Strategic Technology Institute

From the Archives –

Public Policy Commentary

Are 'Neutral Scientists' Ethical?

By Blake L. White

Originally presented at Xavier University, Cincinnati, Ohio, on April 3, 1984

Abstract

Are, so-called, 'neutral scientists' ethical? The facts derived from science may be neutral but the technology and technologists that make use of these facts are never neutral. As such, scientists and engineers have a responsibility to humanity to make the public aware of the implications of scientific developments so the public can play an active role in the scientific decision-making process.

"Unless science is used for the betterment of mankind,

I am at a loss to understand the reason for it at all."

Kwame Nkrumah

Blake White is the Founding Partner of the Strategic Technology Institute, a San Francisco Bay Area network of management consultants and futurists. STI provides technology assessment consulting, corporate development services, and publishing with a focus on the business and societal implications of emerging technologies. He is also the publisher of ***Quantum Leap****, the journal of the Strategic Technology Institute and is the author of* ***The Technology Assessment Process: A Strategic Framework for Managing Technical Innovation****, published by Greenwood Press.*

Are 'Neutral Scientists' Ethical?

We are at a crossroads in human history. Never before has there been a moment so perilous and yet so promising. We are the first species to have taken evolution into our own hands and, for better or worse, we now possess the capability to intentionally or inadvertently destroy ourselves and every other species of plant and animal on our only planetary home. At the same time, we have reached out into space and visited other planets, we have saved lives through medical advances, and we have fed the hungry. Our knowledge has increased exponentially and as many new questions have been raised as answered. Vast knowledge, untapped potential, and unimaginable horrors are typically thought by the general public to be the result of our schizophrenic high-tech society – that somehow, the benefits from science are outweighed by our inability to control its negative side effects. As a result, we blame the creators of this monster (science) and reprimand scientists for unleashing our nightmares.

Is science to blame for our precarious location at a life-threatening crossroads? What kind of evil mentality must scientists possess to have brought us to the edge of an abyss? Do scientists and engineers have a responsibility to society, and if so, what is that responsibility? An attempt at answering these questions and providing a sane alternative to our current dilemma is presented in this paper by examining two basic points:

1. The neutrality of science compared to the inherent bias of technology, and
2. The social responsibility of scientists and engineers as professionals and as citizens.

That we live in a society being increasingly influenced by scientific activities and developments is a matter beyond intelligent debate. Few would argue to the contrary. That this same technological thrust now threatens our existence is also taken as a matter of fact. The raging debate centers around what can be done to alleviate this threat and who should bear the responsibility for implementing solutions. After all, when the threat of biological genocide due to a genetically engineered mutant virus having escaped a pharmaceutical laboratory confronts humanity, who is to blame? When our entire civilization hangs on a fifteen-minute thermonuclear missile flight-time thread, are scientists or politicians the culprits? Those whose education or tastes have confined them to the humanities protest that scientists alone are to blame. Scientists say, with equal contempt, that humanists, politicians, and the commercializers cannot wash their hands of blame because they have not done anything to help direct a society whose ills grow worse from, not only error, but also inaction (2: 5)

As scientist and philosopher Jacob Bronowski points out, there is no comfort in such bickering. Neither solves the problem. Bronowski states,

> "There is no more threatening and no more degrading doctrine than the fancy that somehow we may shelve the responsibility for making decisions of our society by passing it to a few scientists armored with a special magic." (2: 6)
>
> For indeed, "...it should make us shiver whenever we hear a man of sensibility dismiss science as someone else's concern. The world today is made, it is powered by science; and for any man to abdicate an interest in science is to walk with open eyes toward slavery. " (2: 6)

Of equal disdain are those colleagues of mine who work at developing better bombs because of a host of excuses from, "If I don't, someone else will," to "Guns don't kill people, people kill people," to "I'm not responsible for how politicians use my research," to "I'll leave it to the theologians." Such answers are reprehensible cop-outs in an attempt to justify either blood money or academic freedom.

The predicament in which we now find ourselves requires a stop to buck-passing rhetoric, so let us begin by examining the positions of five scientist/philosophers: A. J. Skillen, Jacob Bronowski, Anna Harrison, and Joel Yellin. Maybe their comments can enlighten us as to the social responsibility of "neutral" scientists .

