Aspects of Wholeness

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"That a meeting-point between Biology and Physical Science may at some time be found, there is no reason for doubting. But we may confidently predict that if that meeting-point is found, and one of the two sciences is swallowed up, that one will not be Biology."

J.B.S. Haldane

Holism is the observation that, although natural objects can be resolved into their parts, the parts are to some extent shaped by their participation in the whole object. For example, in organic chemistry it is recognized that the reactivity of an atom or radical is modified by adjoining parts of the molecule, by the solvent, etc. Holism would never have been named, except that it is so common in our scientific tradition for someone to say "We know all there is to know about the parts (atoms, surfaces, fields, genes, etc.), so we can foresee the result of their combination." Good engineering involves knowing the properties of the materials so thoroughly that accurate predictions can be made about their behavior in new structures, but good science requires a willingness to accept the unpredicted when it occurs. Holism, or a non-dogmatic attitude toward the world, recognizes individual uniqueness, rather than averages, and is likely to look for complex causes (especially environmental influences), rather than too easily ascribing traits "to the genes."

Historically, a reluctance to distinguish our present knowledge from possible knowledge, and to distinguish our definition of something from its real existence and fullest potential, has characterized most of the people who oppose holism, and call themselves reductionists. Consciousness, perception, sensation, pleasure, and intention have often been omitted from the world described by reductionists. If we are going to understand life and its possibilities, then it seems that we should begin with an appreciation of its "liveliest" aspects, as an essential dimension of our thinking, even if we are going to work with some of its relatively inert aspects, such as viral genetics.

The relation of energy to structure is, I think, the central question of biology. (The importance of the same question for the physical sciences might indicate in a rough way how Haldane's predicted "swallowing up" might occur.) The ideas of resonance and hysteresis, which are only vaguely defined in physics, have to do with the interaction of energy and structure on various levels of complexity and organization, and are examples of physical concepts that can gain meaning and clarity from biology. When energy flows through matter, order accumulates (as a result of resonance and hysteresis, for example), but we hear so much about "entropy," "randomness," and "symmetry" that we forget most of the formative processes in the material world.

Human (and ecological) health obviously should have the benefits of holistic science, but the actual situation is that biology and medicine have become very product-oriented, and holistic considerations are increasingly left to a variety of "fringe" occupations. Many of these alternative approaches are concerned with the idea of "energy" as the key to health, but in general they lack simple and effective methods for optimizing biological energy, and often use counter-productive methods. In the following pages I will show how some of the most important achievements of ordinary science can be retrieved from the distortions of the medical promoters, and made available for holistic use, that is, for appropriate use.

Non-Genetic Biology

The word, "gene," itself contains an ideology, since it implies origin, or genesis, though its main meaning is something like "a unit of continuity." Building on the word's connotation, dogmatic geneticists explicitly stated their "central dogma": that information flows only from DNA to RNA, and only from RNA to protein. When Temin and Baltimore described the "reverse transcription" of DNA from RNA, all of the professional biologists I talked to said flatly that they didn't believe it was possible. Even when no one was threatening the addition of "information" to the chromosomes, the dominant belief among biologists was that development was closely controlled "by the genes," because the body owes its genesis to the genes. Intelligence, body proportions, and senescence were said to be "specified" or "governed" or "programmed" by the genes. The "congenital" condition was often taken as the "genetic" condition. Textbooks said that the maternal influence was only "genetic,"

because the fetus was "insulated" from events in the mother's body (just as the "germ line" was isolated from events in the rest of the body). Although many kinds of experiments showed both prenatal and transgenerational influences of the environment on intelligence, body proportions, and rate of aging, the genetics-reductionist school ignored them, and defined themselves as the only scientific school of biology.

Mechanisms of Aging

Professor Soderwall and his students at the University of Oregon had shown that the corpora lutea (areas in the ovary which mainly produce progesterone) appeared to fail in aging hamsters, and that vitamin E supplements could extend fertility by a significant amount. His group showed that "aged ova" were not responsible for infertility, but rather that the uterine environment was not suitable for implantation. Soderwall had also demonstrated that excess estrogen could cause failure of the pregnancy at any point, from failure of the embryo to implant, to resorption of the fetus at a late stage of pregnancy.

