested that it should be replaced by the holistic systems approach. In some respects he retreated from the Cartesian-Galilean paradigm of science, which became predominant in the seventeenth century, and went back to the neo-Platonist paradigm of the sixteenth century.[5]

Von Bertalanffy's views may be described as a dialectical synthesis bridging the contradictions between the vague holistic theorizing of the sixteenth century neo-Platonists and the constricted, narrow view of reality characteristic of the Cartesian-Galilean science, and that of the Empiricist and Rationalist philosophies of the seventeenth and the eighteenth centuries. This narrow view of reality has characterized the positivistic tradition in science and philosophy, and also the contemporary analytical philosophy.

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[4] Thomas Kuhn (1962) in his book The Structure of Scientific Revolutions divides all scientists into those who create new paradigms of science and those who work within the established paradigms. The same division may be applied to scholars and philosophers, namely into those who create new paradigms and into those who work within the established ones.

[5] This point may be illustrated by von Bertalanffy's criticism of Bertrand Russell's (1948) statement that scientific progress has been made by 'analysis and artificial isolation' (von Bertalanffy, 1968: 67). von Bertalanffy states 'You cannot sum up the behavior of the whole from the isolated parts, and you have to take into account the relations between the various subordinate systems which are super-ordinated to them in order to understand the behavior of the parts' (von Bertalanffy, 1968: 68). While Bertrand Russell's statement is an embodiment of the Cartesian-Empiricist tradition von Bertalanffy's position is reminiscent of that of Paracelsus. That famous physician of the sixteenth century stressed the importance in arriving at the diagnosis of a sick patient of taking into consideration all possible factors involved in the causation of illness. Even the position of the moon and the stars in the firmament had to be included in, the deliberations. Although Paracelsus views appear to be facetious and mystical by the modern standards they are representative of the sixteenth century neo-Platonist way of scientific thinking.

2. BIOGRAPHY

Ludwig von Bertalanffy was born September 19, 1901 in Atzgerdorf near Vienna. He came from a distinguished family which included many scholars and court officials. His grandfather on his mothers side was the Imperial Counsellor Joseph Vogel, who founded St. Norbert's Printing Press in Vienna. One of his ancestors was a seventeenth century Jesuit scholar. His paternal grandfather Joseph Karl von Bertalan was a state theater director in Klangenfurt, Graz, and Vienna, an important position in the imperial Austria. He received his secondary education in the Meidlinger Karl-Ludwig Gymnasium. His schoolmates included future prominent scholars, scientists and artists such as the paleontologist Sickenberg, the physicist Fritz Regler, the composer Hans Jelinek, the poet Frederick Schreyvogel. After the gymnasium he studied philosophy and biology at the universities of Innsbruck and Vienna. His professors of philosophy were Karl Reininger and Moritz Schlick, the leader of the Vienna Circle of Logical Positivists. At that time Logical Positivism and the philosophy of science based on it dominated the University of Vienna. It was a revolutionary movement in philosophy which put Vienna University in the vanguard of intellectual progress and attracted scholars from all over the world. It was believed that Logical Positivism was going to do away with metaphysics and idle speculations in philosophy, that it was going to put philosophy on firm scientific bases. Opposing the prevailing trend, von Bertalanffy rejected the philosophy of logical positivism which identified meaning of atomic propositions with their confirmation by observations. He also rejected logical atomism and generally reductionism, and considered the Weltanschauung of 'scientism' which characterized Logical Positivism as too narrow. Von Bertalanffy insisted that in science there were no 'immaculate observations.' Das konstituierende, the constituent statements of the protocols of scientific experiments, were influenced by preconceived ideas, presuppositions, and by the explicit or implicit theories of the observer. Briefly, by his whole *Weltanschauung*. The meanings of propositions could not be established by piecemeal observations. They depended on their relations to other observations, and on the context of the present and past total experience. The 'atomistic' approach was particularly unsatisfactory in biology. An organism was a complex whole or a system. Consequently von Bertalanffy decided to seek solution for the enigma of living organisms in a holistic philosophy.

Von Bertalanffy's Ph.D. thesis was on the philosophy of Gustav Theodor Fechner, an epigon of the Philosophy of Nature movement, who was also the founder on psychophysics and experimental esthetics, Fechner, like all the other Philosophers of Nature rejected the reductionist-atomist view of nature. He believed that the universe was a living system existing at a higher level than man. It was governed in addition to the law of causality by the laws of 'stability' and of 'repetition.' These three principles causality, stability and repetition governed biological and psychological phenomena. Moreover the universe had two aspects, the external physical and the internal psychic. The law of psychophysics, which could be expressed in a precise mathematical formula ruled the relationship between these two aspects of the world. Fechner believed that the principle of gravitation in physical realm had its counterpart in the principle of pleasure in mental realm. According to Fechner the universal principle of stability was complementary to the causality principle, and was important for understanding of the growth and functioning of living organisms. The title of von Bertalanffy's thesis on Fechner was: "Fechner and the problem of higher order integrations." (Fechner und das Problem der Integrationen höherer Ordnung.) It was presented to the faculty of philosophy of the University of Vienna in 1926. The topic of this thesis foreshadowed the author's future lifelong commitment to the idea of holism in biology and psychology. This commitment resulted in his becoming a leading exponent of the organismic approach to biology in the twentieth century.

During that period von Bertalanffy as a young scholar was not only interested in biology and philosophy of science. He was also interested in history and generally in humanities. He studied Oswald Spengler's theory of history and has written a paper on this topic.[6] His interest in Spengler's theory of history anticipated von Bertalanffy's lifelong attempts to reconcile sciences with humanities. As many of his contemporaries in German speaking countries von Bertalanffy attempted to build a bridge between *Naturwissenschaften* (natural sciences) and *Geisteswissenschaften* (humanities). In later years he came to believe that the conceptual framework of general systems theory, which was applicable to several disciplines, provided such a bridge.

Von Bertalanffy also studied the works of Nicholas of Cusa[7], a neo-Platonist Renaissance philosopher, on whom he wrote a book[8]. Cusanus, who had a lasting influence on von Bertalanffy, may be regarded as a precursor of general systems theory.

Nicholas of Cusa rejected Aristotelianism dominant in theology and philosophy at the end of the middle ages and adopted neo-Platonist ideas and even went back to the philosophy of Anaxogoras, a pre-Socratic philosopher. Anaxogoras said that 'everything was everything else.' Therefore all categories of thinking were relative and all contradictions only apparent. According to Cusanus the knowledge of infinite God cannot be grasped by human mind it can only be approached from different directions. The idea of God has many aspects which appear to be contradictory. It is similar to a human face which may present different appearances when perceived from different perspectives. However the differences and contradictions are only apparent. They complement one another. The idea of *coincidentia oppositorum*, the complementariness of seemingly incompatible and contradictory aspects of reality, became the cornerstone Nicholas of Cusa's philosophy. Cusanus believed that absolute truth could not be known. Such a knowledge could be only approached from different perspectives providing apparently contradictory appearances of reality, which nevertheless complemented one another. For the neo-Platonist Cusanus all universal forms were real. The most universal form of all forms was the form of the cosmos, called by him the Soul of the World. It reflected God, the infinite absolute but was not identical with him. It was finite, but boundless and undetermined. The form of the universe embraced in its unity all lower forms such as those of genera, of species and finally of individuals. Lower forms are 'contracted' reflections of higher forms. Their apparent diversity was reconciled in the underlying unity of the universe and ultimately the unity of God. God transcended the universe, but was also immanent in it, and also in man. The universe reflected a 'contracted' (constricted) image of God. Man reflected a contracted image of the world. Each man therefore was a universe. (The idea of systems within systems.) Cusanus, apart from postulating a Platonic realism of ideal forms, anticipated the theory of relativity. He said that all motions are relative, and the universe has neither the boundary nor the center. His idea of coincidentia oppositorum anticipated Bohr's principle of complementarity between the wave and quantum mechanics. Apart from the idea of general systems von Bertalanffy took from Cusanus the idea of relativity of categories of

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6 von Bertalanffy (1924).