A. J. Skillen

University of Kent Professor A. J. Skillen's **Philosophical Forum** article, *"The Ethical Neutrality of Science and the Method of Abstraction; The Case of Political Economy,"* refutes the statement that value judgments do not belong in science. By decomposing science, the long held view that science is neutral is shown by Skillen as a fallacy. Specifically, since science dominates our image of empirical rationality and rationality is dominated by abstractness that exists in the mind of feelings, commitments, and attitudes, it should come as no surprise that science (its methods and interpretations) must also be influenced by feelings or values (rather than facts).

Skillen, in an article much too lengthy, filled with witty allusions that are inside jokes to only philosophers and economists, and overburdened with words that send even the best graduate students scrambling for a dictionary, does not make a good case for his position. This may be so partly because of his reliance on Economic Theory as a science. His arguments would have been much stronger with a more quantitative science, such as Physics. As it stands, Economics relies on the psychology of motivation as much as production theory.

In spite of this weakness, Skillen's point of non-neutrality of science has merit. When we consider that our individual interpretations of phenomena will likely depend upon our view of the world (our paradigms as Thomas Kuhn would put it) it is reasonable to assume that our practice of science will likewise be biased. In effect our perceptions of facts will contain value judgments.

Jacob Bronowski

The famous scientist, philosopher, mathematician, literary critic, author and host of the "*Ascent of Man*" series, Dr. Jacob Bronowski reinforces the basic argument that scientists have a responsibility to humanity. In **Science and Human Values**, Bronowski states that the dilemma of today is not that human values cannot control a mechanical science. It is the opposite: "The scientific spirit is more human than the machinery of governments." He sees scientists as belonging to a community that fosters free critical thinking and tolerance – just the characteristics needed by our troubled society. Bronowski argues that science is a human activity and is practiced by "very human" scientists. Although the facts produced by science are neutral, science as a human activity is not neutral. With this established, he advocates a role for scientists as educators of the public on the positives and negatives of new discoveries. Bronowski shuns the idea of scientists as governors and pleads for an adoption of the scientific ethic by world leaders. (2: 71)

The late Dr. Bronowski eloquently and logically argues his points. He shows us that scientists are as fully human as artists and, as such, they display a full range of creative genius. Being human, however, means that scientists can no more shirk their responsibility to improve our lot than politicians. His argument, that scientists have a crucial responsibility (for which they are uniquely trained) to make the public fully aware of the implications of their work, brings the tunnel-visioned researcher back into the realm of political activist and citizen. No longer do scientists have a right to hide behind the veil of scientific neutrality. They must participate in decision making as full partners with the public.

A.J. Harrison

Mount Holyoke College Professor Anna J. Harrison, writing in a commentary for **Science, Technology & Human Values**, presents an interesting case for the expert scientific consultant and against the expert scientific witness in technology decision-making. The president of the American Association for the Advancement of Science, Harrison contends that the integrity of scientists is called into question when an individual accepts the role of witness for a contending party. When this happens the role of that individual necessarily becomes that of marshalling scientific knowledge to support the position of a contending party. She views scientific experts as, by definition, biased and therefore advocates a restriction of their role to that of consultant.

This consultant role is consistent with Harrison's belief that technology, since it necessarily involves a negative impact regardless of its positive impact, should be governed by an enlightened public. She states:

> "My experience has been that, in endeavoring to communicate relevant scientific knowledge to individuals who have limited backgrounds in science, these individuals can comprehend the information very quickly if they understand the nature of scientific knowledge." (7: 123)

From this perspective, Harrison sees the role of scientists as educators of the public and as consultants to special interest groups. In a fashion similar to Bronowski's argument, Professor Harrison once again stresses the importance of scientists coming out of their labs to participate in the decision-making processes of technical innovation by helping us (the public) decide on socially appropriate courses of action.

Joel Yellin

Joel Yellin, Senior Research Scientist at the Massachusetts Institute of Technology, proposes a system of expert advisors who would help create a deeper emphasis on the principle of public participation in technological decisions. Writing for **Science, Technology & Human Values**, Yellin sees the growing use of experts in government agencies and the delegation of public responsibility to these agency experts as being a serious threat to representative government.

