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For the men and women of Hewlett-Packard/AUGUST 1971

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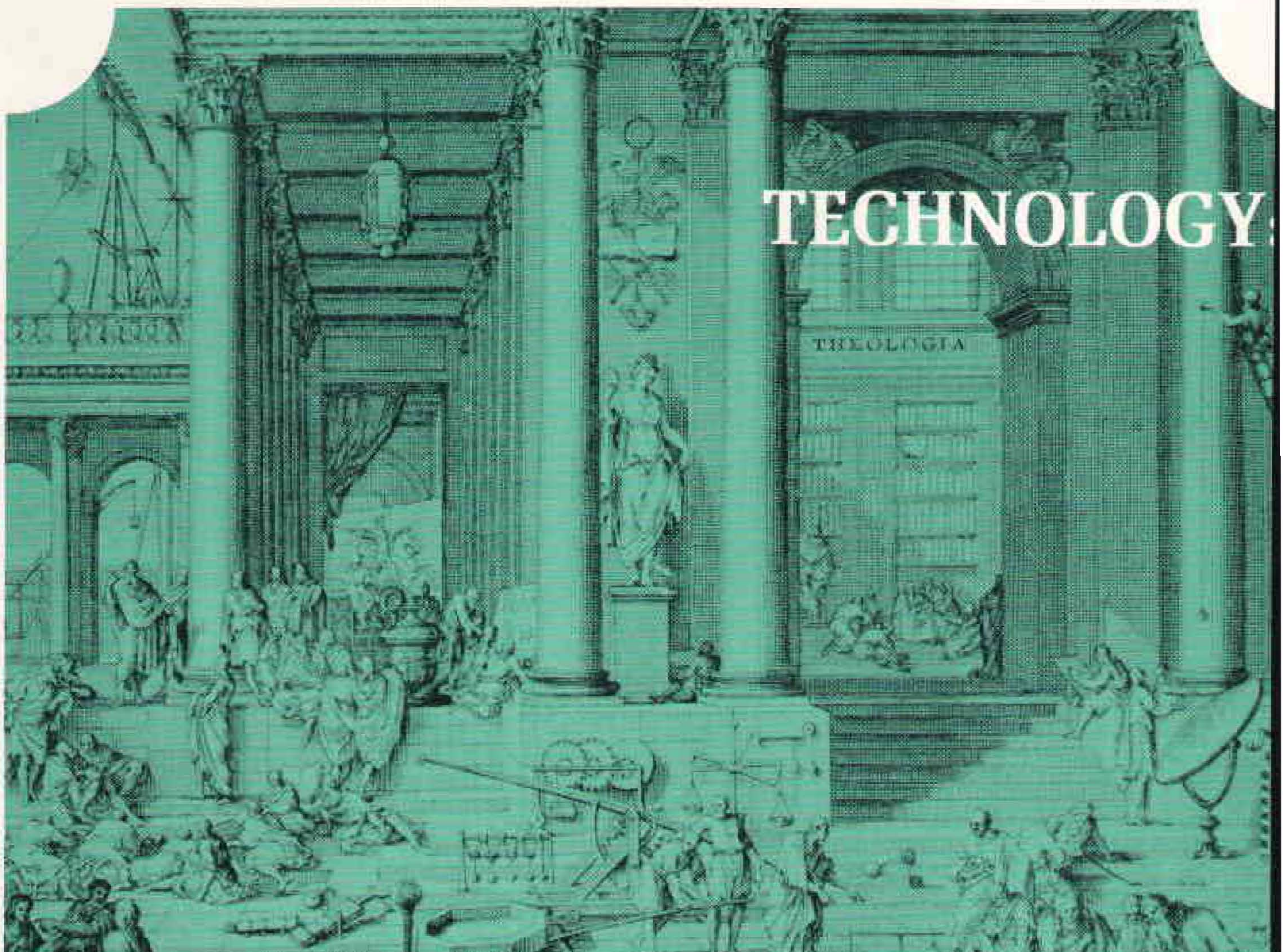


tool for a troubled world

On that day some thirty-two years ago when Bill Hewlett and Dave Packard decided to concentrate on the field of electronic test instruments, they simultaneously committed themselves and their company to an involvement in TECHNOLOGY.

