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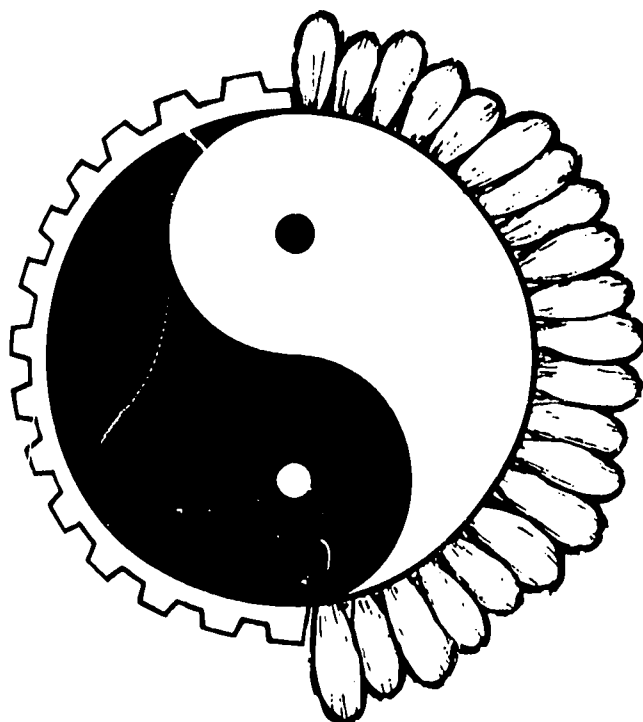
ABSTRACT
            As several authors (Charles Reich and Theodore
Roczak, for instance) have concluded, a new or counter culture is
emerging. It is unlikely, however, that this culture can or will
dispense with technology. Instead, its characteristic will be a new
form of humanism in which the rational and irrational sides of
humanity will be fused into a harmonious whole. Such a fusion poses a
challenge to scientists and their platform of rational objectivity.
Engineers, by contrast, are mediators between science and humanity.
They need to recognize the existence and value of the less rational
components now coming into their own through the new culture.
Engineers should turn towards humanism both in their professional and
personal attitudes. Professionally, they should accept a role as a
responsible mediator, work through their organizations to make sure
the organization works for the good of society, and obtain a broad
rather than overspecialized education. Personally, they should take a
broad interest in society, in the creation of art and literature, in
history, and in life. (Author/JK)

CYBERNETIC SYSTEMS PROGRAM   SAN JOSE STATE COLLEGE

THE
HUMANIZATION
OF
TECHNICAL MAN

GERD D. WALLENSTEIN

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THE HUMANIZATION OF TECHNICAL MAN

GERD D. WALLENSTEIN

This paper attempts to point the way for a rapprochement between technically oriented people and the complex society that they wish to serve. Significant elements of this society are in turmoil. This observation is taken as a point of departure for an examination of the cultural changes in society. Two questions are considered vitally important in this context:

Is the phenomenon widely called a Counter Culture indicative of a deeper and lasting trend towards a New Culture?

If the answer is positive, will the New Culture be in opposition to Technology, or does it seek a new modus vivendi with it?

A review of several recent studies, whose authors cover a wide range of specialized competence and approach, leads the present writer to conclude that a new culture is indeed in the making. A further conclusion seems justified, to the effect that the emerging new culture can not and will not dispense with technology. Rather, its characteristic will be a new form of humanism in which the rational and irrational sides of humanity are to be fused into a harmonious whole.

This paper next inquires into the technical people's response to these profound cultural changes. It is observed that scientists face a very difficult challenge to their platform of rational objectivity. Engineers, by contrast, are seen as mediators between science and humanity. The need to recognize the less rational components, many of which are coming into their own through the new culture, appears as a sine-qua-non for engineers.

The final chapter "The Humanization of Engineers" outlines positive steps of organizational participation, broadened professional outlook, and changed personal attitudes by which engineers may understand and share the new culture. It is implied that they can only through such efforts live up to their calling, to the fullest satisfaction of themselves and of the humanity they serve.

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Foreword

This monograph is the first of a planned series of original works of faculty and students of the Cybernetic Systems Master's Degree Program of San Jose State College. The publications will reflect the varied concerns of modern man as interpreted by personnel engaged in pioneering a unique interdisciplinary college program. The emphasis of the monographs will range across problem areas of technology assessment, information management, behavioral and life sciences, education, environment, human and economic resources, and organization behavior, all of which are subareas of the program. The monographs are published as a recognition of the work of serious scholars and in the hope that they will be of service to groups and individuals.