7 (1401-1464).

8 von Bertalanffy (1928).

thinking, and the idea of perspectivism in epistemology. In later years he applied these ideas to various problems of psychology and philosophy.

Another influence of that period was the philosophy of Idealistic Positivism of Hans Vaihinger.[9] Von Bertalanffy met Vaihinger in Vienna and for a time, as a student, lived in his house.[10] According to the philosophy of Idealistic Positivism absolute truths and ideal norms of human conduct did not exist, rather man created them as fictions important for the individual and social survival. The idea of relativity of truths and norms postulated by Vainhinger bore a similarity to the relativism of different points of view and categories of thinking postulated by Nicholas of Cusa. The philosophies of Cusanus and Vaihinger were undoubtedly instrumental in shaping von Bertalanffy's 'perspectivist' epistemology and his idea of relativity of categories.

Vaihinger's philosophy of Idealistic Positivism influenced also the psychological theories of Alfred Adler.[11] The latter believed that human personality was an integrated whole, purposefully striving to achieve individually created goals. In later years in his criticism of Freud theories and of the reflexology of Behaviorism, von Bertalanffy came to similar conclusions as Adler and perceived human personality as an actively striving system trying to achieve goals created by symbolic processes. However, for von Bertalanffy the goals created by symbolic processes were not 'fictitious,' as they were for Vaihinger and Adler. They were as real as physical objects, because they were constituents of systems which controlled the behavior of individuals and societies.

After obtaining his doctorate von Bertalanffy chose theoretical and experimental biology as the focus of his endeavors. He habilitated in the Second Zoology Institute of the University of Vienna under Professor Versluys, and carried out important studies on the metabolism, differentiation and growth of animals. In 1934 he became a professor of theoretical biology at the University of Vienna and one of the leading exponents of the organismic point of view in biology. This point of view opposed mechanistic explanations of living processes. In 1948 he left war ravaged Vienna. He went first to England and spent some time with Julian Huxley at the University of Cambridge and with Joseph Woodger at the University of London. From England in 1949 he went to the University of Ottawa in Canada where he became the director of the Research Department of Biology. Between 1954-1955 he was a senior fellow at the Center for Advanced Study in Behavioral Sciences at Stanford. Next, he became the director of cancer research division of Mt. Sinai Hospital in Los Angeles. Afterwards he went as a visiting fellow to the Menninger Foundation in Topeka, Kansas, where he did some work on the problems of mental illness. In 1961 he returned to Canada as the professor of theoretical biology at the University of Alberta. While at that university von Bertalanffy, in keeping with his interdisciplinary approach to the problems of human knowledge held a joint appointment in the departments of Zoology, Psychology, and Philosophy. He was one of the founding members of the Center for Advanced Study of Theoretical Psychology at the University of Alberta. In 1969 he left Alberta to join the staff of the newly formed Center for Theoretical Biology at the University of Buffalo, N.Y., where he died in 1972.

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[9] (1911).

[10] von Bertalanffy, personal communication.

[11] (1963).

3. CONTRIBUTION

3.1. MECHANISM, VITALISM AND OPEN SYSTEMS

Ludwig von Bertalanffy is mainly remembered as the originator of the open systems theory in biology, an organismic theory which rejected both the mechanistic and the vitalistic explanations of life processes. Organismic theories focus on the organism as a whole, which is characterized by a complex organization and integration of its physiological functions, and also of its metabolic and differentiation processes. The whole determines the character and functions of its parts. The holism and the integration of living organisms could be explained in different ways. It could be explained by postulating the existence of complex controlling, servo-mechanisms, or by postulating the existence of purposeful vital forces which control and direct life processes. In the seventeenth century under the influence of the Cartesian, Galilean and Newtonian theories in physics, and pioneering discoveries in chemistry a tendency developed to explain life processes in mechanistic terms. Either as systems of pulleys and levers, or as hydraulic systems activated by pressure of fluids. Alternative explanations were offered by chemists who explained life processes in terms of fermentations or in terms of acids interacting with alkalia. These simplistic explanations of enormously complex life processes were obviously wrong and quite unconvincing. The vitalistic theory of life proposed by Georg Ernst Stahl was a reaction to the simplistic mechanistic theories of the seventeenth century. Stahl in his *Theoria Medica Vera*[12] postulated the existence of a vital force, the vitalistic essence, called by him 'soul,' which characterized all living organisms, and more generally all living matter in contradistinction to inanimate matter. The vital force was underlying all life phenomena. It prevented disintegration of living matter was a driving force propelling the growth of organisms and was at the roots of emotions and instincts. Somewhat later Christian Wolff proposed the theory of epigenesis. He postulated that the development and growth of an organism was driven and controlled by vital forces, which were responsible for goal directness of these processes. During the eighteenth century Vitalism became the dominant theory in biology and medicine, although some mechanistic explanations which dispensed with the vitalistic essence of living matter were also offered.

Throughout the nineteenth century the field of biology was dominated by the controversy between Mechanistic and Vitalistic theories of life. According to the Mechanists life processes could be completely reduced to physico-chemical events, which meant that they could be fully explained by the laws of physics and chemistry. Consequently life processes could be fully accommodated within the framework of classical thermodynamics. According to the Vitalists these processes could not be so explained. The Vitalists assumed that in life processes in addition to the physical and chemical forces there was operating a specific agent which was only present in living matter. This agent was called *entelechy* by Hans Driesch, an influential German biologist at the turn of the century. The latter borrowed the term entelechy from Aristotle. It was a design or an organizing principle, a vital force, which imprinted a form or an organization on inert matter and gave it a potential for orderly growth and development (e.g. an acorn contained a potential to grow and differentiate into an oak tree). Some

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[12] (1707).

other terms such as l'élan vital[13] or horme[14] were also used to denote this putative force. The specific factor, or agent, the life force was according to Vitalists responsible for organizing and directing physio-chemical processes in living organisms. The vital principle, or force, was ultimately responsible for s*ui generis* life phenomena, for plasticity of living forms, for their adaptability to a changing milieu, for their growth and differentiation, and generally for purposefulness and goal directedness of life processes. It was an answer to the puzzle of life.

As the nineteenth century progressed, and new advances were made in chemistry and physics, the Vitalists were steadily losing ground to the Mechanists. It was originally believed that organic matter could only be synthesized by living organisms. However Wohler in 1828 synthesized urea, which was followed by synthesis of other organic compounds. By the end of the nineteenth and the beginning of the twentieth century the advances in the new science of organic chemistry allowed synthesis of thousands of organic compounds. The living cell became conceived as a very complex system of biochemical reactions, during which an exchange of energy took place. These were catabolic and anabolic processes.

