CARTESIANISM IS BECOMING LESS A DOGMA[1]

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EMERSON wrote the following lines:

> 'Tis the day of the chattel,
> Things are in the saddle,
> Web to weave, and corn to grind
> And ride mankind.

In Emerson's day, it appears, men were obsessed with the reality of things as over against life.

Things are yet in the saddle. We have so believed in matter—things—that, I fear, we have prayed too earnestly, "Give us this day our daily bread." It seems that, in this respect, we are like the good householder who had resolved to pray for a peck of everything. That night he prayed for a peck of this, a peck of that, a peck of pepper. "Oh, hell! Lord, that's too much pepper." So we find our prayers for bread answered. But hell, Lord, there's too much bread; for our storehouses are filled and our markets glutted with food; while upon all sides our neighbors are found hungry. Our conviction in the reality of bread has caused us to neglect the prayer, "Thy kingdom come." Bread, not personality, has been considered real by men and mankind finds itself in a muddle.

Science has been responsible for this situation. She has been under the sway of Cartesianism during the nineteenth century. The Cartesian revolution was launched by Descartes in the early seventeenth century. Prior to Descartes even men like Kepler and Galileo were seeking rather "divine perfection and purpose" than "sober description." The great value of this revolution lay in the fact that men were freed by it of the authority of the Aristotelian scholastics and of the symbolism that the Neo-platonists saw in numbers, the stars and celestial circumstances. Following this revolution, "Purposes gave way to mathematics, human will and foresight to immutable and inflexible mechanical order."[2] Since Descartes, amoebae have been compelled to ingest food; birds to fly because they were mere machines and youths to aspire to win maidens because of the complex concatenation of circumstances that was behind them and of the fortuitous concourse of atoms that was within them. The reaction of an amoeba, the flight of a bird and the aspirations of men were all determined by what came to be considered the result of "chemic compulsion."

Thus biologists find themselves in a peculiar position as they are confronted with the two mysteries—matter and life. Under the influence of Cartesianism they have chosen the former.

Hence they have the peculiar habit either of defining their sciences as that of life and then hastily reducing life to terms of protoplasm or of referring to it as the science of living matter. They avoid life with its implications of purpose and cooperation.

This attitude on the part of the biologists arises out of the influence of Darwinism, which brought the reign of law into the realm of life. The theory of the survival of the fittest was applied to biological processes in the most detailed manner. I was taught, for example, that I existed only because of the nicely balanced struggle, that was maintained in my body, between its cells and tissues for the necessary materials with which to maintain their respective combustions. Within living forms, there was only struggle. There could be no cooperation. Cartesianism applied to biology, therefore, put cooperation, life itself, out of the universe.

But turn where we will, where we find life there we find cooperation. In our own laboratory we frequently witness two or more amoeba-like animals fusing, as though they were droplets of fluid, in order that a large food-object might be "swallowed" and digested. After the meal has been appropriated the cooperating individuals separate.

Who of us, who saw in Dr. Speidel's film last year a phagocyte struggling until it entered the sarcolemma of a nerve and picked up and carried away a foreign particle from within the sarcolemma, was not impressed with the cooperative aspect of this conduct?

In my own laboratory some interesting observations have been made upon a simple multicellular animal known as *Stenostomum oesophagium.*

This animal possesses no female gonoducts and yet its egg is large and supplied with much yolk. This yolk is needed as food for the embryo that will develop from the egg. Since there are no yolk glands to furnish yolk, material for yolk-elaboration must be obtained in some other manner. To this end wandering cells become phagocytic and consume the "head" with its pharynx, organs of special sense and "brain." The material thus obtained by the wandering cells is carried to the growing "egg" and converted into yolk.

Similar phenomena are displayed by *Stenostomum* under other conditions. Dr. Yoe and I[3] found that

[1] Address of the retiring president of the Virginia Academy of Science.

[2] J. H. Randall, "The Making of the Modern Mind." Houghton Mifflin Co., Boston, p. 227.

[3] Wm. A. Kepner and John H. Yoe, *Jour. Exp. Zoology,* Vol. 66.

if you subject one of these animals to distilled water which lacks the necessary materials for metabolism, the simple epidermis will become stratified and the cells of the inner strata will become amoebocytes that go out into the body and consume the "head" thus supplying the body proper with material by means of which it can tide itself through the period of vicissitude, if this be not too prolonged.