Gerd D. Wallenstein took early retirement from his position as Vice President-Planning of GTE Lenkurt, San Carlos, and joined the Cybernetic Systems Program as student and lecturer in 1970. He is currently teaching a course in International Telecommunication Systems and will complete his degree requirements in January, 1972. The subject of his thesis is "International Telecommunications as Social Systems." During his years with Lenkurt, begun in 1948, he specialized in the development of procedures for study and decision-making for all major products, with personal responsibility for reconciliation of market objectives and technical feasibility. Mr. Wallenstein has authored numerous technical and management publications, including a book on Product Planning. He has served on major committees of the International Telecommunication Union (I.T.U.), where he continues to represent the interests of GTE. Since 1968, he has been Vice Chairman of one of the I.T.U. technical study groups.

Mr. Wallenstein left his native Germany as a refugee just prior to World War II, before having completed his University education. He spent the years 1940-47 in China where he pursued his professional career in radio engineering.

The Cybernetic Systems Master's Degree Program is an interdisciplinary curriculum intended to provide students a foundation understanding of the systems approach used in teamwork solutions of complex societal and technological problems. Emphasis is placed on the best long range interests of humankind throughout the program. Contributors to publications issued under the auspices of the Cybernetic Systems Program are responsible for their statements of fact and expressions of opinion.

Inquiry and opinion are cordially invited.

Norman O. Gunderson, Director
Cybernetic Systems Program

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Introduction

"A specter is haunting Europe - the specter of Communism;" thus Marx began his Communist Manifesto. That specter became incarnated in "scientific socialism," and, for right or for wrong, seems with us here to stay. A specter forshadowing reality: this figure of speech is neither wilful nor coincidental. A coming rational change may manifest itself most clearly in irrational ways.* In collective history as well as in the life of an individual, the irrational and the rational alternate and interact, as the studies of Jung have helped us to understand.[1] To accept and value the irrational along with the rational: that seems to be the most difficult step to take for those who have dedicated their professional life to the pursuit of man's rational faculties. Yet never before has the irrational application of professedly rational science and technology posed such challenge to humanity, such threat to its very survival, as it does today. The challenge, therefore, must not, it can not, be ignored by the practitioners of the rational. Such practitioners are the mediators between science and humanity: the engineering professionals. It is to them that this paper is particularly addressed.

* * *

The New Culture

A new specter is haunting America and is beginning to haunt other parts of the world: the specter of a "New Culture." In a repetition of classic examples, the new culture manifests itself irrationally and is opposed by irrational reaction. Drop-outs from society, drug-taking for "kicks," irrationally loud behavior in public places, irrationally destructive violence, these are some of the manifestations. A catalog and an analysis would be out of place and redundant here. Books such as Theodore Roszak's *The Making of a Counter Culture*,[2] and Charles Reich's *The Greening of America*,[3] have given us an inventory. The official studies of events such as the Kent State University Shootings[4] and the Chicago Convention Riots[5] have given us a view of the irrationality on the part of the supposedly rational powers of reaction.

Rationally educated men bemoan all this irrationality as aberrations in our society. But what can be thought of as more irrational than the "rationale" of defoliating large areas of a faraway country? What is more irrational: the demonstrations against manufacturers of Napalm, or the planning, development and use of such insidious chemistry? Is the programming of computers, a rational methodology for a rational machine, immune to irrational input and output data? The answers to these questions would show that irrationality is part of our and of any human society. Rather than treating it as an aberration, we should approach it positively.

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* In this paper, the term *irrational* is used to designate all that is not rational, by way of contrast. It is not used in any derogatory sense.

The incompatibility of the rational approach and the mixed irrational-rational reality of human life obstructs even the non-violent discourse of reasonable men. For the reviewing of Reich's book, the widely respected and widely receptive Saturday Review chose a professional economist, Robert Eisner. The reviewer can not get outside his rational skin. He faults Reich for paying no attention to economic knowledge: "it strikes me that Consciousness I, II, and III represent about the extent of Reich's use of numbers." And: "Reich's discussion of these issues (i.e. poverty, exploitation of Blacks, pollution, etc.) and what to do about them employs none of the professional tools of any social science."[6] Granted - but the essence of Reich's theme is precisely the birth-giving to a new culture that disavows the reliance on professional tools along with the rational standards of the present society. One can disagree with the merits of such a new culture, and one can criticize Reich's ability to deal fairly and wisely with the old and new that he attempts to describe. But one can not evaluate his work by ruling him out of order in terms of strict rational analysis where the subject is outside the constraints of rational analysis in the first place.