3.2. THERMODYNAMICS

The general framework for understanding of life processes was provided by the laws of classical thermodynamics, formulated by Robert Mayer in 1842. According to the laws of classical thermodynamics, total energy of the universe is conserved. However it tends to attain a state of even distribution. In that state all exchanges of energy cease. Energy becomes degraded and evenly distributed in the form of heat. Since all the physical processes depend on transfer of energy from a higher level to a lower level, the final state of the universe when the transfer of energy ceases may be described as that of thermodynamic death. This tendency to attain an even distribution of energy is called 'positive entropy.' In terms of theory of probability, the state of even distribution of energy is the most probable state. According to the principle of positive entropy, the universe is thought to be 'running down' from a highly improbable state of uneven distribution to a highly probable state of even distribution of energy. It is like an unwinding, or running down, clock. Moreover, uneven distribution of energy is associated with highly improbable configuration of energy-matter. The even distribution is associated with highly probable random distribution of energy-matter. In terms of information theory, the principle of positive entropy says that improbable states of high information value tend to be replaced by highly probable states of low information value. Life processes are highly complex, improbable, and according to the classical thermodynamics, tend to be replaced by highly probable states of death and disintegration. Moreover one could expect that during the transition from states of high complexity to those of low complexity in a 'run down universe' a devolution of complex, highly developed life forms into simpler less developed forms would be taking place. This expectation of course is contrary to the evidence from the history of life on the earth.

In spite of these possible objections to the theory of 'run down' universe, and due to the general philosophical climate of reductionist materialism and positivism prevailing in the nineteenth century science, Vitalism was gradually losing ground, and was gradually replaced

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[13] Bergson (1911).

[14] MacDougall (1932).

by mechanistic theories of life. Man made machines, such as steam or combustion engine became the models of living systems. The functioning of these machines could be understood within the framework of classical thermodynamics. It was hoped by biologists and by physiologists that living systems would also fit the framework of classical thermodynamics and that they could be understood in mechanistic terms as physico-chemical machines. This attitude could be illustrated by the compact to combat Vitalism made in 1845 by four giants of nineteenth century physiology, by Hermann von Helmholtz, Ernst Brucke,[15] Emil Bois-Reymond and Carl Ludwig.[16] However, as the nineteenth century drew to its close, and the mechanistic explanation of life was gaining an increasing number of adherents there remained many aspects of life processes which could not be easily explained by the mechanistic theory. Organisms behaved differently from man-made machines. They showed a considerable plasticity and adaptability. They could regenerate their missing parts. A whole new organism could be regenerated from a small fragment of another organism. It looked as if in organisms the whole determined the functioning of parts. The metabolism of living systems consisted of a continuous disintegration and rebuilding of the constituents of these systems. In these processes the goal tended to determine the direction of action, the growth, and the differentiation of parts of an organism in the manner of the Aristotelian *telos.* It appeared as if the Aristotelian paradigm of science was more appropriate for biology than the Cartesian-Newtonian one. Living organisms manifested the principle of teleology. They were subjects to the formal and final causes in addition to the material and antecedent causes. The principle of teleology and the assumption of the existence of final and formal causes were postulates of Aristotelian physics which were discarded by Newtonian physics. However the principle of teleology seemed to be indispensable for understanding of life phenomena. The growth and development of living organisms was characterized by equifinality. The final stage in the development of an organism was, within certain limits, independent from the starting point.

3.3. The neovitalists

The last battle on behalf of Vitalism against Mechanistic theory of life was fought by Hans Driesch. Driesch focused on equifinality of embryonic development. He carried out experimental studies on the development of the sea urchin, an echinoderm. In this organism the development from an impregnated ovum to the adult stage could be observed in a test tube. Driesch showed that the principle of equifinality quite clearly applied to the embryonic development of the sea urchin. A fragment of its egg could produce a perfect animal, identical with one produced by a whole egg. Two eggs which had been fused produced a single normal animal. In further stages of development, such as that of *morula* or *blastula,* fragments of an embryo produced whole normal animals. Arguing from these findings, Driesch rejected the reductionist-mechanistic explanation of life and reaffirmed the vitalistic one. According to him life could not be explained by purely physico-chemical processes. These processes had to be guided, controlled and regulated by a blueprint of the developing organism, which after Aristotle he called entelechy. Now we know that this blueprint is the information contained in the DNA code. According to Driesch there were specific laws appertaining to living matter and to life phenomena which could not be reduced to the laws of physics and chemistry.

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[15] Brucke was Sigmund Freud's professor of physiology. Freud spent seven years in Brucke's laboratory aiming at becoming a physiologist before he switched to clinical neurology.

[16] Boring (1950).

The French philosopher Henri Bergson[17] in his theory of creative evolution propounded idealistic and antimechanistic metaphysics which was based on the principles of Vitalism. He believed that the creative force called by him *l'élan vital*, was the advancing edge of the evolution of living forms. This creative force could be grasped only by intuition. It could not be understood by rational thinking. *L'élan vital* was mental in its nature and was indeterministic. It endowed inanimate matter with creative properties of life.

The doctrine of Vitalism influenced also psychology. William MacDougall,[18] a contemporary of Driesch and Bergson, assumed the existence of *horme*, a purposeful vital force which found its expression in inborn instincts. This force ultimately controlled the behavior and mental states of both animals and men.

Carl Jung's idea of *libido*, the vital force, motivating human behavior and interests was another illustration of a vitalistic force. The same could be said about Freud's theory of life instinct, the Eros, the force responsible for maintaining life processes, and for opposing the destructive force of death instinct, the *Thanatos*.[19]

3.4. Holism

When von Bertalanffy was starting his career as a young biologist the field of biology was still rife with the vitalistic-mechanistic controversy, which was parallel to the body-mind controversy in psychology and philosophy of mind. As a way out from the dilemma some biologists proposed varieties as organismic theories which tried to resolve the mechanistic-vitalistic controversy. These theories focused on the whole organism which possessed a capacity to integrate its part-functions. It was parallel to the Gestalt theory in psychology which stressed the integration of elements of perceptive experience into meaningful wholes. Both holistic theories, in biology and psychology, became popular in German speaking countries in the twenties of the present century. Von Bertalanffy[20] went one step beyond the pure descriptions and philosophical speculations. He sought explanation for holistic organizing principles in basic laws of physics and chemistry. He proposed a generalized version of classical theory of thermodynamics which was applicable to closed and open systems. Von Bertalanffy proposed the theory of open systems to explain organismic properties of living organisms. This theory demanded a generalization of kinetic principles of chemistry and thermodynamic theory to what became known as irreversible thermodynamics. According to von Bertalanffy the classical theory of thermodynamics applied to 'closed systems' such as the 'running down universe.' The closed system was characterized by progressive changes tending towards an increase of entropy. These changes led to an equalization of energy throughout the system, and the attainment of its most probable state which was that of randomness and disorganization. These developments were predicted by the second law of classical thermodynamics. Apart from the 'running down' universe, man made machines exemplified closed systems.

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[17] (1911).

[18] (1932).

[19] Freud (1955).

[20] (1950a, 1950b, 1951, 1968).