For most of the years that most of us can remember, membership in the fraternity of technology has been held in high regard. The engineer, the scientist and the technician were the benefactors of society. They made things happen. They created change. And weren't change, growth and progress the essence of our way of life?

A lot of people don't think they should be any more. At least, they say, these should not be our primary goals. Many find fault with the trappings of affluent materialism. They say our culture has become a heedless megamachine churning out wave on wave of glittering goodies—"things" that temporarily appease but too often fail to satisfy our basic human needs for personal security and identity. Others claim the megamachine has become so huge and out of balance that wars or the threats of war have become a means of employing the excess productive capacity.

Either way, they say, we have been pouring our limited resources down a rathole—one technology helped to build.

Is that really what technology is all about? Is that its promise to the future?

One answer, of course, is that technology is really a very complex component of society, with most of its parts serving that society very well.

A corollary is that technology has become a handy whipping post for a society that has suddenly uncovered new sources of shame and guilt.

But surely another answer is that technology must become the tool for healing the very ills it is accused of abetting.

That message sticks out among the following commentaries and contributions:

(continued)

Society and Technology in the Seventies

Excerpts from a speech by Barney Oliver, vice president of research and head of HP Labs, before the Institution of Radio and Electronics Engineers of Australia last May.

☐ It's a real pleasure for me to be once again in Australia and to be able to speak to you tonight . . .

The eight years that have gone by since my first visit have brought profound changes in the world and in our social attitudes. Certainly these changes have been profound in the U. S. and I suspect they have affected you as well . . .

It's hard to believe that these were the same years when man first left the earth in spaceships, first saw his planet from afar—a beautiful blue-green jewel in space, flecked with clouds—and first walked on the moon. Nowhere is the dichotomy of the scientific versus the non-scientific culture more glaringly evident than in the contrast between the space program on the one hand and hippie communes on the other. In the former we see man, through science and technology, expanding his horizons, opening up new frontiers of exploration and knowledge, and seeking to unify and educate the world via satellite communication. In the latter we see youth, our hope for the future, walling themselves off into primitive, isolated and therefore eventually inbred, ignorant and disease-ridden enclaves.

How can such divergent trends go on in the same supposedly enlightened world?

The scientific culture pictures itself leading man toward ever more knowledge, toward a fuller life and toward a destiny too great to be limited to this planet. The non-scientific culture, and particularly our youth, see science and technology as a threat to man's survival—as the cause of pollution and the road to atomic extinction.

Talk about bad public relations! The scientific community is suffering from the worst PR in human history . . .

Is it not time, and past time, that science . . . accepted the obligation to provide a new and rational basis for human behavior—for our ethics?

It seems to me that science has led us to a new reverence for *living* things, and toward a morality that seeks to advance man and preserve his world, rather than to insure an individual his reward in heaven. If we as moral scientists and engineers can proclaim those things "good" that ensure the survival, growth and evolution of mankind, and the protection of the environment he shares with other life on this planet—If conversely we can proclaim those things "bad" that diminish in any way man's chance of survival, or of his continued development, or his ability to preserve other life—If we can assert these concepts as the basis of our faith, I think we will find young people on our side once more . . .

Very well then. As moral scientists and engineers what purposeful rational actions should we take?

I think there is no question about it. We must solve the ecological problems posed by our population and by the demands of our technological society. If we do not, that society is doomed. This I believe to be the challenge to technology in the seventies.

In approaching these problems, I think we need to remind ourselves that our goal is to survive not for just another generation or two, but for as long as the sun shall shine —for at least another billion years. When we define the goal this way new priorities become apparent. Some of the ecological problems about which there have been the most concern, such as smog and noise, become much less important than others. The most important ecological problem of all in terms of immediate threat to our technology-based society is

"It seems to me that science has led us to a new reverence for living things, and toward a morality that seeks to advance man and preserve his world..."

(continued)

the depletion of our fossil fuel reserves and of our reserves of certain metals.

There has been a great deal of attention over the last two decades devoted to developing the so-called under-developed countries. Fortunately these efforts have been largely unsuccessful. I say fortunately because if they had been successful we'd be in deep trouble. If the entire world were now at the same standard of living that we in the U. S. and you here enjoy, and if no steps were taken to recycle metals, we'd run out of:

Chromium	in 45 years
Nickel	in 25 years
Tungsten	in 13 years
Copper	in 12 years
Lead	in 11 years
Zinc and Tin	in 9 years
Molybdenum	in 8 years
Mercury	in 4 years
Silver	in 1 year

Where would we be without these metals? What will happen to technology in our children's and grandchildren's time if we don't begin to recycle them completely, and do so as soon as we can? More important than *where* we dump our garbage is what we waste in dumping it.