It must be more than coincidence that favorable views of the noisily emerging new culture are particularly forthcoming from people educated in law (Reich is a Yale law professor). Supreme court justice Douglas's Points of Rebellion[7] is a more concise, more sober, less lyrical treatment of the same phenomena in our society. Even Louis Kelso, a successful corporation lawyer, appears sympathetic with the irrational and with many of the goals of the new culture, judging by his proposal for "universal capitalism" that is to free all men from toil.[8] Like Reich's book (with which it otherwise has little in common), Kelso's book has been ignored or denounced as unprofessional, and his theory as unworkable, by specialists in economics. This indeed must be so, for Kelso does have this in common with fellow lawyers: he has been exposed to, and learned to sense, the irrational side of humanity. He and his colleagues are professionally involved with the resolution of problems that have irrational as much as rational components. It is no surprise that out of this experience can come analyses and proposals that place man's irrational longings and goals as high as his rational machinery embodied in the so-called "establishment." By contrast, in economics, humanity is (literally) rationalized in terms of consumers, producers, capital, and the things involved in their transactions.

What to an economist must seem a betrayal of his professional standards and integrity may be even harder to accept for an engineer: has he not been trained to apply only scientifically proven facts, to accept only the truth of accurate measurements, to devise and operate machines that are self-evident needs of humanity once their construction has been proved feasible? No surprise, indeed, is necessary at the reassuring spectacle of engineering schools remaining outside the turmoil of academic youth: the technical students want no part of a new culture. It has been said that engineering students have too much work to do to engage in any extra-curricular nonsense, but the reason for their non-participation lies deeper than that. It rather seems that the engineering career promises lifelong comfort in the pursuit of abstractions from human foibles, in the devotion to things which can be rationally understood and exploited. What satisfactions beckon to the master over electrons and machines, what excitement in methodically,

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rationally analyzing them when they seem to disobey! A blown fuse and a burnt-out coil, a stalled machine, are casualities that do not bleed and cry - though engineers may be confronted with the human consequences. These statements might appear to be unfair with respect to those leaders in engineering education who have tried, in recent years, to expand the engineering horizon so as to include in their work a human equation, so-to-speak.[9] These are promising and valuable new trends, indeed; we shall review their significance later. None of these new trends, however, is facing up to the new culture and its principal value: the irrationality of man.

But suppose there is no "new culture"? Should not we ascertain first what substance there is to the premises of Reich and Roszak? In fact, Roszak's well researched and scholarly study is much firmer in stating an objective than in the assurance that and how we will reach it. The objective:

> "This, so I have argued, is the primary project of our counter culture: to proclaim a new haven and a new earth so vast, so marvelous that the inordinate claims of technical expertise must of necessity withdraw in the presence of such splendor to a subordinate and marginal status in the lives of men."[10]

This is not to be achieved by noisy and militant radicalism, which may actually aid in perpetuating a (howsoever modified) status quo.

> "For this reason" Roszak says, "the process of weaning men away from the technocracy can never be carried through by way of a grim, hard-bitten, and self-congratulatory militancy, which at best belongs to tasks of ad hoc resistance . . . there must be a stance of life which seeks not simply to muster power against the misdeeds of society, but to transform the very sense men have of reality."[11]

Roszak finds an indication of the needed attitude in a quotation from Chuang-tzu, the Chinese philosopher who extolled the wisdom of "knowing how to do nothing." And yet that attitude is not acquired as a well-intentioned man's second personality, as Roszak quotes the religious thinker Martin Buber, "he who attempts a return ends in madness or mere literature."

In summary: not militancy, not the embracing of fine arts and nature by enlightened technocrats, not the dreamy-eyed return to the primitive can make the new culture flourish. The change must come by affecting man quietly from within himself. Is this too much to hope for? Roszak leaves us with uncertainty. The makings of a counter culture, yes; the coming of a real new culture, perhaps.

Not so Reich. He sees more or less the same conditions and the same makings; but for him, the new culture is already here. The state of man in society he describes as Consciousness III is taking shape right now.

> "All of these signs (i.e. the Chicago riots, the Woodstock Festival, a commune in the courtyard of Yale Law School) might mean very little if change had to be produced by

the efforts of a minority, working against the power of the State. But the State itself is producing these changes, and its self-destruction has only begun. The people of the Movement may grow tired and discouraged, but time and the force of the machine are on their side. And there is nothing on the other side. There are no enemies. There are no people who would not be better off, none who do not, in the depth of their beings, want what Consciousness III wants."[12]

And he ends with the ringing words: "For one who thought the world was irretrievably encased in metal, in plastic, and sterile stone, it seems a veritable greening of America."[13]

This is a remarkably optimistic statement. Some of this language is reminiscent of the neo-romantic Senator proposed for President, campaining on the slogan "in your heart you know he is right." It reads like promoter's talk, and for this reason alone, Reich can not be classed with Roszak. But conceding that Reich seems to get carried away, his underlying positive vision is shared by others. Let us turn to Lewis Mumford, a lifelong humanistic scholar and prolific writer whose credentials have been established before the technological mal du siecle became such a fashionable subject.