3.5. OPEN SYSTEMS

However there existed in nature also 'open systems.' These systems internalized energy and matter from the environment, they utilized them to maintain the system's organized structure and to increase the complexity of the latter. These systems instead of displaying positive entropy displayed negative entropy. They maintained a steady state of dynamic organization of kinetic processes and even could increase their complexity. Thus, these systems could be developing towards less probable states of higher complexity rather than towards more probable states of lower complexity. If living organisms are open systems then their propensity to develop in ontogeny and in phylogeny into higher and more complex forms could be explained without necessity of invoking Bergson's *l'élan vital* and his theory of 'creative evolution.'

There are many examples of open systems in nature. One example is the flame. A flame takes oxygen from the air and maintains a steady upward flow and stratification of hot particles. Living organisms are also open systems but of much greater complexity than flames. Open systems maintain steady states which are not the states of equilibrium with evenly distributed energy. In steady states there are constant gradients of energy distribution with constant differences in its potentials at different points. Von Bertalanffy developed a system of simultaneous differential equations describing physico-chemical processes responsible for maintaining steady states of open systems. These processes maintaining the steady state of open systems operated on the principle of 'mass action' rather than on the principle of discrete feedbacks of cybernetics. Von Bertalanffy rejected the idea that an organism was a sum of its parts in the way man-made machines were. Instead, he stressed the holistic properties of living organisms. A living cell was an open system characterized by a continuous flow of physico-chemical processes, producing 'vortices' and patterns of immense intricacy, which constituted its structure and its 'organized complexity.' This organized flow of energy and matter could be described as a 'Heraclitean' flux *(panta rhei)*. It was undergoing a constant change, but was at the same time maintaining a constant, or only slowly changing structure.[21]

3.6. ORGANISMIC BIOLOGY

Von Bertalanffy did not believe that cybernetics provided an explanatory framework for basic life processes. Discrete feedbacks although purposeful and capable of maintaining ho-

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21 The theory of open systems and of irreversible thermodynamics was developed by von Bertalanffy in the nineteen thirties. His most important publication on the subject was Theoretische Biologie (1932, 1942). The second edition was published in 1951 in Bern by A. Francke A.G., the English title was Theoretical Biology. It originally appeared in two volumes:
(1) Allgemeine Theorie und Physiko-Chemie, Aufbau und Entwicklung des Organismus (1932). (General theory and physico-chemistry of the structure and development of the organism.).
(2) Stoffwechsel, Wachstum (1942). (Metabolism and growth.).
Another publication on this subject was Biophysik des Fliessgleichgewichts (1953). (Biophysics of equilibria of changing-steady state).
These publications were instrumental in securing for von Bertalanffy the post of the professor of theoretical biology at the University of Vienna (1934-1948) as well as the worldwide recognition as one of the leading biologists.

meostasis were characteristic of secondary developments in living systems. According to von Bertalanffy during the secondary developments open systems were superseded by systems controlled by fixed arrangements of feedbacks. These secondary developments, characterized by fixed feedbacks, were manifestations of a progressive mechanization and a loss of plasticity occurring in living systems. Von Bertalanffy believed that open systems, and irreversible thermodynamics, did not supersede classical thermodynamics but were a generalizations of the latter. Consequently he believed that the 'new thermodynamics' and the open systems theory were going to resolve the controversy between the mechanistic and vitalistic theories by substituting for them a new sophisticated version of organismic theory, devoid of mystical overtones.

The organismic theory assumed that biological systems were stratified, presented a hierarchy of levels of organization. At the lowest level there were complex protein and DNA molecules. At higher level there were cells, then at the next higher one, organs. Finally, there was the whole organism, which was an important unit of the biosphere. However, the hierarchy of systems organization did not end at the boundary of the individual organism, but proceeded further to animal and human societies. It could be discerned even in the ecological systems of the biosphere.

Open systems theory was particularly useful for understanding of embryological development differentiation and growth processes of living organisms. The quantitative aspects of growth processes have been formalized as the principles of *allometry*. The laws of allometry describe the mathematical relations of metabolic processes in living organisms. They express the interdependence, organization and harmonization of these processes. Allometric equations are very often power functions. They indicate rectilinear relations between the logarithms of two variables, which means that the ratio of the relative increase of one variable to the other is constant. One example of the laws of allometry is the relationship in animals between their metabolic rate and their surface.[22] Metabolic rate is proportional to the ratio of the surface of the animal to its mass. Metabolic rates in animals of different body weight, do not increase in proportion to their weight but in proportion to the ratio of the animals surface to its body weight. As a result small animal have higher metabolic rate than large animals. The laws of allometry apply also to growth of animals. The ratios of increments of sizes of various organs remain, within certain limits, constant. There is a constant ratio between anabolic and catabolic processes. The constant ratios of the rates of growth can be expressed mathematically in sets of equations. These questions are known in biology as von Bertalanffy's growth equations. Generally the laws of allometry imply that there is really an invariable organization expressed by certain function relationships. The invariable organization constitutes a 'steady state' of an organism which is an open system.

3.7. POPULATIONS, ECOLOGY AND EVOLUTION

As was mentioned earlier the hierarchy of systems organization did not end at the boundary of the individual organism. It extended to animal and plant species, to pools of genes, to ecological systems, consisting of several species of animals and plants, briefly to the whole biosphere. One example of an application of systems theory to populations of animals are Volterra's equations describing the cycles of growth and decline of population of a preda-

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[22] von Bertalanffy (1968).

tor species in relation to the cycles of growth and decline of the population of a species preyed upon. The relation between such two species eventuates in a dynamic balance between the two populations. According to von Bertalanffy the principles of open systems theory did not apply only to the development of individual organisms or to ecological relationships among species. They applied also to the evolution of species. In his book *Problems of Life*[23] von Bertalanffy criticized the mechanistic interpretation of the Darwinian theory of evolution, which attributed development of new species to accumulation of chance minimal variations, to random genetic mutations and to the pressure of natural selection. This ultra-Darwinian[24] interpretation of the natural selection of minute random variations as the mechanism of evolution was criticized by contemporaries of Darwin such as Herbert Spencer and George Romanes.[25] These authors argued that a single small variation would not enhance the fitness of the organism for survival and procreation and therefore will not be naturally selected. Only an accumulation of such small variations which moreover functionally complemented one another could be naturally selected. These critics suggested the existence of some Lamarckian mechanisms which enhanced the natural selection pressures. One such mechanism called 'organic selection' was proposed independently by Mark James Baldwin and by Lloyd Morgan. The mechanism of 'organic selection' implied that acquired characteristics were instrumental, in addition to natural selection, for the selection of certain chance hereditary variations and for the rejection of others.

The discovery of mutations by Hugo DeVries at the turn of the century made allowance for larger units of variation (for as it were 'quantum jumps' of chance variations). However, the probability of a mutation or a series of mutations which enhanced the adaptability of the organism remained indeed very small. Some other factors apart from chance were likely to be present. In his interpretation of theory of evolution von Bertalanffy believed that in addition to the mechanism of natural selection, evolution of species was subject to the dynamics of organizing forces intrinsic to organisms of a species, which were responsible for the particular direction the evolution took in different species. Therefore, manifestations of negative entropy of the open systems, pushed the development of organism in specific directions, and were responsible for the appearance of new, very often more complex forms of life. This may be illustrated by examples of increased complexity and intricacy of shells of sea mollusks found in successive geological strata. It is difficult to imagine, although could not be excluded *a priori*, that increased complexity of the shell pattern was in itself conducive to the survival of the mollusks. Thus, according to von Bertalanffy, in addition to the environmental fitness there was the fitness to the organismic design, the basic blueprint of the organism as a system (Shades of Göthe I suppose).

