An Overture

Evolution, Economics and Education:

Understanding the Consequences of Natural Selection in Health and Disease

An exploration of the economic impact of natural selection and extinction upon the lives of the world's citizenry and of the educational, political, economic, and health consequences of ignorance of evolutionary problem solving.

John R. Jungck
Charles Dyke

In 1971, Lewontin wrote an editorial in *Evolution* entitled "The Yahooos Ride Again." He stated therein that perhaps the reason that evolution could be so soundly criticized (particularly in Texas, Florida, and California which are so heavily funded by NASA) was that they did not perceive Darwin's "theory" of evolution as having pragmatic, i.e. economic, consequences as do Newton's "Laws" which are fundamental to space exploration. Lewontin states: "Some sciences, like evolutionary biology, are expendable, because no one has figured out a way to get rich on them, so they fall prey to the yahoos and the know-nothings. Their defense is left to the teachers and the professors."

The primary intent of this essay is to counter this generally held belief by documenting the health consequences of evolution (particularly, natural selection and extinction) on our lives. We will draw special attention to those aspects of health that involve economic consequences. It is our belief that too much attention in the evolution vs. creation debate has centered on each disproving the other's assump-

tions and that too little attention has been given to the practical consequences of evolutionary processes in everyday human livelihood.

Marc Lappe in his book *Gems that Won't Die: Medical Consequences of the Misuse of Antibiotics* (1982) states that he wrote the book mostly because he was amazed to find that medical students were taught primarily taxonomy and identification in medical microbiology, but taught hardly anything about evolution despite the fact that treatment of microbial diseases almost exclusively involves natural selection.

I wrote this book in the belief that it was time to look critically at the neglected consequences of medical success—and excess. The first glimmerings of my thesis occurred during an innocuous conversation in 1967 when I asked a medical student at the University of Pennsylvania, where I was pursuing my doctorate in pathology, just how much evolutionary theory he was being taught in his bacteriology classes. In my naivete, I assumed that the study of bacteriology would include discussion of the consequences of using agents which would undoubtedly have a profound impact on the evolution of microorganisms. After a moment of bemused silence, he replied that they were only interested in classifying bacterial diseases and targeting them properly for antibiotic therapy.

He goes on to indict the abuse of antibiotics, which has led to natural selection of many microbes that are multiply resistant to many of the commonly prescribed antibiotics. If a common bacterial infection were to become epidemic, then it could become pandemic rapidly because we would not have enough exotic antibiotics on hand to stop such simple infections because the etiological agents ("germs") would already be resistant to all of the commonly available antibiotics. Furthermore, he documents how many "iatrogenic" (doctoring caused) illnesses which occur in hospitals are frequently caused by infections by *Klebsiella pneumoniae* which carry RTF's (drug resistance transfer factors) or plasmids which confer multiple antibiotic resistance to many common antibiotics. The consequent pneumonia spread in bed-ridden, immunologically susceptible patients has been rampant in a number of post-operative wards which, superficially, appear quite clean.

Lappe's analysis is insufficient in two regards. First, many people could read his book without realizing that the whole problem he documents is an evolutionary one. His book would be greatly improved if a small portion of it had been a simple pedagogical exercise in how natural selection oper-

John R. Jungck, editor of the *American Biology Teacher*, is head of the Department of Biology at Beloit College, Beloit, WI 53511. He considers himself an evolutionary biologist. Charles Dyke teaches in the Department of Philosophy 022-32, Temple University, 741 Humanities Building, Philadelphia, PA 19122.
ates and in situating this in broader evolutionary science. Second, Lappe did not castigate the pharmaceutical industry's evolutionary tinkering with our health, always to their economic benefit. The economics works in at least three ways: (1) antibiotics have been promoted as wonder drugs and hence the public uses a great deal of their products; (2) the more antibiotics are used, then the more resistant microbes are selected; hence, more antibiotics or new antibiotics must be employed and developed; and (3) broad spectrum antibiotics are preferred to specific antibiotics for specific diseases because of their economies of scale; thus, they are inherently tied to massive production schemes.

Most people tend to think that evolution is a process that occurs over millions of years (if they believe in evolution at all) and thus feel that our scare about antibiotics must surely be a futuristic scenario. Lappe has described the massive ecological changes which have occurred in just forty years of employing such substances. He states that from almost any stream in any developed country one can isolate bacteria which are already multiply resistant to many antibiotics that have only very recently been invented synthetically. Bruce Levin (personal communication), a population geneticist who works with microbes at the University of Massachusetts in Amherst, has performed experiments on himself which illustrate that resistant populations arise overnight after treatment with an antibiotic. In microorganisms that grow exceedingly fast (divide every 20 minutes in our gut), the genetic composition of a population (our measure of evolution) also changes very rapidly.