In his study "The Myth of the Machine," Mumford undertakes a detailed, comprehensively researched, and erudite survey of the continued interaction of technics with human development. The recently published second volume, subtitled "The Pentagon of Power,"[14] combines the range of observation made by such socio-cultural critics as Reich with a unique and illuminating analysis of the foundations for our present technocratic society. In the process of this analysis, Mumford is able to judge our condition not only by its outward material manifestations, but to attribute its origin to minds and hearts of men who helped shape our culture from hundreds of years ago to the present. Thus his study appears to rise head and shoulders over most other contemporary writing on the subject. He alone seems to have dared to draw on all available sources, be they scientific, historical, philosophical, theological, psycho-analytical, sociological, or artistic. As a result, his thesis in its totality becomes almost unassailable, even if fault can be found with his interpretation of one or the other source. Such a complex work can not be summarized or paraphrased in a few sentences. But one can say this with some impunity from oversimplification; Mumford produces enough evidence and reasoning to assure us that our present dilemma of technocracy's dominance over humanity is no accident, that it is not a historical human imperative, and that it need not be perpetuated. He recommends:

" . . . a spontaneous religious conversion: one that will replace the mechanical world picture with an organic world picture, and give to the human personality, as the highest known manifestation of life, the precedent it now gives to its machines and computers."[15]

Does this mean that in the organic world picture, there will be no place for technology? No, this does not seem to be Mumford's vision; rather, he forsees a fusion of the "two cultures," to quote:

"The present analysis of technics and human development rests on belief in the imperative need for reconciling and fusing together the subjective and the objective aspects of human experience, by a methodology that will ultimately embrace both."[16]

How is this goal to be attained? Here Mumford's voice becomes more vague; it would be "presumptuous to describe even in the barest outline the multitude of changes necessary to turn the power complex into an organic complex . . ."[17] Each human must search in himself for guidance. This self-motivation and self-direction appears a very difficult assignment to all men, and most of all the professional technical men.

There is a danger that technical professionals might, out of a sense of self-preservation, reject Mumford's recommendation. His path to a new culture seems decidely more difficult than Reich's who predicts an almost effortless transformation, with many appeallingly vulgar amenities making the future shape up in familiar terms. Yet for technical man who is part of the technocracy, the effort suggested by Mumford must be made. This difficult task also seems to be implied in a study by futurist Arnold Mitchell,[18] who postulates an increase in "unfolding" type humans in order to create the future society that would agree more or less with the visions of both Reich and Mumford.

Whether vulgarizing, esoteric, or speculative, these diverse writers agree in the coming of a new culture. There remains the question: is so much soul-searching in quest of a new culture a typical American phenomenon; or if it is not, are we myopic to similar signs in other countries? If Reich speaks only of the "greening of America," Mumford and others are speaking in terms of a world-embracing new culture. And there are signs in other countries; but as French writer Jean-Francois Revel points out, the leadership belongs to America.[19]   Here, according to him, the "revolution" has already begun. It is also the only place where it can begin. By revolution he refers to the sum of all those changes, encompassing all aspects of humanity, that lead to the new culture as envisioned by Mumford and others. Revel's analysis is a most valuable contribution to our understanding, for he makes it clear that this new culture must be global and must transcend nationalism. Revel's final words do invite technical man in, as few of the other writers do:

" . . . to take the technological civilization as a means, not an end, and since we can not be saved either by its suppression or its continuation, to countermand it without destroying it."[20]

The Challenge of Hope to Science and Engineering

The confluence of the positive voices envisioning a radiant new culture is a very recent phenomenon. How long ago was it that we first read Huxley's *Brave New World*, Orwell's *1984*? Can the abject despair of Nevil Shute's *On the Beach*, can Mailer's *The Naked and the Dead* be written off as short-lived nightmares? Were the desperate appeals to a higher human conscience by scientists Szilard and Oppenheimer, by Albert Schweitzer, aberrations of cranky intellectuals, much as Bertrand Russell's and Linus Pauling's critical positions are viewed by opinion-making pundits even now? How is it that the dehumanized world foretold by Kafka, now that his desperate visions seem to have become reality, can usher in a new human order?