So far as the behavior of the individual organisms was concerned von Bertalanffy rejected the notion that organisms reacted mechanically to the environment in the manner of passive automata or robots. According to him animals and men were characterized by autonomy and by spontaneous activity. Consequently von Bertalanffy became critical of psychological theories, such as the S-R Behaviorism and the orthodox psychoanalysis which tried to describe human and animal behavior in terms of reflexes and in terms of maintenance of homeostasis: e.g. drive reduction or reduction of tension.

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[23] *(1949, 1960).*

[24] Richards (1987).

[25] *Ibid.*

3.8. Unity of natural sciences and humanities

Von Bertalanffy was a real Renaissance man whose interests went far beyond biology. Like some of his contemporaries and predecessors in German speaking countries he attempted to build a bridge between the natural sciences *(Naturwissenschaften)* and the humanities *(Geisteswissenschaften)*. He came to believe that the General Systems Theory, an expanded version of the Open Systems Theory provided the needed conceptual framework for the basic unity of human knowledge, for the unity of natural sciences and humanities. Consequently, von Bertalanffy was interested in and made important contributions to psychology, psychiatry, sociology, anthropology, cybernetics philosophy and history. He believed that general systems theory of biology was applicable to other disciplines, in particular to those concerned with man. An organism was a system of complex biochemical reactions. A society was a system of communication patterns and institutions, while a culture was a system of symbols. The systems theory was applicable to physiological, psychological and sociological phenomena. Physical, mental and social events may appear to be intrinsically different, however they are organized in systems, which are governed by the same set of systemic laws. The unity of systems is the basis of the unity of nature in spite of the kaleidoscopic motley of external appearances. The idea of the basic unity of science, founded on General Systems theory is reminiscent of Leibnitz's idea of universal language and of general principles. These notions may appear quite revolutionary, but so was Newton's notion that the same laws govern the movements of celestial and of terrestrial bodies.

3.9. Psychology and psychiatry

In the discipline of psychology and of psychiatry and generally in social sciences von Bertalanffy opposed the doctrine of reductionism which maintained that social phenomena could be reduced without a loss of meaning to psychological phenomena and the latter to the physiological ones. He also, as was mentioned earlier, opposed the notion that the behavior of animals and men could be conceptualized as chains of responses to environmental stimuli. Animals and humans were not passively reacting to environmental events. They displayed autonomy and spontaneity actively engaging the environment. This idea put him on a collision course with both the American S-R Behaviorism and the orthodox Freudian psychoanalysis. Von Bertalanffy's anti-reductionist position led him to reject the tendency of the American Behaviorists to reduce human behavior to that of animals and to conceive human motivation in terms of a few biological drives such as hunger, thirst, sex, parenting and aggression. He found grossly inadequate the explanation of human motivation as the quest for satisfaction of these few drives. The tendency of American Behaviorists to reduce human behavior to animal behavior was called by von Bertalanffy 'zoomorphism.' According to him 'zoomorphism' was an inverted image of 'anthropomorphism,' a tendency to interpret animal behavior in terms of categories of human mind. The latter tendency characterized the theorizing of early animal psychologists such as George Romanes.[26] Von Bertalanffy believed that each animal species possessed unique behavior characteristics which cannot be reduced to a common denominator, or a schema, e.g. of an organism as a conditioned reflex, drive reduction machine.

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[26] Boring (1950).

The same criticism of reductionism was applicable to the orthodox Freudian psychoanalysis, which tried to reduce the behavior of adults to that of infants and to regard it as a product of libidinal tension reduction.

Von Bertalanffy also objected to the notion that the acquisition of knowledge and learning could be explained as manifestation of conditioned reflexes, mechanical associations, and drive reduction. As a result von Bertalanffy criticized both American Behaviorism and orthodox psychoanalysis because of the reductionist philosophical implications of these two schools. He also criticized these two schools because they presented an unflattering, mechanistic concept of man, man as a robot. Von Bertalanffy's ideas were based on the Leibnitzian, rather than Lockean concept of man.[27] The Leibnitzian concept envisaged man as a creative, striving agent rather than as passive one, only reacting to and reflecting the environment. However the creator could sometimes be dominated by his own creations such as social and symbolic systems produced by him.

3.10. Homo Symbolicus

The rejection of reductionism and the stress on creativity and organized complexity of human behavior within the context of culture led von Bertalanffy to assert that the human organism was unique and different from animal organisms. Man was unique by the fact that he lived in a world of symbols, or rather in several worlds of symbols. He interposed a world of symbols between himself and the world of physical objects. The most appropriate designation of man was that he was 'homo symbolicus.' Von Bertalanffy's views on the importance of symbolism were influenced by the philosophy of symbolic forms of Ernst Cassirer.[28] Another influence on Bertalanffy to be mentioned in this context was the language theory of Karl Bühler.[29] Karl Bühler was a professor of psychology at the University of Vienna. He, as well as his wife Charlotte Bühler, a developmental psychologist of humanistic orientation were close friends of von Bertalanffy.

According to von Bertalanffy although human behavior was controlled to some extent by physical stimuli and physiological drives, it was controlled even to a greater extent by systems of symbols and values which were his creation. However once created they became a part of culture, had dynamisms and inertia of their own, and could take control of man's behavior. Symbols were not conditioned stimuli or signs. The latter were environmental physical events which became associated by contiguity with biologically significant object. They were imposed on man from outside. In contrast symbols were created by man himself and posited by him to signify, or stand for, objects and events of the external world. Their role was more than just to signify objects or events, but also to endow them with surplus meaning determined by the total system of symbols. This capacity to create systems of symbols, and to interpose them between the subject and the external world was unique to the human species.

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[27] Leibnitz held a dynamic view of the world. For him the essential (primary) properties of matter were not extension and form, but activity (effort). Extension and form were secondary properties. In this respect Leibnitz's views differed from the views of both Descartes and Locke. On the mental side, Leibnitz's monads were characterized by their striving to attain a clarity of consciousness.

[28] (1957).

[29] (1934).

3.11. Language, society and culture: General Systems Theory

The most important symbolic system possessed by man was language. Although the roots of language were in the biological organism the linguistic systems were endowed with a considerable degree of autonomous existence, and with the capacity for spontaneous growth. Thus, although man originally created symbols the symbolic systems once created could take control of human behavior and could dominate it. Although symbolic systems were internalized by human beings they were subject to their own logic of intrinsic rules and showed intrinsic developmental trends. Symbolic systems were not just aggregation of symbols. They entailed systems of rules prescribing the relations of symbols to one another. In language syntax and grammar constituted such rule systems, in mathematics and logic there were the rules of calculus and inference. In music and art there were rules of harmony, of composition and of design. The lawfulness which was independent of associative contingencies was characteristic of all symbolic systems. Similarly to language cultures, religions and ideologies were symbolic systems which often determined human fate. As it was stated before symbolic systems had logic of their own, moreover symbolic systems were not static but were developing in certain directions. Von Bertalanffy believed that the laws of development of open systems applied not only to the development of biological systems, but also to the development of symbolic systems, to that of societies and of cultures.