Although I had investigated the association of estrogen with cancer, and knew from my own experience with migraines that stress, diet and hormones interacted in powerful ways, when I began to investigate the oxidative metabolism of the uterus I didn't realize that it would involve a convergence of several of my main interests. I was familiar with Otto Warburg's famous idea that cancer is caused by a "respiratory defect," and I knew that aged tissue had a diminished respiratory capacity. The textbooks indicated that estrogen deficiency and "aged ova" were responsible for senescent infertility. I found that the uterine endometrium of old animals often consumed oxygen at a high rate, and showed other signs of being under the influence of excessive estrogen. As I tried to understand this, I saw that several things could contribute to a high rate of oxygen consumption. Either too much estrogen, or too little progesterone could have the same effect, since it is the ratio between these hormones which controls their effects. A vitamin E deficiency increases oxygen consumption, and too much unsaturated fat has the same effect. In a vitamin E deficiency, unsaturated oils are oxidized in a way that produces "age pigment," also called ceroid pigment or lipofuscin. This pigment consumes both oxygen and fuel, but produces no usable energy. Estrogen excess synergizes with a deficiency of vitamin E to intensify the formation of this pigment. Partly, this might be because estrogen is a powerful stimulant of iron absorption, and iron is involved in the peroxidation that produces the pigment. But low oxygen concentration is what causes the iron to become active in peroxidation, and estrogen acts in several ways to decrease the availability of oxygen.

The way in which estrogen prevents or terminates pregnancy seems to be by causing the uterus to consume oxygen at such a high rate that there is no oxygen available for the embryo, which has a high requirement for oxygen beginning on the day that it normally implants. The chronic or cumulative effects of estrogen, leading to formation of lipofuscin, happen to act in the same direction as estrogen itself, causing oxygen to be reduced, especially in the uterus, but in all other tissues, too. Estrogen excess can also destroy the corpora lutea, interfering with the production of progesterone. Progesterone's effect in pregnancy is to assure the availability of oxygen and nutrients for the embryo, but it also has the general effect of inhibiting the formation of lipofuscin, and of other aging signs, by improving metabolic efficiency. (Progesterone is unusual among the anti-stress steroids in having no harmful side-effects.)

Although my work confirmed the other research that had been done in Soderwall's lab in the preceding 25 years, the idea that estrogen's influence appears to increase with aging, and even to contribute to the process of aging, was contrary to the doctrine that has been promoted by the pharmaceutical industry. Nevertheless, as I read more, I saw that there was really no evidence contrary to what I had seen in my own work. What existed was a web of interpretation which existed to sell estrogen treatments. Even the fact that estrogen causes abortion was "ignored," very consciously, until the industry had fabricated a more acceptable rationale with which to sell its "contraceptive" pills.

The idea of many factors acting in the same direction, and tending to have a cumulative effect, seemed to me to have a general biological significance. It seemed to be part of the answer to the question of what it is which is lost, or accumulated, during aging, which accounts for the decreased ability to adapt to the changing environment. It seemed to say something about the nature of Warburg's "respiratory defect" in cancer. The thyroid hormone, which governs respiration, is suppressed by estrogen, and by unsaturated fats. The wasteful metabolism of estrogen ➤

dominance tends to use up glucose, and is likely to activate the stress hormones, including cortisol. The main features of aging can be produced directly by administering excessive amounts of cortisol. These features include atrophy of skin, arteries, muscle, bone, immune system, and parts of the brain, loss of pigment (melanin), deposition of fat in certain areas, and slowed conduction velocity of nerves. The physiology of aging (especially reproductive aging) overlaps the physiology of stress.

Puberty and Aging

Many studies have demonstrated that puberty seems to trigger the mechanism of aging, and the idea of a "death hormone," located in the pituitary gland, has been suggested. Many degenerative diseases develop under the influence of excessive estrogen and cortisone (and as a result of the many metabolic changes which follow exposure to those hormones). Many of these diseases, especially those which appear after puberty and are more frequent in women, can be treated very effectively with the anti-estrogen and anti-stress hormones, such as progesterone.

Hans Selye pointed out that estrogen treatment mimics the first, "shock" phase of the stress reaction. An excess of estrogen (or any stressor) causes the pituitary to secrete prolactin and ACTH, and both of these hormones act on the ovaries to stop progesterone production, and contribute in many other ways to the process of atrophy. ACTH, of course, stimulates the secretion of cortisol. The removal of the pituitary obviously isn't a practical way to delay senescence, but protection against the "death hormones" can be achieved to some extent by altering the diet to minimize the effects of estrogen and cortisol. Historical and demographic studies show that certain conditions affect the age at which puberty occurs. Ashley Montague has argued that we need more neoteny, that is, that we should try to preserve and to extend our youthful functions, because those are our most human qualities. If we can generalize from animal studies, delaying puberty could increase brain size and longevity, improve intelligence, decrease violence, and even make people physically more attractive (the "cute puppy" appearance is largely a matter of brain size in relation to the size of the face and body). I think this will be the next step in human evolution. Just as nurturing, stimulation, and freedom promote improvement in the function and structure of the brain, cruelty and oppression act in the opposite direction. If puberty is delayed, then the importance of a culture which supports curiosity, exploration, play and sensuous pleasure seems obvious.