We stand too close to these changes to permit us a clear analysis. Perhaps the voices of despair have stimulated our survival instinct, perhaps the spontaneous and sporadic counter culture, as Reich and Roszak assert, paves the way. There can be no doubt: hope has displaced resignation. With this hope comes a new challenge to scientists and engineers. What is their response? Are they ready to help implement these hopes? What leadership are the scientists giving our society? What knowledge and motivation drives the engineers to work in the direction of a new culture?

POSITION OF THE SCIENTISTS

Regarding science and the scientists, the controversy over their relations to human values is so deep and apparently inconclusive that it would be quite beyond the scope of this paper to enter into it. For reference, Theodore Roszak devotes one chapter of his "*Making of a Counter Culture*" to "The myth of objective consciousness." With quotes and documented references to scientific statements of recent years, he attempts to show that the scientific pursuit of objectivity can lead to an inhuman detachment from humanity and a shirking of responsibility for the applications of science. In this context it is poignantly important and perhaps tragic that even that rare scientist who sincerely expounds "science as a human discipline"[21] can serve as evidence for Roszak's point.[22]

Whatever the individual scientist may rightfully claim as *his* motivation and attitudes, it seems that the combination of his talents with the powers of the megamachine (Mumford's term) and the entire direction of the technocratic society result in the progressive dehumanization that became the source of despair and the seedbed for the counter culture.

So few are the scientists who shared this despair that it may be said that the vast majority of gainfully employed scientists have done no more than would be expected from any professional group: they have occupied themselves with the advancement of their respective positions and with that of their profession as a whole. They would naturally seek more scientific solutions to problems caused by interaction of science and humanity. To them, this is their contribution towards a better world. But to the non-scientist, it can only widen the gap between science's contributions and society's wisdom to apply them. Bronowski says: "The dilemna of today is not that the human values can not control a mechanical science. It is the other way about: the scientific spirit is more human than the machinery of governments."[23] Although Bronowski in his book places

the creativity of poetry and art on par with that of science, this gives little comfort to those who see the identification of science with the "machinery of governments" and its awesome powers. As Roszak observes:

"Productive research results in a handsomely rewarded career, in acclaim and wide recognition. Is it too cynical to suggest that this all-too-predictable result frequently makes it ever so much harder to foresee the probable abuses of one's research?"[24]

In summary, the scientists — as a group — did not share the despair. They think positive, and so the most frequently heard scientific comment is: give us more facilities, more funds, more public encouragement, and we shall surely point the way to a society where so much is known about the secrets of man and nature that solutions can be found to all our present problems.

Two recent examples may be given: an article by biophysicist John Platt[25] and another by Glenn Seaborg.[26] Platt states that the hour is very critical and proceeds to list society's most serious problems, rating them by order of importance from the stand-point of survival of a viable society. This part of his paper is a valuable contribution as it puts broad areas of scientific work in focus, showing some areas as overstudied in comparison to the urgency of others. His sense of social responsibility might be broadly compared to the sense of urgency that motivated Einstein to write the famous "atomic bomb" letter to President Roosevelt. Einstein, who was an individualist and a humanist as well as an outspoken pacifist, thus became co-responsible for the institutionalizing of scientific teamwork that would tackle anything and that has become such an integral part of the megamachine. Platt now believes that such teams can be set to work on our social ills. He proposes task forces of scientists to produce "social inventions." Here is his list: Peace-keeping Mechanisms and Feedback Stabilization, Biotechnology, Game theory — particularly non-zero-sum (what I win you need not to lose), Psychological and Social Theories, Social Indicators, Channels of Effectiveness. This prescription has scientists planning more scientific solutions for all human problems. There is going to be more, not less, of all that measuring, dissecting, machine-programming, that is the critical target of Mumford and the other writers favoring a new culture. Whatever one may think of the motivation and sincerity of Platt, it is clear that he and his colleagues have nothing to share with Mumford, Roszak and Reich. The scientists are not even listening to these non-scientific voices.

Glenn Seaborg, chairman of the U.S. Atomic Energy Commission, has the same sort of thing in mind, but he is more diplomatic about it. He is aware of those forces that we have called here a counter or new culture. But his solutions are still and again based upon supremacy of science; he leaves no doubt about it: "We have a tremendous task before us in humanizing the focus and feeling of science, while at the same time organizing and rationalizing the forces of humanity." He offers the suggestion of more international interdisciplinary conferences, more communication with the public to "encourage the participation of youth in scientific and technical activities . . . We must at all levels engage in the realities of life, not to blunt their ideals or enthusiasm, but for the purpose of cap-

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turing what is good and constructive in them, . . ." Does that sound like meeting our previously reviewed social critics even as much as a quarter of the way? Or is it intent to persuade and buy out their constituency? Our scientists are optimistic, by and large : they seem optimistic not so much that man may prevail, but that man of science may prevail. Whether theirs is the better or superior viewpoint, is not an issue here, but the question: What has this viewpoint to offer to all those who came to their new, humanistic optimism out of despair over the dominance of science and technology? There seems to be no common ground, no discourse.