Atoms don't wear out, they just get lost . . . Clearly we must develop regulations requiring the individual housewife and industry to segregate their garbage into such categories as metals, glass, plastic, paper and degradeable organics. The last can be composted and returned to the soil, the others must be sorted and reused. A whole new salvage industry must be established and the technologies of machine sorting and of refinement of scrap must be developed. I want each of you to start feeling guilty every time you throw away a toothpaste tube or a piece of photographic film with its precious silver.

The matter of our oil reserves is just as alarming. At the present time the world usage of oil is about 45 million barrels per day, or about 16 billion barrels per year. The known reserves are estimated to be on the order of 600 billion barrels, or enough for only 37 more years with no increase in rate. In addition, the rate of increase of consumption has been doubling every 8 years. There undoubtedly are undiscovered reserves, but their discovery cannot keep pace with the growing usage very long. Unless we convert to nuclear power and do so at once, our children are literally going to run out of gas.

The uproar over pollution today will be nothing compared to that that will arise the day they get up, turn on the light, and . . . no light. Think of it. No light. No heat. No refrigeration. No cars. No trains. No planes. A few ships. No place to keep a horse and nothing to feed it. Nothing for people to eat either. Maybe the kids in communes are right after all. Learn to live off the land.

We're going to look pretty ridiculous and pretty criminal, we moral scientists, if we let this happen. Especially since we can prevent it if we act now. Fast breeder reactors can supply our energy needs for millenia. Fusion reactors (if we can invent them) will supply our needs forever. We must begin building nuclear power plants not just to supplement fossil fuel plants, but also to replace them. We must save our oil reserves for mobile, portable and emergency power needs and for important chemical processes, until we can invent other sources and processes.

We should begin a program of public education about nuclear power at once. Safety is not a problem. The radiation level close to a modern nuclear plant in full normal operation is about 1 percent of the natural background—less of an increase than you get from sitting on granite steps or climbing to the top of a high hill. Under the worst conceivable accident —the saboteur who manages, after ten hours labor, to jimmy all the control rods and interlocks and causes the reactor to melt—the result is not the blinding flash and mushroom cloud that haunts the public mind, but only an abnormally high radiation leakage that could cause death under prolonged exposure. Living by a nuclear plant is 1000 times less dangerous than living below a hydroelectric dam.

The public needs to be told these things and we must do it. They need to understand that the so-called thermal pollution from nuclear plants is not much greater than from existing fossil fuel plants—both have about the same Carnot efficiency—but that the latter pollutes the air while the former does not. But what we really should do is site the nuclear plants near metropolitan areas and *use* the waste heat as hot water to supply industrial and domestic needs and to heat our homes.

The city of Reikjavik, in Iceland, uses geothermally heated water to heat the entire city and to supply its hot water needs. The spent water is then used to irrigate and warm the extensive greenhouses where they grow vegetables and flowers.

Every time we use a gallon of electrically heated water we cause two more gallons to be wasted in cooling the power plant. Using one gallon of the hot water *produced* in cooling the plant thus saves three.

The economies and conservation of resources that are possible through applied technology must be brought about through education and legislation. Let me quote from a recent ASEE brochure: "Making Tomorrow Happen:" "Let's agree on another point. If man's survival is being endangered by technology, then there's little doubt that his survival also turns on technology. Part of the solution to the ultimate problem, then, will obviously have to be technological. Equally obvious: the major job of solving that problem must thus be entrusted to men and women capable of dealing professionally with it—the men and women professionally known as engineers.

