HUMAN PURPOSE, THE LIMBIC SYSTEM, AND THE SENSE OF SATISFACTION

by Chauncey D. Leake

For several years I have been offering a no-credit course in philosophy for the benefit of candidates for the degree of doctor of philosophy. I am naive enough to believe that holders of this degree should know something about the subject. The results of my effort have been satisfying, at least to me.

In an attempt to be practical, I ask at the beginning of the course some basic questions that we all have to face up to sometime or other. What are we living for? What motivates us? What are our purposes or goals, in general or in particular? What governs our interpersonal relations? What guides our conduct? What determines our mood and our behavior?

The answers to these questions have been formulated in various ways from the beginning of man's conscious existence. It is interesting here that the dictum of Ernst Haeckel (1834–1919) applies to concepts as well as to embryology: Ontogeny recapitulates phylogeny. This means that as individuals we go through the evolution of our species. As embryos we are like fish with gill slits. But we evolve rapidly in our mothers' wombs until birth. From birth on we mature, often with our brains lagging behind. Yet our individual intellectual maturation follows approximately the long and rough intellectual pathway of our species.

The answers to the basic questions of our existence comprise the various *ethics*. Some three dozen or more well-formulated theories of ethics have been developed since antiquity. They deal chiefly with general purposes, and ways to achieve them: ends and means in life. We learn them, mostly subconsciously as we grow up and mature.

It seems to be apparent that in order to obtain any goal one should

Chauncey D. Leake is senior lecturer in the history and philosophy of the health professions and in pharmacology, University of California, San Francisco. "This essay," says the author, "is dedicated to William Bennett Bean, until recently Sir William Osler Professor of Medicine, University of Iowa, and now director of the Institute for the Medical Humanities, University of Texas, Galveston."

[*Zygon*, vol. 10, no. 1 (March 1975).]
© 1975 by the University of Chicago. All rights reserved.

have some information about it, whether to get a new job, build a bridge, or restore a sick person to health, or, on the evil side, to rob a bank, kidnap someone, or obtain power. This raises the question of what the truth is about our goals, ourselves, and our environment, and how one may acquire the truth. The answers to this question comprise the various *logics* which have been formulated over the centuries. The most satisfactory answer so far seems to be by way of the sciences. This way permits independent verification and thus leads to substantial agreement, always with the understanding that the truth is relative, subject to revision, as more verifiable knowledge accumulates.

Then one has the job of effectively applying one's knowledge to the accomplishment of one's purposes. This requires judgment, discrimination, and experience. This involves the *esthetics*. The esthetics are primarily concerned with the arts, the humanities, and the technologies.

Thus, in my scheme of practical philosophy we deal with the ethics (purposes that are right or good), the logics (reasoning or knowledge, the sciences), and the esthetics (methods of applying knowledge, as one learns from the arts, the humanities, and the technologies). The first aphorism ascribed to Hippocrates (460–377 B.C.) applies: "Life is short, art is long, experience fleeting, judgment difficult."

The sense of satisfaction has to do with the ethics. It is the sense that comes with the accomplishment of a purpose. It is a most important sense and is strongly conditionable. Since it involves a built-in neurophysiological mechanism, it is an evolutionary proposition. To achieve satisfaction seems to be the biological answer to the basic question, What are we living for? I will try to explain what I mean.

A Search for a Scientific Ethic

On several occasions I have told the story of this search. There had been talk during the Great Depression on ethical theory. The question was raised of whether scientific inquiry could be applied to the development of a viable ethic.

In the summer of 1939 the American Association for the Advancement of Science met at Stanford University. My wife and I had a few acres of redwoods west of Palo Alto on the San Lorenzo River. There we had a dam for a very cold swimming pool, a cabin, and a couple of fine redwood circles. One we used as a barbecue, and the other as a seminar setting for our pharmacology students. With a blackboard on a towering redwood, and with rustic benches around the circle, it was a pleasant spot for relaxed discussion.

We asked some of our AAAS friends to join us in a Sunday after-

noon seminar discussion on science and ethics. There came Edwin Grant Conklin (1863–1952), the distinguished cytologist, president of AAAS, and my Princeton teacher of a quarter-century before; Olaf Larsell (1886–1966), the keen neuroanatomist from the University of Oregon, and my teacher at Wisconsin two decades earlier; and C. Judson Herrick (1868–1969), top neurophysiologist from the University of Chicago. My colleagues, Charles Gurchot, with a Gallic slant, and Otto Guttentag, with a Germanic outlook, were the other discussants. The dozen or so graduate students and their wives who were there said little as usual, except wisely to agree!