By contrast, one of the fathers of modern science, Max Plank (Quantum Mechanics) had this to say:

> "Is there something in the nature of man, some inner realm, that science can not touch? Is it so that when we approach the inner springs of human action science can not have the last word? Or, to speak more concretely, is there a point at which the causal line of thought ceases and beyond which science can not go?" And he answers: "The fact is that there is a point, one single point in the immeasurable world of mind and matter, where science and therefore every causal method, of research is inapplicable, not only on practical grounds but also on logical grounds, and will always remain inapplicable. This point is the individual ego. It is a small point in the universal realm of being; but in itself it is a whole world, embracing our emotional life, our will and our thought. This realm of the ego is at once the source of our deepest suffering and at the same time of our highest happiness."[27]

Will future scientists echo this more humble view? Or is this view gone forever in Seaborg's *Good New Days?*

POSITION OF THE ENGINEERS

While science has been in the public light, receiving much glamor but also much scorn, engineering has been operating in a much lower key. Engineers and engineering get good-natured credit for appealing designs and products, mostly of the consumer market. When they get blamed for malfunctions and failures of their products, it is somewhat in the same spirit as the U.S. Government gets criticized about the income tax. The most widespread engineering attitude can be summed up in the rhetoric question: "Who, me? I just work here," an attitude reciprocated by the general public. It is an attitude commensurate with the position of hired hands.

Perhaps this attitude was bred and justified during the rapid technological growth period that coincided with a surviving business tradition of laissez-faire. During the years of our immediate past, when despair seemed to get the upper hand in public attitudes and the relationship of science and humanity became a favorite discussion subject, not much was said about engineering. Engineering was generally supposed to implement all and anything that some vague power groups, variously described as management, investors, big government, or just "they," wanted technology to accomplish. And while many questions were raised where science would be taking us, for a long time nobody questioned where engineering would take us. This was fine with most engineers, too, because it

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avoided awkward questions about professional responsibility and in any event left un-
questioned a continuous demand for more engineers.

These attitudes are changing now. The hopeful aspects of the new culture and the
critique of the counter culture are companion reasons. If there is hope for a much more
humanized culture, why can not engineers orient their work in that direction? Engineering
has been described as the mediator between science and humanity. This means that those
in engineering work on things, services, and conditions that do something to or for humans
by way of applying technology. They are therefore one step closer to humanity than
scientists. Should the general public perhaps concern itself more with these mediators? In
the limit, if the public rejected a scientific proposal as harmful or monstrous, it would
only have to stop the engineers from "reducing it to practice." Then the scientists could
go on forever reading papers about it, without consequences to society.

In a climate of such questions, the profession of engineering and the individual
engineers are in for some difficult times. It seems that from now on, those who choose
this profession must do it out of some sense of usefulness, some relevance of their work,
in order to be counted as professionals. This relevance is not a passing fad, it is coming
to be expected of all those who participate in the tasks that give direction to our society.
And the engineering profession, through its mediating technological role mentioned
before, is in the forefront of these tasks. The relevance expected from the work of
technically trained men is so self-evident that there seem to be only two alternatives for
achieving it: either by order of an authoritarian regime, or by self-direction. Which
of the two shall it be?

It is important for us to stop and consider at this point that there is a clearcut
social relevance, a social responsibility in fact, spelled out for engineering and its pro-
fessionals in the socialist societies. On the shoulders of these professionals rests the
principal burden of material progress for the society. They are therefore not left to
grope for their appropriate role; it is defined and assigned to them by the power
structure of the ruling party. Whatever the individual may think of it to himself, he is
officially recognized as a highly educated worker making an informed contribution to
the well-being and welfare of his society, and he can take pride in his work on this basis.
Most Americans would agree that here, too, a principle burden of material progress for
the society rests on the shoulders of those in engineering. The rapidly growing public
concern over the desirability of this progress, and the direction that it should take, is only
one more strong case to prove the point. If there is bitter argumentation over the
application of engineering talent to improvement of the ecology instead of its deteriora-
tion or instead of destructive application outside the borders of this country, it de-
monstrates the dependence of this society on engineering for its welfare.