Carter[4] and Hess[5] have obtained other evidence of the cooperative conduct of the amoebocytes and histiocytes of *Stenostomum*.

Finally, where would we be if it were not for cooperation on the part of the cells, tissues and organs in our own bodies? Where, for example, would I be at this moment if the tissues in my lower extremities were to refuse to do their part on the basis that their aristocratic fellows, the neural tissues, were not doing their share of work and yet were being better cared for and protected? My state would be no less unfortunate if the neural tissues of my body were to rebel on the basis that they were the important individuals in my body and would demand all the food and drink and not condescend to help the more lowly tissues. In the one case I'd collapse; in the other I'd faint. In either case this address would come to an end, and you all would be filled with a cooperative impulse to help a fellow being. In the economy of a metazoan's body there is no place for either the arrogant aristocrat or the cringing communist. All life is cooperative, and Wheeler[6] is justified in saying that "the social is a correlate of life."

Life, however, is purposive as well as cooperative. Indeed, cooperation seems to imply purposiveness.

It is because of this purposiveness that I was able to point out some years ago[7] that physicists and chemists differed from biologists in that they need only the phrase "as a result of" in referring to their facts, whereas the biologists are compelled to use the phrase "in order that."

This distinction yet holds. I was greatly impressed with the apparent scientific attitude of a recent psychobiographer who would consider all the conduct of his subject to be the result of the subject's past experience. His subject, for example, had a keen sense of right and wrong, which arose out of his experiences when his mother weaned him. As a result of having been weaned the world was no longer entirely good; there was also wrong. As a result of all this a keen sense of right and wrong had been developed in the subject's mind. Throughout the first half of the book the psychobiographer got along fairly well with the phrase "as a result of." But near the middle of the book he fell from his strictly scientific attitude; for he said, "The censor [conscience] has been built up in order to keep the ego in check."[8] This is the purposiveness that even a psychobiographer must recognize in life.

I have been told that one biologist is revising his text-book with the object of using only the phrase "as a result of" and deleting anything that may imply the phrase "in order that." To my mind this will be a difficult task; but even if accomplished it is needless. For the book is being revised *in order that* it may be ultra-scientific. A mechanistic biologist must needs show purpose, for he too lives.

An amoeba takes in food in order to satisfy a metabolic demand. There is more here than a mere chemic compulsion; for, as William James has indicated, amoebas do not fill gluttons' graves. Men struggle that ideals may be realized and not because of chemic compulsion. Jennings is justified in ascribing to biologists the guilt of the monstrous absurdity "that ideals and purposes play no part in life."[9]

Moreover, it must not be overlooked that metabolism presents a unique situation for the science of biology. Metabolism represents a flow of matter through the body of an organism. The substance thus carried into and out of the body is used in building up (anabolism) and breaking down protoplasm (katabolism), with the result that energy is made available for the work of the organism.

Matter in an organism is therefore transient. It has been estimated that there is a complete turnover of material in one's body every seven years. Hence it was a foolish Japanese who, after having lived in the United States for twenty years, had decreed that his body should be burned and the ashes sent back to dear old Japan from whence they had come. Good old American ashes had been sent back to Japan. The material of his body had been transient, but his personality had persisted during those twenty years.

Nuttycombe and I[10] have held an animal that eats another animal and appropriates the "loaded guns" (nematocysts) of its victim away from the "gun-maker" for twenty-six asexual generations. One of the more than two million potential individuals of the twenty-seventh generation ate a "gun-maker," appropriated and used its "guns." Thus through twenty-six generations of bodies matter had been streaming—had come and gone—and yet none of it had had experience with "gun-makers" and their "guns." However, the instinctive knowledge to appropriate and use the "guns" had persisted.

4 J. S. Carter, *Jour. Exp. Zoology*, Vol. 65.
5 Margaret Hess. In manuscript.
6 W. M. Wheeler, SCIENCE, 64: 437.
7 Wm. A. Kepner, SCIENCE, 73: 692, 1931.
8 L. Pierce Clark, "Lincoln: a Psychobiography," p. 87. Scribner's, New York, 1933.
9 H. S. Jennings, SCIENCE, 65: 24, 1927.
10 Wm. A. Kepner and J. W. Nuttycombe. *Biol. Bul.*, Vol. 57.