How well informed is the average patient (or even the average physician) about the course of antibiotic action? Too frequently after taking an antibiotic, a patient notices a marked increase in well being and hence stops the antibiotic treatment even though given strict instructions to take, for example, the penicillin prescription for a full 10 days despite how they felt. After stopping the medication, the patient has a relapse which is worse than the initial infection. What has happened is that after the initial treatment with antibiotics, the pathogenic bacteria, which were susceptible to a low dosage of antibiotic, died. However, in the absence of continued antibiotic, their more resistant relatives proliferated and caused the onset of a massive re-infection, which is more stubbornly resistant to treatment than the initial infection. Natural selection was at work.

The consequences of not teaching evolution are thus immense both in terms of the immediate health condition and in terms of the economics of the pharmaceutical industry. If antibiotics are abused, the pharmaceutical companies will need to produce greater and greater amounts to overcome resistance levels of pathogenic microbes and/or they will have to develop new more exotic, and probably expensive, antibiotics to take over when common ones fail.

NOTE WELL: Even the creationists (such as Gish) openly admit that they believe in micro-evolution; that is, they are willing to admit that mutation, migration, natural selection, and genetic drift work to change gene frequencies. What they are not willing to admit as an evolutionary process is speciation. Yet by their staunch refusal to teach evolution (even microevolution) to students, we raise a generation of students who cannot reasonably make sound health decisions about such simple aspects of contemporary medical care as the use of antibiotics. Furthermore, similar selectionist scenarios could easily be made for the regular use of powerful antibacterial mouth washes, antibacterial soaps and deodorants, foot and jock itch fungicides, toothpastes, eye wash solutions, nose sprays, etc. Almost all aspects of personal hygiene involve some selection on microbes living on our skin or mucous membranes. To what degree do we know what evolutionary processes are occurring on us as an ecological community?

"Modern medicine" as it is practiced by the medical industry in western society is grounded on the maxim, "Identify the problem; then kill it or cut it out." An alternative medicine (perhaps practiced in the East) would be grounded on the maxim, "Identify that which is out of harmony with the whole; then act to restore the harmony." Evolutionary genetics is a crucial pivot point between these two perceptions of medicine. We could pursue a research program in genetics that would allow us to get better at identifying problems and knowing how to cut them out or kill them. But a research program can also be pursued which allows us to understand the harmony of the whole and provides us with guidance in correcting disharmonies.

Neither of these programs is more "scientific" than the other—when "science" is understood in the standard, positivist sense. Nor are the two programs contradictory in an abstract sense. But in a concrete historical setting the two programs are totally at odds. That is, given a limited set of resources in terms of funding, expertise, and educational capacity, it's impossible to make efficient progress on both programs at the same time. Furthermore, as we train people to carry out one of the programs, the ethos that underwrites the other program erodes in two ways. First, any sign of advance in one of the programs breeds optimism—and eventual elimination of the alternative—because long term or broadly considered criticisms look superfluous if not downright mean minded in the face of local progress. Second, the successful pursuit of a program requires

OVERTURE 139
the dedication and commitment of a critical mass of single minded investigators. So recruitment and the establishment of orthodoxy have to be high on the agenda. This means that the particular program has to gain doctrinal control of the educational system in order to train new personnel. For example, an interesting situation recently has arisen in which the kill and cut school maintains virtually monopolistic control of the education of doctors, but has lost control of much of the education of nurses, who are increasingly becoming advocates of more holistic approaches to health care. This development can be attributed to three related phenomena: the emergence of a dynamic feminism; the difference between the doctor/patient and nurse/patient relationship; and the growth of a scientifically informed ecological movement.

But given the structure of authority within medicine, the nurses have no access to the agenda setting of underlying biological research. Consequently the agenda continues to be controlled by the “kill and cut” industry. It will take something more than environmentally concerned nurses to change this situation. Three identifiable lines of pressure for change are emerging from the evolution of medicine itself. The first, an absolutely evolutionary force, is the use of killing agents such as antibiotics, which sets up thousands or even millions of tiny ecosystems within which natural selection is occurring extremely rapidly. The number of microorganisms resistant to the standard antibiotics is already enormous. Indeed, the search goes on for new killers, to which the new generations of microorganisms are vulnerable. And such new killers are found. But, as any evolutionary biologist knows, “nature is always the last at-bat,” and the genetic and chemical stock from which to breed new killers is finite. So in the end, whenever it comes, “disease producing” microorganisms will have survived our campaign of microbial genocide. Thus new ways of dealing with disease producing organisms become ever more attractive, and may well begin to attract the time and resources of our research facilities.

The second pressure for change is our success in controlling the effects of genetic anomalies such as juvenile onset diabetes and hemophilia. As biological research (including, of course, recombinant DNA research) provides us with the means to provide the compensating enzymes and blood serum proteins these people need, more of them will survive, lead normal lives, and breed. Thus the incidence of these anomalies will rise. But the compensatory treatment of genetic anomalies is an ecologic rather than a kill and cut matter. To provide insulin, clotting factor 8, or some other compensatory protein is to manage the internal environment of the inflicted and bring it back within the range of viable harmony. This model can become a more and more powerful one as we begin to recognize, for example, that in some sense every disease is a genetic disease. That is, we have evolved in such a way that we have no natural defenses against certain “pathogens” we encounter occasionally in our environment. Just as the hemophilic has incomplete defenses against trauma, so the flu sufferer has incomplete defenses against the diversified array of evolving influenza viruses.