Thus, we have no disagreement with the basic social tasks or the socialist societies,
but we do have a disagreement with the method of accomplishing the desired results.
Instead of relying on an all-powerful party intelligentsia to define the goals in detail, and
a party bureaucracy to implement them by directing professionals to their tasks, we prefer

to rely on self-direction and the free choice of work association. That — like every other rule of the democracy game — only makes it a more difficult job for the engineering professional in this and in other societies that we call western democracies. When the initiative for seeking social relevance of one's job is left to the individual, it does not mean that he can walk away from it. He has the constitutional right to do so, while the rules of our society retain that right of the individual: but if he does, he denies his engineering work the social significance that the society has come to expect from it. Therefore, he contributes to the classification of his and his colleagues' work to that of so many faceless hired hands. If enough of those in the engineering profession become known for a disdain of social responsibilities, some powerful leaders of public opinion will eventually arise who can make a good case for (literally) socialization of this profession. It is the heavy burden of the professional in the democracy to voluntarily respond to the social demands of the times. Not only that, it is the further and separate burden to interpret these demands in terms he alone should be best qualified to do, and to participate in the trial and error that is inevitably associated with this difficult task.

Fortunately, some leaders of the engineering profession have been aware of this burden for some time and are providing new directions. The very fact that there has been a council on engineering education indicates some timely soul-searching, regardless of the merits of its published recommendations. A steady stream of thought-provoking articles in professional publications has dealt with the problem of social responsibilities for engineers. The president of the IEEE, in March 1970, gave a keynote address at the institute's convention under the theme "The Spectacular 70s," in which he expressed serious misgivings about this theme and "his concern that engineers, by and large, are ill-equipped for their responsibilities in the decade ahead."[28]   He goes on to say: "We need help. We can hope to find that help from other professionals . . . the whole gamut of people who are professionally concerned with our world and with our fellow human beings."

The idea of seeking such help, in the form of interdisciplinary collaboration, has already been put to work on some major societal problems through the leadership of men like Prof. William Linvill, chairman of the Engineering-Economic Systems Department at Stanford.[29]   Another interdisciplinary pioneer advanced degree program is Prof. Norman O. Gunderson's Cybernetic Systems at San Jose State College.[30]   These are very hopeful educational system trends, indeed. But it must be recognized that only small numbers of engineers are affected by such programs, and that the best of these programs will still retain a strong academic, para-scientific flavor. They can make an engineer feel responsible for his impact on humanity, they can make his work relevant in terms of complex human systems the extent of which he would otherwise not even have guessed. It is a beginning, but much more must happen. What is needed is that extra effort which the scientists apparently are unable to make, the effort at self-appraisal in the light of the stirrings of the new culture. There must be some recognition by engineers of the yearning behind this new culture, some effort at understanding, some discourse with its proponents. This leads to the question: what can individual engineers do?

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The Humanization of Engineers

Any change, any new concept involves negative as well as posit've efforts. To quote German humorist Wilhelm Busch:

The Good — this we may prove direct,
Is but the Evil we reject.[31]

The attitudes most likely to turn the engineer towarus humanism are the counterpart of those that kept him away from it. We may attempt to group them as follows:

NEGATIVE	POSITIVE
Professional Group Attitudes	
Fancying himself a scientist (pursuit of knowledge for its own sake)	Accept role as responsible mediator
Classing himself as a hired hand (Do what "they" want)	Work through the organization (make it do what does good to society)
Overspecialization	Broadended technical education
Personal Attitudes	
Professionalist in private life	Broad interests in society and the irrational creativity of arts and literature
Narrow outlook: next month's promotion, next week's project	Perspective on life and history

Let us review the key attitudes one by one.

WORK THROUGH THE ORGANIZATION

How can the engineering professional make the transition to the role of a responsible mediator? He can do so by identifying himself more closely with the organization in which he works. This may seem a paradox to some: is not the organization per se considered one of the archvillains of dehumanization? If we take this view, we would soon return to the state of despair, for we would assume that no organization can be made compatible with humanistic values. The limitations of present organizations must be seen in the context of the limitations of people who staff them. No organization is immutable, each engineer can contribute his influence.

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The professional works in an organization not as a specialist of a certain engineering field, but as an integral part of that organization's effort. The individual professional contribution is equated with the company's contribution to society's market, which in turn should have some social significance if the company's market position is at all tenable. No matter what a philosophizing social critic may think of that particular endeavor, a society with a relatively free market play determines a product's or service's social significance by the market's reaction. Therefore, engineering's social responsibility does not need to be limited to projects concerned with pollution and urban renewal. Taking this limited view would only redirect the military glamor technicians to civilian glamor projects, and leave all those contributing to society's myriad ordinary needs without motivation. Yet it is precisely the use of engineering in the transportation, power, communications, appliances, entertainment industries — to name only a few — where increasing public inquiry and pressure raise questions of professional motivation and concern with social responsibility.