In an argument similar to Anna Harrison's, Yellin concedes that modern administrators of agencies such as the Environmental Protection Agency (EPA) have far broader responsibilities than initially envisioned by politicians. They are called upon to assure worker health and safety, to protect and improve air and water quality, and to guarantee the safety of complex engineering systems. They also must predict the long-term consequences of major industrial and government decisions which today, increasingly involve technological innovation that results in social changes which surpass the capacity of the general public to absorb these changes, not to mention understand all aspects of the technology. Yellin concedes the necessity for technical experts but warns of the dangers of the professional technocrat. (17: 126)

His solution would place the scientist on a representative advisory board formed by the public with competence and the public interest as its chief operating rules. Whether or not one agrees with Yellin's method, we certainly see another argument for responsible scientists participating in technical decisions rather than merely allowing the stated neutrality of science to cause an abandonment of this responsibility to professional bureaucrats.

It seems that there is adequate support among the scientific community to encourage an active role by scientists in the decision-making processes of new technology implementation. Certainly it is no longer adequate for scientists to lock themselves in their laboratories and blindly discover neutral facts. Skillen, Bronowski, Harrison, and Yellin have a common thread running through their viewpoints -

science may or may not be neutral, depending upon which semantics one wants to adopt, but *scientists* are not, and should not be neutral.

To further investigate scientific responsibility, let us take a closer look at the characteristics of science and technology.

The Essence of Science and Technology

What do we mean by *technology*, or for that matter, *science*? Numerous definitions and descriptions of these words have been written, none of which have been able to succinctly encompass all of the characteristics of these terms. The "man in the street," according to J. B. Conant, considers science to be the activity of people who work in laboratories and whose discoveries have made possible modern industry and medicine. (4) This statement, although it may appear to be true to many laypersons, is quite deficient as a meaningful description of what science is. For example, many people who clearly qualify as scientists do not have any association with laboratories and their discoveries do not have any demonstrable applicability in either modern industry or medicine. As important as contributions to these areas have been, this concept illustrates the importance of developing a working definition with significant key words so we may clarify just what concepts *science* and *technology* employ.

Science is the body of knowledge obtained by methods based upon observation. Derived from the Latin word *scientia*, which means knowledge, the modern usage employs the German concept of *wisenschaft*, which means systematic organized knowledge. Thus, science implies not mere isolated facts, but knowledge that has been put together in some organized manner. (2) In particular, the science with which we are concerned is a body of knowledge which derives its facts from observation, connects these facts with theories, and then tests or modifies these theories as they succeed of fail in predicting or explaining new observations. In this sense, science has a relatively recent history – perhaps four centuries. (11) Although science as an activity has existed as long as humans have existed, the modern Western notion of science begins with the European awakening during the High Middle Ages, the Renaissance, and the Industrial Revolution. Therefore we should clearly recognize that science, as America understands it, is a European concept that describes the process used to gather data about nature, use that data to draw general conclusions, and test the conclusions under critical observation. The crucial difference between the modern view of science and the ancient view rests on methods and ultimate aims. More will be said about the alternative historical views of science shortly; for now, let us develop an understanding of the term *technology*.

Much of the relevancy of science to society arises by way of technology. There are close relationships between science and technology and technology; yet science is not technology and technology is not science. The origin of the word *technology* gives valuable indications as to its meaning. It is derived from the Greek words, *techne* and *logos*. The former means art or craft, and the latter signifies discourse or organized words. The practice of technology frequently is that of an art or craft, as distinguished from science, which is precise and is based upon established theoretical considerations. Even though we do not normally think of *technology* as consisting of written or spoken words, as implied by l*ogos*, it does involve the systematic organization of processes, techniques, and goals. Technology is applied, but is not necessarily based upon science. In fact, as California State's Robert Fischer notes, "to define technology as applied science is to miss much of the significance of the relationship that exists between science and technology." He defines technology as the totality of the means employed by peoples to provide material objects for human sustenance and comfort. (6,76) Robert Hammond, of North Carolina State University, defines *technology* (*engineering*) as a means by which the knowledge of mathematical and rational sciences is applied with judgment to develop ways to utilize the materials and forces of nature for the benefit of mankind. (8,5)

One connotation of the working definition of technology is that it is a human activity. It is people who use the products of technology. Furthermore, it is people whose sustenance and comfort is the goal of technology, whether this goal is actually accomplished by technology or not.