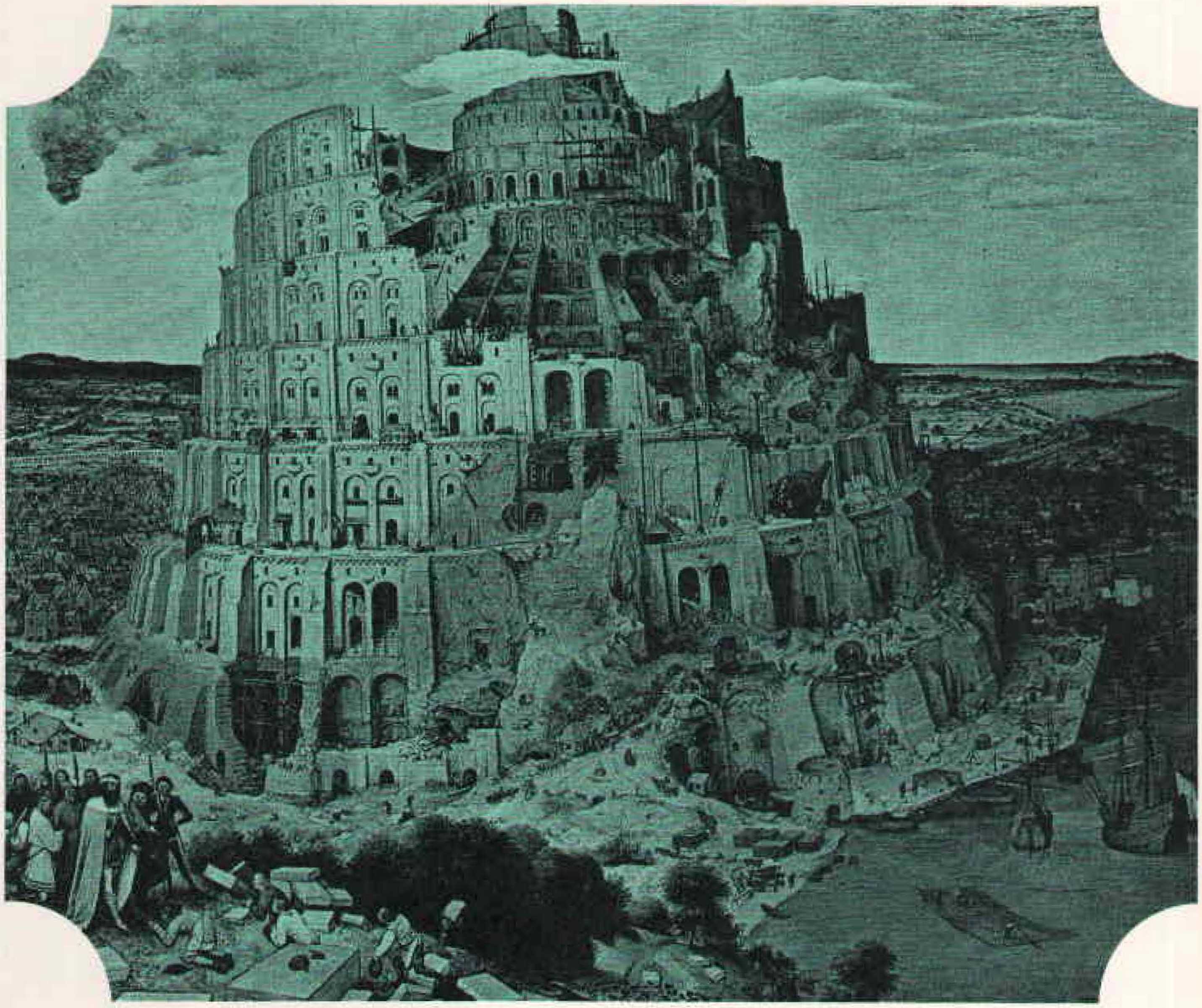
"If this is so, and it's hard to believe otherwise, then a subtle and important change must take place in the ranks of American leadership.

"Historically, the men who have shaped this country—the men who have directed it, governed it and handled its political, social and financial affairs—have been men who were trained as lawyers, businessmen, entrepreneurs; these leaders had seldom been trained as scientists or engineers. In fact, their insight into engineering was often much less than what engineers knew of the liberal arts, humanities and social sciences.

"Now, however, one can see far enough into the future —a disquieting, almost frightening future—to know that the kind of leadership we will need must include both engineers and scientists."

Scientists and engineers can no longer afford to play the role of servants to society, building its cars, planes and bombs without regard for their effect on society. We are part of that society—a part with more power and therefore more responsibility than ever before. We must insure that our efforts are directed at those problems we know are important. We must become as important contributors to world peace and to man's survival as we have been to world war and man's destruction. This is the task I see ahead of us. If we are successful we can leave our children the greatest legacy of all: an unscarred world at peace, one with an indefinite future before it. □

"... our goal is to survive not just for another generation or two, but for as long as the sun shall shine..."