We set ourselves the task of seeing whether we could formulate a naturally operating principle involving human relations which would have ethical significance. We figured there must have evolved such a principle, and that it would operate whether we liked it or not, or whether or not we were aware of it. Something like the principle of gravity but not easily measurable except statistically.

We discussed the idea, and gradually there emerged this formulation: The probability of survival of a relationship between individuals, or groups of individuals, increases with the extent to which that relationship is mutually satisfying.

This statement, quite scientifically based on probability, is inducible, we thought, from the plethora of individual experiences we all go through in relations with other people. It is commonplace in the marriage relationship, or between parents and children, or between rivals in love or business, or between teachers and pupils, or between capitalists and working people, or between rival cities, states, or nations. Whatever the relationship may be, if it is not mutually satisfying, it is adjusted by trial, by give and take, or by hostility, until it is mutually satisfying, either by voluntary agreement or by force.

This formulation was tentatively debated at a symposium on science and ethics which I arranged for the Philadelphia meeting of the AAAS in 1940. It was published on several occasions.[1] When Professor Patrick Romanell became my colleague at the University of Texas Medical Branch in Galveston, we continued our debate.[2]

Although we had shown how several respected biologists agreed with our general position, the matter languished. We were stymied over the question of what is "satisfying." That satisfaction is an emotionally conditionable feeling there was little doubt. But what is it in neurophysiological or scientific terms?

The Basic Life Activity of Two Cell Groups in Our Limbic Systems

The answer came a decade or so later in the clear, experimental

studies of Paul D. MacLean of the National Institute of Mental Health in Bethesda, Maryland. First clearly expressed at one of the famed Macy Foundation Conferences, arranged by Frank Fremont-Smith at Princeton in 1958, it was more recently put in semipopular form in *Zygon.*[3]

The limbic system in humans has evolved from a primitive fish and reptilian part of our brain stems. It is a general relay set of neurons through which incoming sensory nervous impulses are shunted to various parts of our cerebral cortices for recognition and storage. Through it also go motor impulses from the cerebrum and cerebellum for coordinated muscular activity. In it are two anatomically close groups of cells, one of which, as MacLean puts it, has to do with individual survival by regulating food intake. The other has to do with species survival through regulation of sex activity.

The cells regulating food intake seem to function with a sort of glucostat. When the energy-producing compounds in these cells—the sugars and glucose—get metabolized away, the glucostat goes on, and the food intake cells become active. The whole organism is oriented toward the search for and ingestion of food. It matters not whether in the primeval jungle or in a sophisticated society; every six or eight hours, we begin to scrounge around for food. Muscle tension rises, blood pressure and heart rate go up, vision and hearing become more acute, gastric function increases, and we get hungry and aggressive.

When food is ingested, it is digested in our alimentary tracts; the resulting chyle goes through our portal circulation to our livers, where much is metabolized to sugars and glucose—some of which, going into the general circulation, raises blood sugar; some of which, entering the cells in our limbic systems, raises the level of energy-producing compounds therein—and the glucostat shuts off. We relax; muscle tension, blood pressure, and respiration fall; vision and hearing become less acute; we lose aggressiveness, become sleepy and contented. We are satisfied.

This sense of satisfaction is strongly conditionable. Babies readily fall asleep after feeding. The warm, comfortable feeling at one's mother's breast is firmly imprinted. It becomes conditioned in various ways, but we continue always to seek, however subconsciously, that comfortable feeling of satisfaction.

As we grow older, those limbic system cells associated with species preservation become active. Under the mysterious alchemy of our gonads, we mature sexually, and the sex-drive cells of our limbic systems begin to operate.

The mechanism of the activity of these sex-drive cells seems to differ from that of the food-intake cells. There seems to be no specific

"stat." However, as the inevitable metabolism within these cells proceeds, they tend to become polarized. The positively charged ions within them tend to migrate toward the surface of the cells, while the negatively charged ions tend to congregate in their interiors. Positively charged ions, such as those of sodium, potassium, calcium, and magnesium, and of positively charged organic radicals, move toward the cell surface membrane, while the negatively charged chloride, sulfate, phosphate, and similar ions stay near the center of the cells. The cells become polarized, and the more they are polarized, the more active they become in firing off nervous impulses into all the vast complex of our nervous systems.