He called this extended version of the open systems theory - the General Systems Theory. Similarly to living organisms and biological species artistic styles and forms of music displayed orderly growth and development. They tended to become increasingly complex, to reach a zenith, then to become stereotyped, to decline, to lose artistic vigor, and finally to die, and be superseded by new styles and forms. Von Bertalanffy divided symbols into 'discursive' and 'experiential.' The first denoted external objects or aspects of the latter. The second connoted the experiential and emotional meanings of objects and ideas. The 'discursive' symbols were concerned with cognitive information. They were the currency of mathematics and science. The experiential symbols were concerned with values, morals, ethics and esthetics. Value systems, were systems of symbols which motivated and guided the behavior of individuals and societies. They determined the social rules which behavior had to follow in concrete situations. They formed the systems of rules which constituted the basis of ethical and legal codes. They made certain objects and types behaviors preferable to others, and provided the 'categorical imperatives' of human conduct. Although sometimes they originated in biological drives, values were autonomous and could become more powerful motives than biological drives. Martyrs died for their faith. The controversy between the doctrines of transubstantiation and of consubstantiation, a purely symbolic distinction, resulted in thousands of deaths at the stake. The most noble deeds of heroism and altruism were instigated by value systems. Also the most base and cruel atrocities were motivated not by the biological instinct of aggression but by the value systems of ideologies of men who perpetrated these atrocities. The Nazi concentration camp guards were usually not aggressive psychopaths, but men who were loving husbands and fathers, were loyal to their friends, and were kind to their guard dogs. Thus, systems of ethical and esthetic values had their own autonomous compelling force independent of biological drives. This force could take control of human behavior. Moreover man could simultaneously internalize several incongruous values systems which could lead to conflicts, consequently he could suffer from value disorientation. Alternatively man could produce his own private symbolic system which was at variance with that of his society and culture. According to von Bertalanffy this happened in schizophrenia. A schizophrenic was living in his own private symbolic world. Von Bertalanffy believed that symbolic conflicts and disorders were of a greater importance for human psychopathology, than conflicts between biological drives. In this respect the views of von Bertalanffy were at variance with those of psychoanalysts. The latter attributed human psychopathology to a repression of biological drives and to their conflicts. Von Bertalanffy's views on the importance of value disorientation and conflict in human psychopathology were influenced by those of Charlotte Bühler, an early humanistic psychologist who was interested in developmental and clinical psychology. Charlotte Bühler emphasized the importance of values in the development of adolescents and the psychotherapy with them. She believed that value disorientation played an important role in their psychopathology.

According to von Bertalanffy the consequences that man was symbolic animal were immense. Biological evolution which was determined in other animal species by genetic changes was superseded in human species by cultural history based on the accumulation of experience handed down from one generation to another. In addition to the accumulation of experience cultural history was characterized by the development of symbolic skills and symbolic systems. The latter although created by their users were, as in the case of language subject to their own intrinsic growth and development. This factor could be an additional influence on the behavior of the participants in a symbolic system and to accelerate further the cultural and social changes. At other times the inertia of symbolic systems could cause a delay in adaptation to changing social and economic circumstances - the phenomenon which goes under the name of 'cultural lag.' One consequence of the fact that cultural history had in human species superseded biological evolution was a change in its time scale. The time scale of geological epoches by which biological evolution was measured had been replaced by a much foreshortened scale of historical periods by which the sociocultural change was measured.

In human adaptation to the external environment trial and error learning by association was replaced by reasoning and argument. These procedures implied manipulations of symbols according to certain rules. Consequently the desired results were attained more efficiently and faster. The ability to utilize symbols made possible the achievement of the true Aristotelian purposiveness. The goal anticipated in the future but nonexistent at the present could be represented by an image or a symbol. The latter could guide the goal directed behavior with a greater efficiency and flexibility than was possible in case of instinctive behavior of lower animals. Finally, symbols representing ethical rules which guided interpersonal and social behavior, could be encoded in formal laws. The aggregates of such laws produced complex legal systems which had autonomous existence, imperatives and logic, superordinate to individuals and groups. It required a special discipline of juriprudence to disentangle the meta-rules which were behind the legal codes regulating social behavior.

3.12. HISTORY

The notion that human societies obeyed the laws of systems theory, and that they could be regarded as open systems, showing certain autonomous developmental trends, which were not environmentally determined (were not reactions to environmental influences), turned von Bertalanffy's attention to theories of history. Von Bertalanffy rejected the anti-historistic notion that history was an idiographic science or art. This influential notion was propagated by such scholars as Wilhelm Dilthey, Wilhelm Windelband and more recently by Karl Popper.

Dilthey[30] believed that history should be approached through the hermeneutic method of understanding *(Verstehen)* of past events in the context of their epoch, as well as through the understanding of the minds of the actors participating in those events. Windelband[31] divided sciences into the idiographic dealing with unique phenomena, and the nomothetic dealing with general laws and with classes of phenomena. According to him physics was a nomothetic science and history was an idiographic one. Finally Karl Popper[32] attacked historicism because of its implication that societies were 'closed,' were holding men in bondage, and were negating their freedom.

Von Bertalanffy believed that history was a nomothetic science, and that there existed the laws of historical development, which could be formulated within the framework of general systems theory. The belief in historical laws constitutes the essence of historicism. On the issue of historicism von Bertalanffy sided with Giambattista Vico,[33] Karl Marx,[34] Oswald Spengler[35] and Arnold Toynbee.[36] Von Bertalanffy[37] was a particular admirer of Spengler's historicist theories.[38]

Oswald Spengler's version of historicism was presented in his *The Decline of the West,* published in 1918.[39] Coming out at the moment of defeat at the end on the First World War the book had a considerable influence on intellectuals in war ravaged Germany and Austria. Its pessimistic outlook suited the postwar mood of both countries. For youthful von Bertalanffy Spengler's biological metaphors used in the analysis of historical processes must have had a special appeal. Spengler rejected the all embracing linear view of history which characterized Hegel's and Marx's versions of historicism. Instead, he viewed different cultures such as Classical Greek or Western European cultures as distinct unconnected organisms, which were similar to biological organisms. They were characterized by cycles of development. In each culture the period of heroic youth was followed by the period of maturity. The latter in its turn was followed by the period of aging, exhaustion and decline. All cultural cycles lasted about one thousand years. Cultures were qualitatively different. However they could be studied and compared 'morphologically' in the way biological organisms were compared. Cultures made different metaphysical assumptions about ultimate reality and had different concepts of space and time. The Classical Culture of Antiquity which Spengler called 'Appolonian' was characterized by a narrow and limited concept of space which did not extend much beyond the limits of a city. On the other hand the Western European culture, called by Spengler 'Faustian' was characterized by the concept of vast, boundless space. This concept of space produced lofty spires of medieval cathedrals, and opened the whole world to daring journeys

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[30] (1961).

[31] (1901).

[32] (1945, 1957).

[33] (1948).

[34] Marx and Engels (1960).

[35] (1922).

[36] (1954).

[37] (1924).

[38] Spengler (1922).

[39] (1922).

of discovery as well as to colonial expansion. Cultures although they set limits on human behavior did not determine it, leaving a scope for individual freedom and creativity. Spengler's views were not very scientific nor logically consistent. However, they induced Von Bertalanffy, a young biologist, to see a formal similarity between biological and historical processes, thus allowing him to bridge the gap between sciences *(Naturwissenschaften)* and humanities *(Geisteswissenschaften*). Since the Weltanschauung and ethos of each culture could be understood only from the point of view of a given culture Spengler promoted the view of cultural relativism. Spengler's relativistic position fitted well with the relativistic views of Nicholas of Cusa. Both were responsible for fostering the theme of relativism which ran through von Bertalanffy's philosophical speculations.