Tower of Babel, Pieter Bruegel, 1563

Should it be done?

The rear view mirror of history clearly shows that technological progress at times has been a very mixed blessing. Think how city fathers once proudly advertised their belching smoke stacks. Think also of those thousands of scientists, engineers and technicians in the U.S. who have lost their jobs as a result of recent cutbacks in high technology programs.

To some people, including various leaders in the electronics industry, what seems to be needed is a better definition–a statement of national policy, perhaps–regarding the place of science and technology in our society. Only then, they feel, do we have a chance of avoiding the excesses of unbridled "progress" on the one hand, and maintaining a high level of technological effort and morale (and public acceptance) on the other.

The following briefly represent some of the kinds of current arguments that swirl around this issue:

Having credited the engineer for his triumphs, we can ask to what extent is the engineer at fault when technology fails? Probably less than his critics would claim; perhaps more than he may realize. The engineer, in his concentration on making miracles happen, assumed the public realized that such miracles are seldom beneficent to everyone. There's always a price to be paid. The engineer rarely makes the point, just as the public often forgets it.

Housewives, for instance, do indeed prefer "whiter than white" washes. Chemical engineers devised a way to give that to them. The price was phosphates. The proper amount is fine, but too much phosphate by too many housewives in too little water can result in a changed environment. The word becomes "pollution."

That's just one example from a list that could be endless. Further examples would also illustrate a basic fact of this or almost any other free society: we tend to make decisions about innovations and improvements on the basis of the greatest good for the greatest number. A major bridge, for instance, can be built between points A and B, providing a transportation convenience to thousands of residents and commuters. However, the same bridge can take jobs away from five or six crews manning the old ferry boat. Should the bridge be built?

The answer is not only obvious, but it is part of a larger problem whose solution will be fully worked out by the coming generation of engineers–because, simply, they will have to work it out.

(continued)

By and large, engineers have been asked to solve a specific problem. Period. By and large, they have not been asked to measure the after-effects of their solution.

If the roster of problems and crises in the years ahead is to be dealt with successfully, changes are very much in order.

At one level, a necessary change will be enlightenment on the part of the state and federal governments to seek the advice of engineers.

In their turn, engineers as a professional group are finding ways to voice their concern when their professional insight and experience can affect the quality of the nation's future.

And as individuals, engineers now see that they owe to themselves, their profession and their country a new thoughtfulness about the social implications of their achievements.

Making Tomorrow Happen
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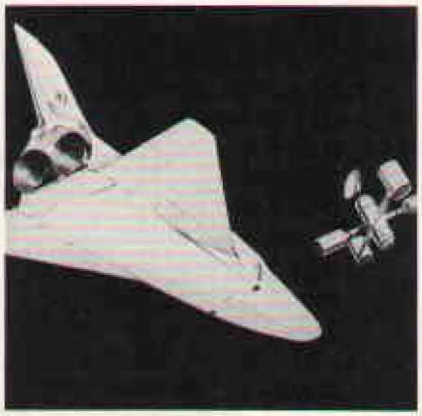
should it be done?



To the Editor, *The New York Times*:

Professors Adams and Katznelson have done a public service in focusing attention on the space shuttle, though ironically their recent letter shows no conception of its importance; to them, it is clearly just another military-industrial boondoggle.

We can manage (for a few years at least) without the SST; we have alternative means of transportation. But the shuttle is the precise equivalent of the DC-3; where would aviation be now without that? By replacing the present one-shot rockets by reusable vehicles, it will enable us to get payloads into orbit at a fraction of today's costs.

This must be done, if we are to save our planet. It is now obvious—except to the wilfully ignorant—that many of the solutions of our present social and environmental problems lie partly in space. (As the mathematicians would say, the space segment is necessary, but not sufficient.) Geodetic, meteorological and communications satellites have amply demonstrated their value; the potential of earth resources and—perhaps above all—educational satellites is even greater.