Technology is never neutral in that it is directed in specific instances toward specific material objects, that is, toward the production of physical objects. This is not to exclude the importance of non-material concepts to mankind's sustenance and comfort, but it is meant to drive home the central theme that technology is driven by physical needs. Technology also involves our relationship with the environment. It involves our attempt to control and shape the environment and to make use of whatever resources are available in that environment. (6,77) The basic motive for "bringing about technology" is the desire to obtain more or better material things. There are of course more immediate and less profound motivations for individuals in either science or technology, such as the desire to get a paycheck and to retain one's job. Other points of comparison involve grander motivations -- such as the ancient African, Egyptian, and Greek beliefs of devoting technical monuments to gods, heroes, or esthetics. The concept of technology as "more and better material things " is once again a Western concept born out of the flowering of knowledge and materialism that was the European Renaissance. Therefore technology as a Western concept is relatively new, but less so than science.

Technology has a much longer history than science -- a history as long as humanity. We have evolved together with our tools and techniques over millions of years. The major changes in human population are due to the technology we have developed, such as the domestication of grain, the development of irrigation, and the invention of methods for storing and preserving food. We exist by the generosity of the Earth, but how many of us live and how many of us starve depends on how well we use and distribute the Earth's bounty. During the great pre-European period of the Inca, Aztec, and Mayan civilizations, perhaps 15 million people lived in the Americas, most living in major civilizations with cities in Mexico, Central and South America, where agriculture was relatively advanced. Most human labor was used to obtain food. We now have over half a billion people in the Americas with less than 5 percent of our labor force needed to produce food. (11) Without technical developments in agriculture we could not sustain such a population growth, and in no way would we have the time or energy to develop a more advanced civilization. All of our time and effort would be devoted to the maintenance of life.

Technology has developed separately from science throughout most of recorded history. Technological change has generally derived empirically, simply by trial and error. The method used in proceeding to the development of new technological advances is determined primarily on the basis of two factors: the existing technology and the existing knowledge of the properties of matter and energy, that is: existing scientific knowledge. This scientific knowledge used in technology is not a replacement for the trial-and-error methodology of technology; rather, it provides a means of selecting what trial to undertake next and thus contributes to the efficiency and effectiveness of the trial-and-error method. Technology can use scientific knowledge and, in this sense, can be sometimes viewed as applied science. Yet much technology continues to be developed with little or no basic scientific knowledge. For example, the photographic process was developed to a high degree of sophistication even without the fundamental or basic understanding of the underlying chemical phenomena. (6: 77)

Suffice it to say for our purposes that *technology* is science plus purpose. While *science* is the study of the nature around us and subsequent development of scientific laws, *technology* is the practical application of those laws, in sometimes non-rigorous ways, toward the achievement of some purpose -- usually material. (5: 1)

Science, however, employs two aspects of medieval scientists' work as its foundations: the empirical approach based upon objective, rational observation and the use of a mathematical approach to describe nature. These principles laid the groundwork for modern scientific methods of inquiry and were forcefully argued by Descartes, the philosopher and Francis Bacon, the theologian and subsequently became imprinted on the social fabric of Europe as well as modern Western science. (3: 15)

This new approach, going all the way back through Bacon, Newton, Copernicus, Aristotle, and to scholars from the ancient colleges on the African continent, included the process of observation, generalization, explanation and prediction. The last three are thought of in more modern terms as the *hypothesis*, *theory*, and *law*.

A *hypothesis* is a tentative assumption made in order to test its scientific consequences, but which as yet has received little verification or confirmation. A *theory* is a plausible, scientifically acceptable statement of a general principle and is used to explain phenomena. A *law* is a statement of an orderliness or interrelationship of phenomena that, as far as is known, is invariable under the stated conditions. (6: 47)

It should be stressed that the term *law* is used differently in reference to scientific knowledge than to other areas of everyday life. A scientific law is descriptive rather than prescriptive. It is a statement used to describe regularities found in nature, and is not a statement of what should happen. It is not correct to consider that natural objects obey the laws of nature; rather, the laws of nature describe the observed behavior of natural objects. In contrast, the laws of a human government are prescriptive in that they prescribe how people should behave. Other underlying principles in scientific inquiry assume that:

1. Nature (the physical realm) is real
2. Nature is orderly
3. Nature is, in part, understandable (6: 64)

To what extent can we know nature? Carl Sagan, eloquently expresses our potential and limitations as he compares our physical realm to the world of a grain of salt. He demonstrates in **Broca's Brain**, that the 10 million billion sodium and chlorine atoms versus the neurons in the brain (the circuit elements and switches that through electrical and chemical activity allow our brains to function) with connections of dendrites in the brain make the total number of knowable things less than the total number of atoms in salt. Therefore we can never expect to know every- thing in the microscopic world of a salt grain, much less know everything in the universe on the equally large cosmic scale. (13: 15)

However, if we use the empirical approach and seek out regularities and principles, we can understand both the grain of salt and the universe through extrapolation. We may never understand everything, but we can get some pretty good indications and allow rational conclusions to be drawn. Sagan's main point here is that our scientific method of inquiry is based upon our senses. Since we inhabit three dimensions of space and one of time, things outside this realm, or things of the microscopic world of the interior of atoms or the macroscopic world of the universe are beyond our physical senses. True, we may use electron microscopes to probe the atom or radio telescopes to probe the universe but these are merely devices that transform signals into the formats that our senses can recognize. If we understand our limitations, we will be forced to understand the limitations of science.

This is precisely why science and technology cannot solve our social problems or answer our theological questions. Social problems transcend mathematical description and involve emotions that cannot be touched, measured, or manipulated successfully. Theological questions transcend our three physical dimensions of space plus our one of time. What exists beyond those dimensions can only be speculated about or believed through blind faith. Science cannot define God. But, just because science is limited does not imply that scientists should limit themselves.

Science is also based upon a search for the truth in a society that bends the truth to suit its needs. Jacob Bronowski stated it this way:

> "The society of scientists is simple because it has a directing purpose: to explore the truth. Nevertheless, it has to solve the problem of everyday society, which is to find a compromise between man and men. It must encourage the simple scientist to be independent, and the body of scientists to be tolerant. From the basic conditions, which form the prime values, there follows step by step a range of values: dissent, freedom of thought and speech, justice, honor, human dignity, and self respect." (2,68)

In an absolute sense, truth and neutrality in science is limited to the facts of nature that are there for observation via our senses. In a less absolute sense, truth in science is limited to that which is directly observed and sensed by the observer. Even here any expression of absolute truthfulness is limited by the time and space relationships between the observer and that which is being observed, and also by the restrictions inherent in the use of language to express the observation. Anything beyond this is, in effect, a belief rather than absolute, true knowledge. In brief, it is impossible to separate fact in nature from one's own interpretation of it, as voiced by Robert Fischer.

The two criteria for scientific truth -- which, by the way, is a dynamic rather than a static entity -- either one of which is generally sufficient to cause persons to accept a principle are:

1. It can be checked by observation or, to state it differently, its consequences lead to its support rather than to contradictions; and

2. It can be derived from intelligible principles. (6,49)

Therefore, science is usually considered by Western culture as the highest form of mental activity with truth as its goal. Another guiding principle of science is its supranationality -- its inherent right to transcend national boundaries and allow scientists throughout the world to verify experimental results, challenge, theories, and allow technology to piggy-back on new discoveries.

Recent efforts by members of the Reagan Administration to implement a variety of new restrictions on the open communication of unclassified scientific information in the name of national security are for the most part unwarranted and likely to be counterproductive. That was the main conclusion of a special panel of a joint committee of the National Academy of Science, the National Academy of Engineering, and the Institute of Medicine in the fall of 1982.

According to the panel's report, Scientific Communication and National Security, much of the conflict between the Administration and the university-based researchers stems from a series of actions taken by the Government starting in early 1980. Ranging from requiring governmental approval of microelectronics research papers before publication, to universities being asked to help monitor the movements of foreign students, to U.S. Customs Service searches of foreign students, to recommending amendments to the Freedom of Information Act, the Reagan Administration believes such tactics will plug leaks of "militarily significant" information .

On the basis of its assessment of the costs and benefits of tighter controls, the panel concluded that the best way to insure long-term national security lies in a strategy of security by accomplishment, and that an essential ingredient of that accomplishment is open scientific communication. The panel believes that the risk of adversaries becoming aware of U.S. findings is acceptable because the speed of U.S. technological development would continue to give America the advantage.

Long-term technological applications are also an issue here. Attempts to restrict access to basic research would require casting a net of controls over wide areas of science that could be damaging to overall scientific and economic advance, as well as to military progress.