3.13. Relativity of categories of thinking

Coming from the Germanic background von Bertalanffy was nurtured in the tradition of Kantian transcendentalism with its synthetic *a priori* propositions and its a priori categories of reason. However von Bertalanffy, similarly to his contemporary at the University of Vienna Konrad Lorenz, questioned the doctrine of Kantian apriorism. Konrad Lorenz[40] in an important paper on categories of reason suggested that such categories were not *synthetic a priori*, but should be regarded as modes of experiencing and categorizing the world produced by the vicissitudes of the evolution of a particular species. As a result of a distinct evolution each species lived in its own Umwelt and categorized the surrounding world differently - the idea which was put forward originally by Von Üxküll. Von Bertalanffy went even further in an important paper[41] he maintained that particular categories of reason were products not only of biological evolution, but also of cultural development. The categories used by different cultures and in different historical epoches might be quite different. The idea which bore a similarity to the Whorfian hypothesis in linguistics. Such categories as 'body,' 'mind,' 'matter,' 'substance,' 'energy,' and 'cause and effect' could be categories of thinking which were typical of Western culture. For example, according to von Bertalanffy the Cartesian doctrine of body-mind dualism was a product of the particular categories of thinking, such as the Aristotelian category of substance adopted also by Descartes. Substance was one of the categories adopted by the Western culture. The hard line separating the physical from the mental disappeared when one considered the experiences of children, the experiences induced by psychedelic drugs or those of schizophrenics. It disappeared also when one stepped outside the ambit of Western culture and considered the experience of people from other cultures. Also modern physics showed the relativity of many common sense categories such as matter, energy, space and time. Quantum mechanics and wave mechanics conceived the subatomic events in different ways. The same applied to electro-magnetic phenomena. These phenomena could be viewed as waves in an electro-magnetic field, or as streams of quanta of energy. An electron could be at different places at the same time. We did not know whether we were talking about the same electron or two different electrons. The identity of objects became blurred. The speed of objects depended on the position of the observer. The space-time framework became relative. Consequently von Bertalanffy came to the conclusion that generally the categories of thinking were relative, and that reality could be contemplated from different perspectives. In

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[40] (1943).

[41] Essay on Relativity of Categories, published in 1955 in *Philosophy of Science.*

adopting the position of 'perspectivism' and in denying that categories of thinking were absolute von Bertalanffy followed the footsteps of Nicholas of Cusa. He was also influenced by Oswald Spengler's idea of cultural relativism.

3.14. Perspectivism

As will be remembered, Nicholas of Cusa believed that absolute truth could not be known. Such knowledge could be only approached from different perspectives providing apparently contradictory appearances of reality which nevertheless complemented one another (*coincidentia oppositorum*). In his philosophical orientation von Bertalanffy embraced the doctrine of epistemological perspectivism. I suspect that von Bertalanffy was basically a monist, who believed that the structure of systems constituted the ultimate reality, which depending on the perspective from which it was viewed presented different appearances, these appearances were complementing one another as exemplified by Niels Bohr's principle of complementarity between wave and quantum mechanics.

Von Bertalanffy found the idea of perspectivism particularly useful in dealing with the problem of mind-body relation. In his paper on body-mind relation,[42] von Bertalanffy gave a new interpretation of the old problem, the unsolvable conundrum, of the Cartesian doctrine of body-mind dualism. This doctrine was based on the metaphysical notion of substance, on Aristotelian category of thinking adopted by Western culture and its philosophy. This category was prominent in Cartesian philosophy and prompted Descartes to postulate the existence of two substances mind and matter which were incommensurate with one another. As the consequence of it the explanation of interaction between body and mind became impossible. Attempts at explanations led to all sorts of philosophical sleights of hand, such as invoking the Divine Benevolence, or the occasional miraculous interventions of God, or the preordained harmony.

However they more often led down the slippery path to solipsism or to the crass materialism of LaMettrie. This difficulty disappeared when one stepped outside the ambit of Western philosophical tradition and abandoned the categories of thinking belonging to this tradition. According to von Bertalanffy bodily and mental events were two different aspects of organismic events and were isomorphic with each other. This indicated their basic identity. The isomorphic structure of the organismic events could be studied within the framework of General Systems theory. This theory since it was applicable to both physiological and psychological phenomena provided a bridge between body and mind, and pointed to the basic isomorphism of bodily and mental events.

3.15. Reaction to America

In the final part of the essay I would like to describe briefly von Bertalanffy's reaction to the American intellectual scene. After his arrival on the American continent von Bertalanffy worked both in the field of applied biology (cancer research) and also in psychiatric-psychological settings. He was struck by the narrow-mindedness, limited horizons, paucity of

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[42] Psychosomatic Medicine (1964).

ideas and preoccupation with technical minutiae of cancer researchers on the American continent. According to von Bertalanffy this criticism applied not only to cancer research, but also to basic research in science, and to American scholarship generally. Von Bertalanffy was particularly critical of the lack of historical perspective of American scientists and scholars. They were usually not interested in the history of their disciplines and of the problems they were working on. Consequently, the image of their disciplines was flat, two-dimensional and lacking in depth, which the understanding of historical development could provide. The lack of historical knowledge resulted in the 'Columbus Syndrome.' Old ideas and theories were rediscovered and presented as original. The lack of familiarity with older literature led to unnecessary reduplication of research. While at the University of Alberta von Bertalanffy offered a superb course on the history of biology, which took two years. (It was in a striking contrast to one semester courses typical of American universities).

Von Bertalanffy was keenly interested in the history of various institutions and organizations. One of his hobbies was the history of postal systems. He wrote a long paper on commerce and sea mail of the Venetian Republic.[43]

Von Bertalanffy came into contact with American psychology through psychiatry. Two leaders of American psychiatry Silvano Arieti and Karl Menninger, who were dissatisfied with the orthodox psychoanalysis, became interested in von Bertalanffy's theory of open systems. Silvano Arieti asked von Bertalanffy to contribute a chapter on general systems theory and psychiatry to the American Handbook of Psychiatry. In that chapter von Bertalanffy[44] described human personality as an active, multi-variable system characterized by an organization, differentiation, self-maintenance, and goal directness. There was some similarity between von Bertalanffy's view of personality and that of Alfred Adler. There was also a similarity between von Bertalanffy's views on human development, both physical and psychological, and Heinz Werner's theory of orthogenesis.[45] Both human organism and human personality were systems characterized by progressive differentiation of functions and their integration at progressively more complex levels. In that chapter von Bertalanffy also emphasized the importance of symbolic processes in understanding of mental illness. Karl Menninger found open systems conceptualization useful in his formulation of the theory of vital balance, a balance between processes leading to growth, to the enhancement of vitality and of mental health, and processes resulting in stagnation, mental illness and death. Von Bertalanffy spent two years as a visiting distinguished scholar at Menninger's foundation working on the problems of mental health and illness.