Living as I do in Ceylon, I am well aware of the problems of developing nations. Recently I visited India, filming the impact of the forthcoming ATS-F satellite project. This will broadcast family planning, agricultural and educational programs to the entire subcontinent—so that they can be picked up by ordinary domestic receivers with about \$200 of auxiliary equipment. It needs only one receiver per village to start a social and economic revolution, at a cost of about \$1 per person per year. And this applies not only to India but also to South America, Africa, Oceania—the whole of the underdeveloped world.

What has the shuttle to do with this? One answer is given—perhaps accidentally—by the illustration of the Orbiting Astronomical Observatory which appeared with the Adams and Katznelson letter.

That satellite cost \$50,000,000. It failed, through a minor circuit defect, immediately after it went into orbit. A man with a screwdriver might have been able to fix it.

As our applications satellites become larger and more complex, space shuttles will be essential not only to orbit them, but to carry the technicians who must check, service and repair them. In the next decade this will be so obvious that it will seem incredible that intelligent men ever disputed it. But there will be no shuttle in the next decade—unless we start planning it now.

Arthur C. Clarke
Vice President
The Spaceward Corporation
May 22, 1971

"...there is one excellent proposal—
that a national science and tech
and maintained as a public law."

Recently, there has been talk in the Congress and the Executive Branch of a need for a complete overhaul of the nation's science and technology policy. Movement in this direction has not yet developed into a cohesive program, but there is one excellent proposal–that a national science and technology policy be stated and maintained as a public law. We think that is an appropriate place to start. Indeed, we believe it should have your immediate attention.

If there had been such a policy five years ago, it might have been possible to alleviate or minimize the effects of today's aerospace and defense cutbacks; zero in on domestic problem solving and create a market for new electronic hardware and computer software before the need became urgent; prevent government cutbacks of science and engineering research at colleges and universities throughout the country.

The WEMA Board of Directors this month unanimously approved a resolution that this Association work for the establishment of a national science and technology policy.

Merc Mercure
President, WEMA (Western Electronic Manufacturers Assn.) in the Congressional Record, May 24, 1971

ology policy be stated

The collective failure to recognize the traumatic imprints made by the original megamachine (alias "civilization") led one culture after another to repeat, to the point of exhaustion, the mischiefs originally made. As the scope of the power system widens, however, the once genuine possibility of making a fresh start in another place, through another people, with a different culture, becomes less likely, for the very success of mass production and the mass media has spread and solidified civilization's ancient errors. What is needed to save mankind from the megamachine–or whoever controls the megamachine–is to displace the mechanical world picture with an organic world picture, in the center of which stands man himself . . .

The unrestricted increase in population, the overexploitation of megatechnical inventions, the inordinate wastages of compulsory consumption, and the consequent deterioration of the environment through wholesale pollution, poisoning, bulldozing, to say nothing of the more irremediable waste products of atomic energy, have at last begun to create the reaction needed to overcome them. This awakening has become planetwide . . .

Nothing less than a profound reorientation of our vaunted technological "way of life" will save this planet from becoming a lifeless desert.

Lewis Mumford
"The Pentagon of Power"

From an overall standpoint it's clear that we are changing our priorities somewhat from space and military research and development to the civilian side of the economy and to human needs in the country and throughout the world.

The problem in science and technology is to implement that conversion, and this is not an easy thing to do. We are working very hard at it. And we're making progress.

The public . . . has been sort of doubting the value of R&D, or at least has been saying that science and technology cause as many problems as they cure . . . You hear people ask, for example, "Well, if we can go to the moon, why can't we control pollution and clean up the environment generally and reform our health care system?

I think the answer to that is very straightforward: We can do all those things, but it takes time. Harvey Brooks, dean of the Engineering School at Harvard, has recently written a paper in which he points out that it takes ten years for technology to respond to a new goal of society.

Dr. Edward E. David Jr.
Science Advisor to President Nixon; Director of The Office of Science and Technology

What can technology contribute?

In its special report on "Perspectives for the '70s and '80s," the National Industrial Conference Board said: "Seldom has the world, in general, and this nation (the U.S.) in particular, been forced to pick its way through problems of such number, scale, complexity, and strategic importance as now . . . The explosive growth of science and technology is increasing the rate and scale, and altering the character, of social change so fast that plans and programs are outdated before they are implemented. Without more accurate long-range forecasts, key decision makers in business and government are 'backing into the future.' " The report, using a panel of 120 experts, went on to develop a list of 20 priority "areas of concern." It was from this list that MEASURE selected a number of areas that seemed most appropriate for world-wide consideration. Then various divisional R&D departments around the company were asked to contribute their thoughts on one of these areas. The contribution could come from an individual or a group. Specifically, each was asked: "In what ways can technology—that is, science and engineering—contribute to a favorable resolution of this problem?"