Therefore, the panel recommended that, "the vast majority of university research, whether basic or applied, should be subject to no limitations on access or communications." (14: 74) The Reagan Administration, or any other political body for that matter, treads dangerous ice when it attempts to repress scientific knowledge, especially since our entire society depends so intimately upon science and technology. John Stuart Mill summed it up this way: "A state which dwarfs its men, in order that they may be more docile instruments in its hands, even for beneficial purposes, will find that with small men no great things can really be accomplished."

As we have seen, science has many facets. In essence it derives pure neutral knowledge extracted painfully from nature through systematic means for dissemination to all humanity. Technology is not science. Technology is how we do things, not how we think of them. However, technology relies very heavily upon basic scientific knowledge in addition to prior technology.

There is also a strong influence in the reverse direction. Modern science relies to a large extent upon existing technology as well as upon prior scientific knowledge. Science and technology reinforce each other by complex interactions. Each one, science or technology, can build upon itself or upon a cross linkage from one to the other. Technology is dependent upon science for knowledge of the properties of materials and energy and for predicting the behavior of natural forces. Science is dependent upon technology for its tools and instruments, for the preparation of materials, for the storage and dissemination of information, and for the stimulation of further research. (6: 77)

Indeed, *science* is not technology and *technology* is not science but they are forever interrelated. One could not exist in modern society without the other.

Science, Technology, and Ethics

As previously shown, science in its purest sense is a semi-neutral activity. We search for truth and as a result we get neutral facts. It is technology, that "ah ha" that "this is how it can be used" idea that almost immediately takes over and draws upon our biases. Humanity's needs, wants, and desires (no matter how novel or how perverse) are realized through technology.

We may be drawing a fuzzy line between science and technology, or scientists and engineers, but after all it is not the knowledge of nuclear fission that scares us; it is the application of fission that plays on our paranoia. Therefore I believe that engineers and applied scientists bear most of the responsibility for our precarious tottering on the abyss of destruction. It is one thing for the biologist to know how to perform gene splicing; it is quite another for biological engineers to actually create harmful forms of life.

We have also spent quite a bit of time developing science as a high form of human activity. We have seen that its search for truth, its honest attempt at objectivity, tolerance for alternate views, its openness to objective evaluation of new data, and its supranationality epitomize many of the highest ideals of humanity. What Jacob Bronowski points to as the "scientific ethic" is the underlying essence of the community of scientists. (2: 68) We certainly must respect that community's encouragement of the independence of the single scientist and we applaud its fostering of dissent, freedom of thought and speech, honor, human dignity and respect. These ideals are practiced by a body of people who have for too long been absent from the political scene. Absent also from politics has been the scientists' cooperation across national and racial boundaries. The primary components of world peace can be found in the scientific community. So where have we gone wrong?

Scientists and engineers have erred by having misplaced loyalties. They have become servants to organizations rather than to the public. The basic canons of professional ethics have been prostituted to gain employment and to preserve power structures in the forms of nations.

As an example of the types of codes of ethics ignored by technologists, consider the following:

-- The National Society of Professional Engineers declares itself "to hold paramount the safety, health and welfare of the public" in the performance of their professional duties. (9: 294)

-- The Engineers' Council for Professional Development declares that engineers must "uphold and advance the integrity, honor, and dignity of the profession by using their knowledge and skill for the enhancement of human welfare." (9: 300)

- The Institute of Electrical and Electronics Engineers declares that its members must "protect the safety, health and welfare of the public and speak out against abuses in these areas affecting the public interest. (9: 302)

To the engineering profession we ask, "Are you following your own professed ethics when you build a nuclear device?" I contend that you have not! Emmanuel Mesthene, in **Technological Change** argues for a reorientation of our technological goals. Similarly Ian Barbour, in **Science & Secularity**, sees the danger lying, not in technology as such, but in uncritical preoccupation with technological goals and methods. (1: 65) We have fostered a gee-whiz attitude of applying technology either for technology's sake or for the short-term profits of our employers. Such shortsightedness can cause permanent damage to our environment, our children's lives, and our survival as a people.