In addition to this, we have been able to mutilate these animals extensively after they had been removed from "gun-makers" by fifteen or more generations. Regeneration of lost parts was followed by normal conduct toward "gun-makers" and their "guns." It is true that the individuals in all these generations represented but one gene complex; but taking cognizance of that point, the peculiar fact remains that even genes must respire and that matter, therefore, had come and gone through countless numbers of gene-generations. Matter in the case of microstomum was transient, but the manifestation of life had persisted.

In the purposive, cooperative effort of life and in its persistence throughout the metabolic flow of matter, biologists are confronted with characteristics that are peculiar.

The Cartesian dogma would ignore these characteristics of life. Many biologists yet consider that they can not afford to recognize these phenomena. To do so would jeopardize their scientific attitude.

The physicists and chemists appear to have less respect for the foundation upon which the Cartesian dogma was based. In the nineteenth century the atom was looked upon as the only form of reality. It was solid and immutable. Out of various combinations of atoms all forms of matter and phenomena arose. The physicists and chemists are becoming less dogmatic in their conception of matter and the atom as an ultimate form of reality. The concept of the atom is changing and in the case of hydrogen is considered to be nearly empty. One physicist speaks of matter as being a "derivative of consciousness." Others claim that matter may be reduced to terms of energy or electricity. Finally, no scientist is prepared to tell us what electricity, of which protons and electrons may be composed, is. One has in all this a decline of the attitude that had been assumed by scientists since Descartes.

Biologists, too, are becoming less inclined to reduce all vital phenomena to terms of matter. In the nineteenth century even mind was held to be an epiphenomenon. The brain secreted thought as the liver secreted bile. There could be no psychosis without neurosis. The regulative, cooperative conduct of an animal is now seen to involve all the tissues and cells; so that, in the case of the animal that eats "gun-makers," one is compelled to modify the phrase "no psychosis without neurosis" to run "no psychosis without epidermosis, endodermosis and mesodermosis." Or as one of my colleagues has said, "One's consciousness is realized through the cooperation of all the cells of one's body." The cells of one's toe as well as his cortical brain-cells play a part in the realization of consciousness. Wells, Huxley and Wells, in reviewing the knowledge men have of psychic phenomena, conclude that "mind and matter are two aspects of universal stuff."

Some scientists have, therefore, departed far from the idea that the atom of matter represents ultimate reality and life is no longer held to be a product of matter. Matter may be electricity. Electricity and life may be two phases of reality.

I have never seen electricity perish and I have never seen life die.

A child was watching me clean fish one day. As I went on with my work she ran on with her child's mind. The following conversation was opened by the working of her mind:

"Daddy, have these fish died and their souls gone to heaven?"

"Little Lida, do you know what electricity is?"

"Of course I do, have I not been shocked by it when I put my fingers into the outlet by the floor?"

"Do you know what life is?"

"Of course I do; am I not alive?"

"Now then, I may be in a position to answer your question concerning these fish. Can you see electricity by means of your brother's electric locomotive?"

"Yes; for if electricity is there, it runs."

"If while it runs one breaks the engine, does that destroy electricity?"

"No."

"If a mechanic repair the locomotive can you again see electricity by means of the repaired engine?"

"Yes."

"Well, the situation with reference to these fish is similar [analogous]. Life, like electricity, is everywhere. Our bodies are like machines through which we see life in one another. When these bodies break we can no longer see life, just as when an electric toy is broken we can no longer see electricity manifested. Now these fish's bodies are broken machines. Were I an expert biologist, I could repair them and then you would again see life manifested by these bodies. You may some day see my body break, but that will not necessarily mean that the life you recognize as Daddy will die. Living daddies and their daughters never die, though their bodies break and disintegrate in time."

The little girl closed our conversation with "I like dat story, Daddy."

So I close my address by reminding you that Cartesianism is becoming less a dogma. This dogma has led us to an unsatisfactory social situation, wherein the "ever-increasing beauty and power of science are manifest"; but wherein "the power of religion" has not "grown to render impossible hate and strife between races and nations"[11] and individuals.