As mentioned earlier, von Bertalanffy was critical of both American behaviorism and of orthodox psychoanalysis because of the reductionist philosophy subscribed by these two schools, and also because they presented an unflattering, mechanistic image of man, man as a robot. This view of man was the Lockean view, man who was passively mirroring the external world, was reacting to it and was moulded by it. In contrast von Bertalanffy subscribed to the Leibnitzian view of man, man as an active, creative, striving agent. Man also unlike animals created symbols and lived in the world of symbols. In his 'Organismic Psychology and Systems Theory'[46] and in his book Robots, Men and Minds[47] von Bertalanffy criticized American

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[43] *Postal History Journal,* **7,** (1963); also von Bertalanffy (1963).

[44] (1966).

[45] Werner (1948).

[46] *Heinz Werner Lectures,* at Clark University, 1966.

psychology for presenting a 'zoomorphic image of man.' He considered it 'zoomorphic fallacy' which was equally erroneous as the 'anthropomorphic fallacy' of early students of animal behavior. The orthodox psychoanalytical view of man was equally unflattering because it tried to explain the complexities of human behavior by the mechanism of drive reduction of libidinal and aggressive impulses. Both behaviorism and psychoanalysis explained human motivation in terms of animal drives and instincts and regarded symbolic processes as only secondary. These shortcomings of Behaviorism and orthodox psychoanalysis made von Bertalanffy feel sympathetic to the third theoretical current on the American psychological scene, the so called 'third force' or Humanistic psychology which was trying to remedy the shortcomings of the behavioristic and psychoanalytical schools. Humanistic psychology presented a more dignified image of man. It emphasized the importance of total personality, rejected reductionism, and put stress on the uniquely human psychological phenomena. However von Bertalanffy was wary of the idea that human motivation could be explained in terms of the self-actualization of one's unique potential. This could be true of certain historical periods such as the Renaissance, but was not true of other periods such as the Middle Ages. Anonymous medieval monks who sacrificed their personal interests and relations for the sake of good works and the glory of God provided an example which cannot be easily subsumed under the rubric of self-actualization. Humans often sacrificed their personal interests and goals to become parts of a super-personal symbolic system actualizing some impersonal ideals. They tended to efface their individuality and at times their identity as unique human beings. The medieval European and the Asian Buddhist monks provided several convincing illustrations.

The emphasis of the Humanistic psychologists on the continuous growth and development of human personality, as exemplified by the theories of Gordon Allport[48] and Carl Rogers,[49] was particularly appealing to von Bertalanffy. He commented approvingly on Gordon Allport's theory which conceived human personality as a 'Heraclitean' continuous becoming. However von Bertalanffy believed that uniquely dynamic and creative aspects of human nature described by the Humanistic psychologists could be explained on he basis of open systems theory. Therefore they fitted into the framework of hard science and did not require a mystical explanation.

Among other contemporaneous psychologists von Bertalanffy felt a strong affinity with Gestalt psychologists, who stressed the importance of organization of perceptual field. He was sympathetic to Kurt Lewin's topological theory of personality and to Kurt Goldstein's organismic theory. As was mentioned before von Bertalanffy's interest in the growth and development of organisms made him very receptive to Heinz Werner's theory of orthogenesis. In his memorial Werner's lecture von Bertalanffy commented that Werner's book on *Comparative Psychology of Mental Development* appeared in 1926, two years before von Bertalanffy's book on Modern Theories of Development. Both these books quite independently presented a novel conceptualization of developmental processes. According to this new conceptualization developmental processes were controlled by certain very general laws. Von Bertalanffy was also very sympathetic to the Piagetian theory of mental development, because Jean Piaget quite early rejected mechanistic associationism and the view that human mental growth consisted of an accumulation of discrete habits. Instead Piaget conceived mental growth as a de-

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[47] Braziller (1967).

[48] (1955).

[49] (1961).

velopment of cognitive systems of increasing complexity and flexibility. Von Bertalanffy was a close friend of Karl and Charlotte Bühler, who emphasized the importance of symbolic processes and of values in human motivation and development. Karl Bühler's theory of language[50] as well as Casssirer's philosophy of symbolic forms[51] shaped von Bertalanffy's views on symbolic processes and on their importance for man. Finally von Bertalanffy was a life long friend of another Viennese Arthur Koestler, the author. He was considerably influenced by the latter's rejection of the mechanistic idea of man which dominated contemporary American social and intellectual scene. The American behavioristic psychology with its reductionist views and the 'zoomorphic fallacy' epitomized that mechanistic view of man, man as a drive reduction conditioned reflex machine, reacting to and being passively molded by social forces, conceived also mechanistically. A man thus conceived was an isolated social atom, motivated by profit, buffeted by social forces, passively submitting to them. Such a man was basically alienated from society, which was fragmented and lacking in internal cohesion. Taking a wider view and approaching the problem from the point of view of sociology of knowledge von Bertalanffy attributed the creation of the mechanistic image of man, 'man as a robot' to an interplay of powerful social forces in the contemporary America.[52] These forces attempted to mold the average citizen into a passive obedient operator of a factory assembly line, and a commercial goods consumer, easily manipulated by the media and advertising. A consumer whose vote at the ballot box was determined by the skill of the image makers employed by the candidates for political office. In his criticism of the American society and of its intellectual climate von Bertalanffy addressed himself to similar themes as Eric Fromm in his *The Sane Society*,[53] as Jules Henry in his *Culture Against Man*,[54] as Arthur Koestler in his *Lotus and the Robot*[55] and *The Ghost in the Machine*[56] and as David Riesman in his *The Lonely Crowd*.[57] All these critics of the American mass society of the twentieth century focused their criticism on its soul destroying conformity on the 'other directness' and 'me first' attitudes. They were critical of the American tendency to jump on the band wagon. Even American crime was characterized by the 'copy cat' imitations. Further, they considered social atomism, the lack of cohesion, the mechanization of work and pleasure to be the hallmarks of the contemporary American society, and of the American man who was controlled by positive and negative reinforcements. The externally over-stimulated man in such a society was a passive victim of the market place forces, regulated by an 'invisible hand' for the benefit of a few. These trends according to von Bertalanffy were reflected in the American approach to mass education, which was superficial, based on mechanistic memorization of facts and regurgitation of the latter in multiple choice quizzes. The culture instilled in young people a morality based on fun and financial success. According to von Bertalanffy such an upbringing resulted in mass illiteracy and an epidemic of juvenile delinquency.

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[50] Bühler (1934).

[51] Cassirer (1957).

[52] von Bertalanffy, *Robots, Men and Minds (1967).*

[53] (1955).

[54] (1963).

[55] (1960).

[56] (1967).

[57] (1950).

4. CONCLUSION

Von Bertalanffy died in 1972, sixteen years ago. One can ask what is the status of his contributions to biology and other disciplines today. I am not qualified to judge his technical contributions to the generalized thermodynamics and to the understanding of physics of open systems. His writings as far as psychology and social sciences are concerned were of a programmatic nature. They did not amount to a definite theory, but offered some general ideas and metaphors. However they drew attention of psychologists and social scientists to the dangers of an atomistic and mechanistic model of man and society - a model which did not pay enough attention to the relations among the elements and to their organization into systems.

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Center for Systems Research
University of Alberta
5-21 Tory
Edmonton T6G 2H4 Canada

Director: Richard Jung

TELEPHONE +403.492-8330
Telex 037-2979 (Att'n: CSR)
Telefax +403.492-7219 (Att'n: CSR)

ELECTRONIC MAIL:
CSR@UALTAVM
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