In the past the actions of individuals or single industries or even single nations mattered little to the outcome of the world. Modern technology is quantitatively more pervasive in society and leads to quantum changes in the qualitative influences of technology. "The rifle wiped out the buffalo, but nuclear weapons can wipe out mankind," as Mesthene states. (10: 25) We have a whole new generation of weapons, microbes, and chemicals that can influence the future of the planet. With this established, scientists and engineers must go back to their professed ethics. They must stop developing the technology of destruction. Make no mistake here. The knowledge of these weapons does not threaten mankind. It is the hypocritical prostitution of admirable codes of ethics by technologists that gambles with our future.

From this perspective, engineers and scientists must be part of the decision-making process. Engineers as a group and as individuals have special responsibilities as citizens, which go beyond those of non-engineer citizens. All citizens have an obligation to devote some of their time and energies to public policy matters. Minimal requirements for everyone are to stay informed about issues that can be voted on, while stronger obligations arise for those who by professional background are well grounded in specific issues as well as for those who have the time to train themselves as public advocates," as put forth by Philosopher Mike Martin and Engineer Roland Schizinger, authors of **Ethics in Engineering**. (9: 29l) In addition, Paul Goodman notes that “as a moral philosopher, a technician should be able to criticize the programs given him (her) to implement." (9: 1)

So, we see that technologists should have more of a responsibility to humanity than to their employers or their governments. We have seen that their professions support this concept (at least verbally). It only remains now for technologists to step forward and internationally embrace their ethics.

The scientific values of truth, objectivity, dissent, independence, respect, and supranationality, coupled with the engineering ethic of serving the benefit of humanity, could solve many of our most pressing problems. But, as with any bold challenge, the first step must be taken by the technologists, not the politicians.

A Case in Point: The Technology of Destruction

A proposal for technologists to ban together in an international effort to stop warfare is somewhat idealistic but workable. Indeed it may be our only alternative if true peace is desired. As the great philosopher Bertrand Russell noted, "I do not think that there will long continue to be human beings unless methods are found of permanently preventing large-scale wars." (12: 718)

It is just such a plan that Russell proposed in his 1955 essay, *Science and Human Life*. Paraphrasing Russell, the plan is outlined below.

> "The problem which most preoccupies the public mind is that of scientific warfare. So let us create social institutions that will make large-scale war impossible and/or let us not allow war to become too scientific. Large-scale scientific warfare by nations is just as anarchic as to allow complete liberty to an individual. But the relations between states are not governed by law and cannot be until there is a supranational force strong enough to enforce the decisions of a supranational authority.
>
> ...Therefore men of science have a new duty towards this new world that they have been creating?
>
> ...Men who do not understand scientific work can utilize the knowledge that the scientist provides. The men who decide what use shall be made of the new techniques are mainly politicians whose professional skill consists in knowing how to play upon the emotions of masses of men. And so the scientist finds that he has unintentionally placed new powers in the hands of reckless men.
>
> ...A difficult readjustment in the scientists' conception of duty is imperatively necessary. Unless we are ready to give up some of our old loyalties, we may be forced into a fight, which might end the human race.
>
> Your paramount interest, if you are aware of the situation must be to preserve the existence of mankind by preventing a great war. It is clearly the duty of men of science to bring the facts home to the governments and peoples of both East and West. This is no easy task. The governments of both East and West, whether from ignorance or from motives of prestige,

are engaged in trying to persuade their populations that thermonuclear weapons will destroy the enemy but not themselves.

...Clearly, scientists both of the East and of the West have an imperative duty: namely, the duty of bring home to the protagonists the fact that the time is past for swashbuckling and boasting and campaigns of bluff which, if the bluff is called, can end only in utter disaster.

...I wish all men of science, in all countries, to subscribe to a clear statement of what is likely to happen in a great war." (12: 722)

This kind of action by scientists will involve a great degree of heroism and self-sacrifice. I imagine that some who refuse to work on weapons will be shot as traitors, but those who continue to develop the technology of destruction only postpone death, they do not prevent it.

The death faced by the people of the world is one of total annihilation of our species. Scientists know this. They have information that shows how organisms live and die. We are no different than the bacteria that die from overpopulation, waste, and competitiveness in a culture dish. For that matter, we are faced with the fate of the dinosaurs, which died from their inability to adapt quickly to changing environments.