The physiological age of the parts of an organism depends in some way on the developmental stage of the whole organism. This contradicts the reductionists' idea that cells or tissues have an "intrinsic" lifespan which will cause them to deteriorate after a certain limited number of divisions. When pieces of breast tissue or skin were repeatedly transplanted from old animals to young animals of the same (syngeneic) strain, they were still in good condition after ten "life-times," and their survival was apparently limited only by the necessity of trimming them each time they were transferred, to make sure that no host tissue was transplanted with them. When old rats were grafted onto young rats, the old member of the pair lived to twice the expected age. Recently, young female mice were grafted onto old females, to investigate any hormonal factors in aging. The ovaries of the young animal appeared to age, and its production of progesterone decreased.

This kind of evidence (and the simple observation that the cells in skin and intestine undergo thousands of divisions in an individual's life-time) strongly favors the idea that a systemic energy problem is involved in aging.

Energy and Evolution

When mammals and birds achieved the ability to sustain a high metabolic rate by keeping their bodies at a steady, fairly high, temperature, their "food chain," based on photosynthesis, consisted of organisms that generally lived at a lower temperature.

Sugars, proteins, and the saturated fats produced by warm organisms can be eaten by warm-blooded animals with no particular side-effects. Organisms that live at low temperatures, however, contain unsaturated fats. The consumption of large amounts of unsaturated fats lowers the metabolic rate, and accumulated unsaturated fats are susceptible to a spontaneous and toxic form of oxidation. (The toxic effects include damage to the respiratory apparatus and to the circulatory and immune systems, increased rate of aging, and cancer.) These "low energy" foods in effect counteract the evolutionary achievement of a high metabolic rate. Several studies show that decreased consumption of unsaturated fats can delay puberty. Other studies show that an excess of unsaturated oil in the mother's diet can damage the development of the fetus's brain. The choice of foods which have less unsaturated fat tends to reinforce the achievements of evolution.

The seed oil industry has created a national phobia about the consumption of saturated fats and cholesterol, but there is no basis for the idea that those foods should be avoided. People with hypothyroidism are susceptible to heart disease, but their elevated blood cholesterol becomes normal when their thyroid function is restored.

The body's highest concentration of cholesterol exists in the brain. The level of cholesterol in the blood strongly influences the production of the protective hormones, such as progesterone. The brain contains

by far the body's highest concentration of these hormones.

In the winter and at night the respiratory energy producing system is damaged, and the protective hormones decline, and the harmful stress hormones increase. The immune system becomes less active, and mortality increases. Although ultraviolet light interacts with unsaturated fats in the skin to accelerate aging (E.R. Pinckney, *Medical Counterpoint,* Feb., 1973) and to produce cancer, ordinary visible light has several beneficial effects in animals. One effect is the "regeneration" of the enzyme SOD (superoxide dismutase), by causing its copper atom to be re-attached to the protein. Light also increases the activity of normal respiratory enzymes, and tends to normalize (or maximize) the production of hormones, including progesterone and thyroid. Animal migration to reproduce in regions with longer days is a way to benefit from this energy-promoting action of light. In adult birds, the increase of hormones in the spring causes the growth of new brain cells in the area that controls their singing. (In humans, the space inside the cranium keeps increasing into old age, and the amount of DNA in the brain also keeps increasing with age, but it has been assumed that such changes in adult brains result from an increase in the size of nerve cells, and an increase in the number of connective tissue cells, rather than from a continuing increase in the number of nerve cells.) I would expect an increase in the temperature of the earth, and increased use of artificial light (or migration) to lead to a prolongation of youth and the development of better brains.

Pollution

Besides the distortion of our food supply by the propaganda of the seed oil industry, there is increasing contamination of our food supply by heavy metals. Lead, for instance, has been spread everywhere, largely as a result of its use in leaded gasoline. Food additives are often contaminated with heavy metals from the sulfuric acid used in their manufacture. Practically everyone knows about the famous experiments in which food restriction increases the longevity of animals, as if eating were toxic. But removing toxic heavy metals from the food, without restricting the amount of food eaten, has had the same life-extending effect in experimental animals.

When estrogen is elevated (as at puberty, or in pregnancy, or with medical estrogen treatment) the absorption of iron is stimulated. During aging, the body's load of iron increases, especially if there is a deficiency of copper, and the body's content of copper decreases with age. Copper is an essential component of cytochrome oxidase, which has the crucial last position in the mitochondrial respiratory system. Copper is a component of the cytoplasmic SOD enzyme, which decreases with age. Ceruloplasmin, a major copper-containing protein, helps to keep iron in its safe oxidized form. Copper is involved in the production of melanin (itself an antioxidant) and elastin. The loss of melanin, elastin, and respiratory capacity, which is so characteristic of senescence, is also produced by excessive exposure to cortisol.