But the minute we begin to look at all “diseases” as genetic—i.e., as consequences of evolutionary ecology—we notice that we already exploit this model to some extent, and could exploit it a great deal more. Sanitation is nothing more or less than the management of human ecology. Vaccination is nothing more or less than the exploitation of genetically available capacities of our immune system to modify our internal environment. In fact, throughout the last 100 years an ecologically oriented medicine has been working in the shadow of the kill and cut orthodoxy, and is available to be marshalled for the fundamental reorganization of medical priorities.

The third source of pressure for an ecological medicine is our current effort to understand control cancer. Cancer has already been recognized as an ecological disease. The sad spectacle of cancer victims mutilated by having their offending parts cut off or by undergoing chemotherapy, which is a chemical shotgun blast at them in the hope that the malignancy will be killed before the rest of them, is surely a spectacle we want to endure no longer than is necessary. But until we face cancer environmentally and holistically in the context of a healthy world for healthy human life, the spectacle will be with us.

But this brings out an important point. Because of centuries—even millenniums—of environmental mismanagement and industrial insult to the natural world, we are going to be faced with the spectacle for some time to come. All we could do to rebuild the harmony of the natural environment would not help the existing victims of the carcinogenic paradise we’ve built over so long a time. So, during what promises to be a long transition, we’re going to have to tolerate a kill and cut component to our medical praxis. A measure of our progress will be the rate at which the killing and cutting can decrease.

Ecology is the private property of no one. The techniques of an ecological medicine cannot be managed on a competitive market basis. The practitioners and those who supply them with their instruments and drugs can obtain a monopoly over the means to cure us. Secondly they can maintain a monopoly of entry into the medical and scientific professions, creating a priesthood in sole possession of the sacraments of health. On the other side, there
can be no priesthood of prophylaxis. Everyone necessarily shares in the creation and maintenance of a healthy world. “Garbage collector” becomes the title of a respected medical professional. Already the radically differential availability of health care is an important issue. Already the class, race, and sex biases for entry into the medical and scientific professions is recognized and documented. But so far the solutions to these glaring inequalities have been sought in the progressive socialization of kill and cut medicine. We think that this strategy is short sighted.

A truly ecological evolutionary genetics could help a lot in our attempt to recapture a sense of the multiplicity of human excellences. It could provide many analogies to show us the dynamic dialectical interplay of participants in materialistic ecological wholes. With a strong understanding of evolutionary biology we could generate meaningful contrasts to the picture described above. Instead of pastoral romantic utopias of mutual bliss with no foothold in reality, solid scientific assessments of the possibility of material flourishing would become available.

Finally we come to the political economy of creationism and its role in the struggle for a human world. The issues here are as abstract and vast as the conception of human life itself, and as concrete and practical as the health of a newborn baby. Everything we have been advocating here requires a deep understanding of the material conditions of human life as those conditions reside in us and in the world around us as a consequence of the forces of evolution. If we try to rebuild a world fit for human habitation without that understanding we’ll blunder around ignorantly, making worse what is already intolerable. There is no alternative. Evolutionary understanding must be deepened and shared.

However, creationists combat this understanding. Their current efforts restrict such evolutionary understanding to those rich enough to live in the more affluent suburbs where they can obtain education outside the confines of creationist influences. The children of the poor have no such access. So once again they’re denied the means to a better life. Their early education is truncated almost as if there were a deliberate attempt to hamper their competitive efforts for the quality slots in higher education which the society rations out. At one level, creationism is a schizophrenic anachronism in a world which exploits evolutionary genetics in a way that impinges on the life of each of us medically, industrially, cosmetically. And as an anachronism it will eventually crumble of its own absurdity. Meanwhile it serves as one of the instruments of oppression; and it is in this role that it has to be combatted at every possible opportunity.

References


Cover Story Continued

Rosalyn S. Yalow

Curie. I had wanted to become a doctor of medicine; but, even should I have gotten into medical school, which was unlikely then, I could not have afforded it” (Kent 1978). Maurice and Gertrude Goldhaber co-advised her for her Ph.D. at the University of Illinois. Later Edith Quimby, a leading medical physicist, introduced her to the person who obtained the job for her at the VA hospital in New York, where she has worked since December 1948.

In previous cover stories, theoreticians, experimentalists, activists, and visionaries have been described. In this instance we have a tool maker. Yalow has provided us with a tool that allows us to make inferences about the inner workings of a single cell through measurements using that amount of material, rather than by extrapolating from millions or billions of cells. Biology henceforth cannot help but be radically transformed by such a contribution. Hence, again we acknowledge and benefit from the contributions of diverse people with diverse approaches to science.

References


Laura DeMarco and John R. Jungck
Department of Biology
Beloit College
Beloit, WI 53511