Our technology is causing social changes at a tremendous rate. The destructiveness of modern weaponry has outpaced our social ability to cooperate. Scientists and engineers have a history of cooperation on their side. They can be the vanguard of a total international movement to save humanity. If they do not, our lease on the future may be unrenewable.

The great scholar Alfred North Whitehead delivered a series of lectures in 1925 in which he warned us of the danger of non-cooperation.

"During the past three generations, the exclusive direction of attention has been a disaster of the first magnitude. The watchwords of the nineteenth century have been struggle for existence, competition, class warfare, commercial antagonism between nations, and military warfare. The struggle for existence has been construed into a gospel of hate. However, successful organisms are those that modify their environment so as to assist each other. A species of microbes that kills the forest also exterminates itself.

In the history of the world the prize has not gone to those species which specialized in methods of violence, or even in defensive armour. In fact, nature began with producing animals encased in hard shells for defense against the ills of life. It also experimented with size. But smaller animals, without external armour, warm-blooded, sensitive, and alert, have cleared these monsters off the face of the earth. Also, the lions and tigers are not the successful species.

There is something in the ready use of force which defeats its own object. Its main defect is that it bars cooperation.

Every organism requires an environment of friendship. The Gospel of Force is incompatible with a social life." (16: 259)

Humans would fare much better if we follow the lessons of nature. Cooperation and a moral use of our non-neutral technology are the key ingredients to the success of the human organism. I contend that scientists can teach us this lesson, that the scientific ethic is the doctrine that should be embraced, and that engineers and other technologists can be the agents of success. In either case, scientists and engineers who insist upon remaining neutral are, in effect, unethical. As Malcolm X succinctly stated, "If you are not part of the solution, you are part of the problem."

"It does not require a clever brain to destroy life. In fact any fool can do that. But it takes brains –and extraordinarily brilliant brains to create conditions for human happiness and to make life worth living."

- Kwame Nkrumah

Speech at the Academy of Sciences, Accra, Ghana

November 30, 1963

"People whose lives are affected by a decision must be part of the process of arriving at that decision."

- John Naisbitt

Are 'Neutral Scientists' Ethical?

Works Cited

1. Barbour, Ian G.; **Science & Secularity, The Ethics of Technology**; (New York: Harper & Row), 1970.

2. Bronowski, Jacob; **Science and Human Values**; (New York: Harper & Row), 1956.

3. Capra, Fritjof; **The Turning Point**; (New York: Simon and Schuster), 1982.

4. Conant, J.B.; **Science and Common Sense**; (New Haven: Yale University Press), 1951.

5. Dorf, Richard C.; **Technology, Society and Man**; (San Francisco: Boyd & Fraser) , 1974.

6. Fischer, Robert; **Science, Man & Society**; (Philadelphia: W. B. Saunders), 1975.

7. Harrison, Anna J.; Commentary in **Science, Technology & Human Values**; (Boston: John Wiley & Sons for Harvard and MIT),Vol. 9. , Iss. 1. , Winter 1984, No.46.

8. Hammond, R. H., Buck, C. P., Rogers, W. B., Walsh, G. W., Ackert, H. P.; **Engineering Graphics**; (New York: The Ronald Press), 1971.

9. Martin, M. W.; and Schinzinger, R.; **Ethics in Engineering**; (New York: McGraw-Hill) , 1983.

10. Mesthene, Emmanuel G.; **Technological Change**; (New York: Mentor), 1970.

11. Platt, Joseph B.; "*The Value of Science and Technology to Human Welfare*", **Bulletin of the Atomic Scientists**; October, 1973.

12. Russell, Bertrand; **The Basic Writings of Bertrand Russell**; Edited by R. E. Egner and L. E. Denonn; New York: Simon & Schuster), 1961.

13. Sagan, Carl; **Broca's Brain**; (New York: Random House), 1974.

14. **Scientific American**, "*Secrecy vs. Security,* " December 1982.

15. Skillen, A. J.; "The Ethical Neutrality of Science and the Method of Abstraction; The Case of Political Economy," **The Philosophical Forum**; Vol. XI, No.3, Spring 1980.

16. Whitehead, Alfred N.; **Science and the Modern World**; (Philadelphia: The Franklin Library), 1979.

17. Yellin, Joel; Commentary in **Science, Technology, & Human Values**; (Boston: John Wiley & Sons for Harvard and MIT); Vol. 9, Iss. 1, Winter 1984, No.46.