In answering their question, it is apparent that they also answered a number of other common questions, namely: "Do engineers have ideas about their role in society?" "Do they care?" And, "Should they speak out?" . . .

The management of change

Let's examine one of the overriding problems brought on by the automobile. Namely, how does one attempt to cope with the problems of fossil-fuel depletion and air contamination, either technically or culturally, while remaining within the framework of an open society in a political democracy?

If health effects from air pollution were the primary problem, a proper response might be to insist upon air-contaminant emission control technology. If, however, the depletion of fossil fuels is more critical, a better response might be to develop a more efficient engine or a mass-transit system. Each of these is a technological advance to ameliorate a problem created by previous technology.

There is, of course, another way. The total number of cars or the amount they are driven might be reduced, whether voluntarily or otherwise. The average family, for example, is estimated to make eight separate car trips per day, and one wonders if shopping trips for food (say) at less-frequent intervals might not be possible.

The point here is that technological effort can certainly improve problems that exist because of previous technology. But there are ultimate laws of nature that technology cannot buck. Thus, if air is becoming toxic, the cure lies not only with technology but also with a cultural life-style change of its residents. They must drive fewer cars; they must invest in mass-transportation methods; they even must walk; or as a final desperate measure, they must refuse to live in such a congested and polluted area, even though it means a lower income and slower-paced life in a less-crowded environment elsewhere. More succinctly, even with technology, it is difficult to have your cake and eat it too.

Note that virtually all resource diminution—air, water, noise, land use, critical raw materials—occurs by choice, either of the individual or of the society using the products. It is a consequence of air conditioners, central-heating systems, electric toothbrushes, and the other material acquisitions by people no less than it is a function of industrial decision and misapplication of technology.

The fact remains, and it is becoming increasingly apparent to us, that the earth's resources are not infinite. What role technology will play in the resolution of this dilemma remains to be seen, but it clearly will be instrumental in many areas including pollution control, recycling of "waste products," and substitution of synthetic materials for natural.

However, the overriding problem, in my view, is not just technology itself, but the fact that man's technological capacity today has far outstripped his philosophical capacity. To claim that more technology will save us from the unforeseen and undesirable effects that previous technological advances have bequeathed us is to beg the question of who decides, and upon what basis, the direction of our technological future. Christian faith, economic *laissez faire* or even pragmatism are simply not acceptable guideline philosophies to cope with the technological potential for resource destruction.

Inasmuch as democracy is an outgrowth of those guiding principles, it is an almost irrelevant government form by today's realities. Without suggesting a better replacement, it is plausible to suggest that man is a pawn of his technology, albeit at a high creature-comfort level, to a more profound degree than Egyptian slaves were to the pharaohs.

Charles House,
R&D engineer, Colorado Springs;
Member, Colorado Air Pollution Control Commission

The "have" and the "have-not" gap

Technology has enabled us to use the resources of the whole of the world—to create wealth for a few nations. The gap between the "haves" and "have-nots" is therefore at least partly a product of it. Even within the wealthy communities there exist large under-privileged groups whose positions are steadily being further eroded. Simultaneously, by its effect on the environment, technological progress seems bent on the erosion and eventual destruction of our society as a whole. Thus technology could perhaps be viewed not as our hope for the future, but as, itself, a threat to our survival.

As world resources are limited, disparities between the rich and the poor must be examined in terms of redistribution rather than simply of a need to create more wealth. For example, there is evidence to suggest that we could produce enough food today to feed the two-thirds of the world which goes hungry. Yet we cannot distribute it, partly because of transportation problems, but fundamentally, perhaps, because our trading system is still founded on barter and is incapable of supporting a true transfer of wealth from rich to poor. Even within nations, progressive taxation and death duties apparently do little to redistribute wealth.

Progress, therefore, must involve change in social structure, and a reduction of the wealth of the "have" nations, rather than a redirection of technology alone.

Nonetheless, suppose we take advantage of technology, what can it achieve?