Perhaps the next generation of biologists will look

[11] Richard Willstätter, SCIENCE, 78: 274, 1933.

upon protoplasm as the "medium of vital manifestation" rather than the physical basis of life and thus establish a better foundation upon which to build the social and personal progress of human beings. Humanity has been admonished to seek life rather than things.

OBITUARY

HENRY TITUS KOENIG

1891–1934

BORN, Pittsburgh, Pa., July 14, 1891, son of George F. and Barbara Dinkle Koenig. Graduated from Tarentum High School in 1908. Obtained B.S. degree in chemistry, University of Pittsburgh, June, 1912. From 1912 to 1914 associated with fellow classmate, the late Glenn Donald Kammer, and with the late Dr. Charles H. Viol, in laboratory of Standard Chemical Company, Pittsburgh, in pioneer work on radium recovery from carnotite ore from Colorado, resulting in a method for profitable radium recovery from this ore. In 1914–15, studied under Professor George H. Hulett at Princeton; while there, with Dr. Willy A. Schlesinger, established experimental laboratory of radioactivity. The two incorporated the Schlesinger Radium Company, which began operating in 1915. In this laboratory, in Denver, Koenig developed luminous materials which were employed by the U. S. Government during the World War. In 1919, Koenig, while on leave of absence, spent six months with Professor Herman Schlundt in the University of Missouri. He continued as chief chemist for the Schlesinger Radium Company until 1921. While there, he developed methods for increasing the radium recovery from 50 per cent. of the content of the ore to 88 per cent., thus obtaining about one gram of radium from 200 tons of handpicked ore. Then the rich ore from Katanga in the Belgian Congo was announced. Koenig was called by the Union Miniere of Oolen in Brussels, Belgium, to apply his recovery methods to the richer ore. At the same time he installed apparatus for the recovery of radium emanation, or radon. The Belgian development cut the price of radium in half and the American industry ceased. After the Belgian development, he spent about three months with Madame Curie and frequently visited Professor Aartz in Holland. In 1923, he returned to America, when his interest shifted from radium to vanadium, and in the service of the U. S. Vanadium Company in Colorado, he developed the chloride-bisulfate roasting process for vanadium recovery. He patented the process, which was commercially successful. During 1923–24, his process for forced precipitation of potassium yielded phosphorus-free ferro-vanadium. Following this, he spent four months with Professor Colin G. Fink of Columbia, and then joined Harry Payne Whitney at the Hudson Bay Mining and Milling Company. As chief chemist, he developed methods for treatment of complex sulfide ores containing gold, silver, copper and zinc and was co-patentee of the process. During this association, which lasted until 1931, plant construction involving almost twenty million dollars developed. In the fall of 1931, he opened consulting laboratories in Denver, Colorado, which he continued until his death, May 20, 1934.

Koenig made the same sacrifice as his fellow pioneers who had entered the radium recovery field—succumbed to the insidious effects of radium when only 43 years of age. He is deserving of the highest tribute for his pioneer venture into an unknown and dangerous field, and for his valuable contributions there and the other developments cited.

He is survived by his mother; a sister, Mrs. George H. Spacke, of Denver; another sister, Mrs. Louise von Warren, of San Diego, California; and a brother, Walter J. Koenig, technical director of the Sloane-Blabon Corporation of Philadelphia.

ALEXANDER SILVERMAN

RECENT DEATHS

DR. NATHANIEL LORD BRITTON, for thirty-three years, until his retirement as director emeritus in 1930, director-in-chief of the New York Botanical Garden, previously professor of botany at Columbia University, died on June 25. He was seventy-five years old.

JOHN MERTON ALDRICH, associate curator of insects in the National Museum, died in Washington, D. C., on May 27, at the age of sixty-eight years.

PROFESSOR LEONARD P. DICKINSON, head of the department of electrical engineering at the University of Vermont, died on June 3 at the age of sixty years. Before going to Vermont fourteen years ago, he had served on the faculty of Lafayette College, of Rhode Island State College and of Robert College, Constantinople.

PROFESSOR RICHARD THORNTON FISHER, director of the Harvard Forest at Petersham, Massachusetts, died suddenly on June 9, at the age of fifty-eight years.

DR. HARRIET W. BIGELOW, head of the department of astronomy at Smith College, died at Soerabaja, Java, on June 29. Miss Bigelow was sixty-four years old.

DR. JAKOB JOHANNES SEDERHOLM, director of the