If the individual professional is the mediator between technology and its social application, then his employing organization is the mediator between the professional and the society. The professional and his organization's leaders therefore must learn to connect their respective activities, so that the society to be served becomes transparent to the professional buried in his work inside the organization. In turn, society recognizes the professional's social responsibilities by its interpretation of the products or services offered through the organization. In time, the market play will more and more reflect the standards of the new culture, thereby gradually changing the market goals of the organization in step with the engineer's preparedness within the organization.

BROADENED TECHNICAL EDUCATION

Specialization is, by definition, the concentration on a part of a whole field. The greater the degree of specialization, the greater the distance from a view of the whole. At some point of specialization, the whole is no longer visible at all; in fact, it may only be possible to think in terms of many divergent items. The result of overspecialization is thus an alienation from things human. If this logical connection is not obvious, a reading of Mumford will be found helpful. Suffice it here to say that the atomistic view permits subdividing all matter into smaller particles from which one can no longer reconstruct any whole object without a complex plan and model of the object as a whole. As Pierre de Noüy has pointed out, all our knowledge is valid only as recorded and measured on the human scale. He gives a simple example: an equal parts mixture of black and white grains appears to us grey; but to the eye of an insect, each grain would be a separate block of contrasting color; there would be no wholeness of the mixture.[32]

From a practical standpoint, overspecialization is apt to make the professional foreseeably obsolescent, as demand for specialized skills tends to change with changing technology. For these reasons, a broader education enables the professional to understand and stay in tune with the human uses and abuses of the projects on which he works, as well as making him feel as a responsible contributer.

PERSONAL ATTITUDES

Broad interests in society: this is a deliberately vague statement. Nothing can be more truly human as spontaneity, emotional uplift or despondency in response to music, or any of the innumerable manifestations of human ingenuity, playfulness, and irrationality. It is in the description of these manifestations that Reich's book is a veritable compendium; we need not duplicate it here. In my article titled "The Myth of Obsolescent Knowledge,"[33] some examples of possible cultural interests were described. One dissenting engineer commented that to him, ballplayer Koufax meant more than author Kafka. He missed the point, namely that he should feel free to choose whatever makes him feel as a whole human being.

The same article gives the outline of a new perspective on life, a perspective that would be similar to our optical perspective. It seems to me that such a viewpoint would be more in harmony with our humanity and would permit us to maintain our place in history without succumbing to that threatening discontinuity. If the professional engineer could acquire such a view, he would be able to detect the distant past and the distant goal spreading before his eyes on a gentle slope. This can convince him that the utterly inhuman, steeply rising exponential slope that has been assumed to trace our human development is just a purely mechanical point of view, one that counts linear accumulations of facts, pieces of paper, like algae in a polluted lake. But it is not the quality of facts and things that matters alone; it must be brought into relation with our ability to see and use them. The dream of reason produces monsters, so captions Goya one of his works. It is a dream of reason to count events as if counting grains of sand in a dune, and then refuse to see the gently receding dune instead of a linear pile of grains.

Continuity with perspective: that should be the engineer's attitude as well as that of other humans. Every day we see anew, but we stay in line-of-sight with what we saw yesterday. And everyone of us is empowered to see differently his own self, his family, his professional colleagues and his place in humanity.

In the words of Pablo Casals, a wise indefatigable nonagenarian whose mastery of music may have enriched more lives than has many a celebrated scientific breakthrough:

"Each second we live in is a new and unique moment of the universe, a moment that never was before and will never be again. And what do we teach our children in school? We teach them that two and two make four, and that Paris is the capital of France. When will we also teach them what they are? We should say to each of them: Do you know what you are? You are a marvel. You are unique. In all of the world there is no other child exactly like you. In the millions of years that have passed there has never been another child like you. And look at your body — what a wonder it is! your legs, your arms, your cunning fingers, the way you move! You may become a Shakespeare, a Michelangelo, a Beethoven. You have the capacity for anything. You, you are a marvel. And when you grow up, can you then harm another who is, like you, a marvel? You must cherish one another. You must work — we all must work — to make this world worthy of its children."[34]

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To see this marvel, this unique potential in each child, man and woman, each human must start with himself; not pretending what he should or would seem to be to others, but finding what he is. In this act and in sharing it with one close human being, he will be unfolding as he helps another unfold, as Martin Buber's wisdom suggests.[35] And if the engineer can unfold, he will open "the gates of the technocratic prison" (Mumford's term) in which he has become his own jailer.

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NOTE: Mr. Revel's book has since been published by Doubleday & Company, Inc., under the title *Without Marx or Jesus: The New American Revolution Has Begun*, translated by Jack Bernard. For the definitive English text of the referenced passage, the reader should consult this edition.