The protein, metallothionein, is rich in sulfhydryl groups, which bind heavy metals. It is assumed that this protein helps to detoxify and eliminate the toxic metals. This protein is induced by exposure to either a heavy metal or cortisol. A larger amount is produced in response to the combination of heavy metals and cortisol, than by either alone. Since copper, like the toxic metals cadmium, lead, mercury, and silver, reacts strongly with sulfhydryl groups, the body is likely to lose some copper when it is subjected to heavy metals or cortisol. I think this chronic loss of copper accounts for the obvious features of aging, such as loss of elasticity of the skin, lungs, and blood vessels, the depigmentation (demelanization) of skin, hair, and (in Parkinson's disease) substantia nigra, and for the decrease in respiratory capacity. The replacement of the copper by iron (and the loss of the copper-enzymes which protect against iron-catalyzed free radicals) probably accounts for the increased formation of lipofuscin during aging. When copper-dependent mitochondrial respiration fails, lipofuscin has the ability to sustain energy production through glycolysis (by keeping the coenzyme NAD, nicotinamide adenine dinucleotide, relatively oxidized), so it is possible that lipofuscin is a primitive sort of defense against stress.

In animals, copper supplementation can restore natural color to white hair, and in one experiment, it increased longevity. At present, there isn't enough knowledge about the safety of different ways of administering supplemental copper. It can be toxic, and it oxidizes other nutrients. Besides choosing foods high in copper and

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low in iron and other heavy metals, other dietary choices which support thyroid function will tend to promote the retention of copper. Other dietary practices can minimize our production of cortisol (e.g., combining fruits and protein, since protein foods lower blood sugar and stimulate the secretion of cortisol).

Self-Regulation

Physical science provides a much richer picture of the qualities and potential of the material world than geneticists recognize. Even many physicists don't recognize the richness implied by the body of experimental results in their field. Many well-known physical scientists have had relatively holistic attitudes (e.g., J.C. Bose, Michael Polanyi, B.V. Deryagin, Frederick Soddy, V.I. Vernadsky). A rich view of physics has much to offer to biology. However, when I say that a holistic view of biology is open to using physics and chemistry, as well as ecology, history, and cosmology, to achieve an adequate understanding, I should mention that there is a school of weird (immaterial and "quantum" centered) physics which is presenting itself as a holistic world-view. To them, I think Einstein's remark still applies: "You believe in a dice-playing God and I in perfect laws in the world of things existing as real objects...." Elsewhere, Einstein observed that an object's fields amounted to an extension of its material substance, i.e., he preferred to materialize fields, rather than to dematerialize things, as some of the popular philosophers of physics do.

The orderly, epitaxial growth of crystals has been shown to occur across the thickness of a plastic film. A detailed study of this sort of long-range ordering process was made by Alexander Rothen. He was able to demonstrate biologically specific adsorption at relatively great distances. Many other types of research in adsorption fields and long-range order make it clear that the interactions of atoms and molecules in cells needn't be governed by either direct contact or by random motion. When cell components are rearranged, they return to their normal position in relation to other components, revealing a great capacity for self-assembly or self-ordering.

The medical tradition of naturopathy recognizes a great capacity of the body for self-regulation and self-healing. I think these attitudes can be usefully expanded now, in the light of new knowledge about energy and structure. On the short time scale in which we think about the health of an individual, and on the transgenerational scale relating to having healthier, more intelligent children, and on the evolutionary time scale, I think we can see a tendency, not just to preserve homeostasis, but to move upward in energy and greater generality of structure and function. To provide more energy and scope for using it stimulates our ability to use energy meaningfully.

Some Implications

There is considerable flexibility in living organisms, and in higher and lower levels of organization, and we can see some of the ways in which structures of different complexity accommodate themselves to the surrounding conditions of energy and structure.

The conditions under which the brain develops, including gestational support and the later nutritional-hormonal-behavioral conditions, the degree of stress and stimulation, contribute to the brain's

structural complexity and metabolic energy use, and to the organism's ability to cope successfully with the environment.

Vicious circles of physiology often stabilize an organism on a low energy level, which may involve disease or rapid aging.

The existence of a few systems of positive feedback (self stimulation), however, indicates that in our fundamental structure we are biased in an expansive, upward direction. Progesterone (and its precursors, pregnenolone and cholesterol) and thyroid hormones participate in some of the important positive feedback systems, involving energy production, stress resistance, and brain growth.

In therapy and in everyday living we can try to protect and promote our energy-producing and energy-using systems by seeking the stimulation, the conditions of light and temperature, and the foods that are appropriate for our evolutionary level.

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