The whole organism becomes oriented toward a sex object. Muscle tension goes up; blood pressure, respiration, and heart rate increase; the senses are alerted; the individual becomes aggressive; and sex activity is anticipated. The process speeds up in direct sexual activity until the polarization in the limbic system sex-drive cells is beyond the capacity of the membranes of the cells to maintain. Rapid depolarization of these cells seems to occur at orgasm, and the cells become inactive.

At orgasm, individuals usually relax. Muscle tension goes down, along with blood pressure, respiration, and heart rate; the senses become less alert; and there is often a comfortable feeling of drowsiness, easily conducive to sleep. This is again the feeling of satisfaction. It comes from the completion of sex activity, whether auto, homo, or hetero.

The desire for this feeling is strongly conditionable with regard to the satisfaction both from sex gratification and from eating. It is interesting that whereas gratification from eating, the satisfying feeling when the glucostat shuts off, has been pleasantly socialized in dining, the gratification of sex drive remains generally a highly individualized and private affair. Conditioning in these matters surely does play a large role.

This conditioning, through the accumulation of individual experience, may result in seeking many other goals, in addition to food and sex, to the achievement of which there may come that same sense of satisfaction, so deeply desired. It may be a new job, a promotion, more money. It may be victory in physical, economic, or prestige rivalry perhaps involving combat and risk of life. It may be the winning of a desirable sex object. It may be the completion of an arduous task, physical, mental, or technological. It may be any purpose or goal, the achievement of which is earnestly desired either because it is already one of those programmed in the limbic system or because it has become a condition for one or more of them.

My discussion seems to have ethical consequences. Indeed, the sense of satisfaction, as I have outlined it, seems to be a fundamental answer to those basic questions we all ask of ourselves sometime or other, consciously or subconsciously: What are we living for? What motivates us? What guides our conduct? What governs our interpersonal relations? What directs our conduct? What determines our moods and behavior?

The various answers to these questions, which have been formulated in our cultures over the millennia of our species existence, comprise the various ethics. Elsewhere I have tried to discuss these at some length.[4] The most satisfactory answer so far seems to be, as I have indicated, to be satisfied. This answer is built into us, through the operation of the limbic system cell groups concerned with self-preservation in the drive for food and species preservation in the drive for sex—in general, in the cybernetic mechanisms that are necessary for life.

Since the operation of these limbic system cell centers is cyclic, about every six hours or so for food intake, and in varying cycles for sex, there is little opportunity for continuing satisfaction, unless by unusual ascetic mediation one can suppress or sublimate these built-in drives. The sex drive seems easier thus to suppress than the drive for food. Self-preservation seems to be a more basic built-in drive than species preservation.

The Psychodynamism of Dissatisfaction and the Focusing of Frustration

If it is the case that there seems to be little chance for continual satisfaction, except as we grow too old to care, then it becomes pertinent to examine what may occur when one is dissatisfied. The psychodynamism of dissatisfaction has powerful ethical consequences also.

When someone begins to suspect that there may be a possibility of not getting what is ardently desired, anxiety becomes apparent. This often is a spur to greater effort to get what is wanted. Anxiety increases alertness, disturbs autonomic nervous function, and is usually accompanied by insomnia. This adds to the jittery feeling. Tranquilizing drugs are often taken, with merely temporary relief. Anxiety clouds judgment and feeds on itself.

If the anxiety continues to grow until there is realization of the probability of not reaching one's goal or achieving one's purpose, then frustration develops. A frustrated person vacillates, fears to make a decision, is distracted, pessimistic, and uncertain. Usually a frustrated person relieves some of the distress of frustration by focus-

ing it on someone else, often near and dear. By focusing frustration on someone else, a frustrated person preserves some precious ego image, figuring that someone else is to blame for the difficulty in getting what one wants.

A frustrated person begins to resent the one on whom the frustration is focused. This resentment reverberates to hostility. If nurtured, it goes to hatred. Then creeps in the notion of "getting even" with the one on whom frustration has focused and who is thought to be responsible for the frustration. Vengeance, in the grief it causes an often innocent victim, is a terrible consequence of the focusing of frustration.

Sometimes, if the focusing of frustration does not smolder too long, it may break out or explode in anger. This often clears the air. If one recognizes that someone near and often dear is beginning to become the object of focused frustration—by being unable to be looked at squarely in the eyes, for instance—it is wise to try to get right to the bottom of the matter at once. Let the anger come out, and often it may resolve in tears or in a laugh.

If the anger is contained, if sulking comes along, and the resentment and hatred build up, the psychodynamism may go to rage. Then anything may happen. Violence may erupt. Here is the frequent genesis of homicide or suicide.

Examples of the focusing of frustration may often be noted. It is the usual factor in marital discord. It is often to be noted in difficulties between parents and children, between teachers and students, between workers and bosses, between subordinates and officials, or between people in minority and those in dominant ethnic groups. Usually the underling is frustrated by a feeling of inferiority. It takes wise understanding for administrators, executives, and people in positions of superiority to maintain balance, good humor, and tact to avoid the focusing of frustration upon them.

Sick people in a hospital are usually frustrated. They want to get well, to go about their accustomed lives, to get away from the confining routine of a hospital. They often feel like inmates in a prison, and sometimes they are treated as such. Prison outbreaks and prison violence are expressions of the focusing of frustration. Frustrations of poverty focus in such nonsense ways as "zebra shootings," or in robbery and violence, resulting in the frustrations of prison if one is caught, and the consequent violence of a Marin Court slaying, a Patricia Hearst kidnapping, and such bombastic but cool revolutionary threats as those of the "Symbionese Liberation Army."

The control of frustration is an individual conditionable matter, in which personal, individual understanding is the prime essential. We

all have the responsibility for understanding and thus for helping one another to avoid the focusing of frustration and to prevent the possible consequence in violence. Society has always had to protect itself against violence and disorder. Whether or not society can abolish poverty, the principal cause of frustration among the mass of people, remains a problem and may always be so. The struggle of the have-nots to get what the haves have is an ancient one, and *les misérables* are ever present.

Les misérables can get out of their predicament and frustrations by seeking individual goals which are modest and obtainable and, having reached them, by moving along in accordance with their abilities. It is not wise to have champagne tastes when one merely has a beer pocketbook.

It is wise, however, to condition oneself to work toward obtainable goals, being honest with oneself as to capability. The satisfactions coming from modest goals and purposes that have been reached may start self-generating cycles of satisfaction. This can effectively prevent dissatisfaction and its potentially disastrous psychodynamism. The sense of satisfaction, no matter how minor, is a comforting one and an encouragement to seek it again.

Recapitulation

The sense of satisfaction seems to be the built-in answer to the basic question of what we are living for. This emotional feeling of comfortable, contented satisfaction seems to originate from the cyclic operation of our primitive limbic system cell groups concerned with self-preservation through food intake and species preservation through sex activity. The search for satisfaction is strongly conditionable.

Since the cyclic chemical operation of the limbic system cells for self and species preservation makes continual satisfaction impossible, one would be wise to understand the psychodynamism of dissatisfaction, with its potential dangers in the focusing of frustration. One may continue to seek satisfactions in the achievement of conditioned goals possible to reach by one's abilities. Even the poverty-stricken can make a positive start toward satisfaction by working for goals which they can achieve without harming anyone else.

Members of the health professions and services have a social obligation and responsibility to aid others to achieve a sense of satisfaction. Specifically, they may help to prevent the psychodynamism of dissatisfaction and the potential dangers of the focusing of frustration.

NOTES

1. C. Judson Herrick, "Little Academies I Have Known," *Scientific Monthly* 53 (1941): 133–41; Chauncey D. Leake, "The Relations between Science and Ethics," *Nature* 148 (1941): 783–84, and in *Science and Ethics,* ed. C. H. Waddington (London: Allen & Unwin, 1942, pp. 130–33; Chauncey D. Leake, "Ethicogenesis," *Scientific Monthly* 60 (1945): 245–53; Patrick Romanell, "A Philosopher's Reply to a Scientist's Ethic," ibid. 61 (1945): 293–306.

2. Chauncey D. Leake and Patrick Romanell, *Can We Agree?* (Austin: University of Texas Press, 1950).

3. Paul D. MacLean, "The Brain's Generation Gap: Some Human Implications," *Zygon* 8 (1973): 113–27.

4. Chauncey D. Leake, *Practical Philosophy* (Westbury, N.Y.: PJD Publications, 1973), pt. 1 ("The Ethics").