Our high-technology products are needed for desalinizers, improvements in farming, in both animal stock and better seeds, better communications, both by electronics and by better transport. Better sewage schemes and better medicine will all be needed. Education is fundamental to progress.

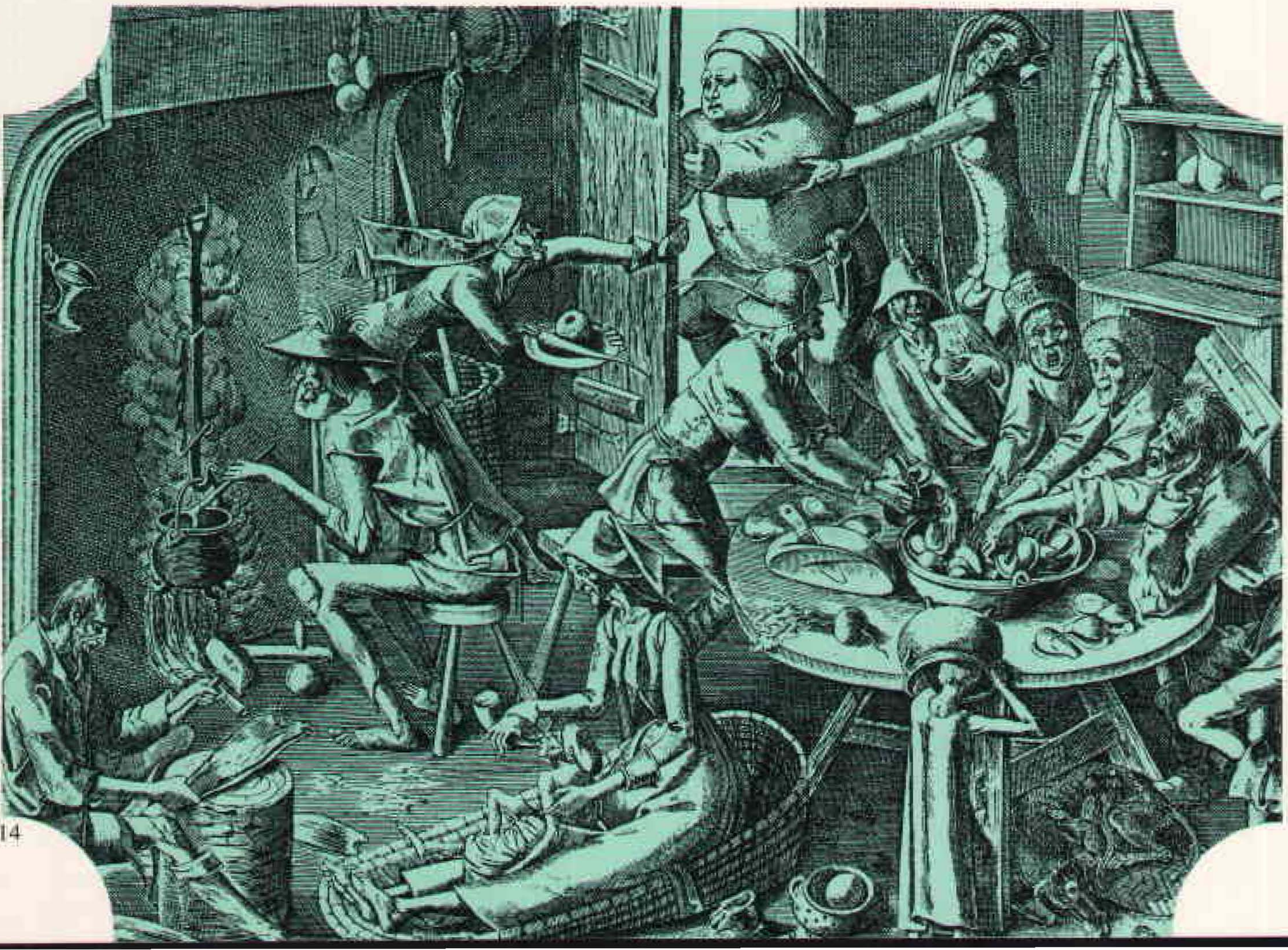
Many of these things can be produced as a result of research and production in the wealthy countries, and made available to the needy. Others, particularly changes to the infrastructure, can be best achieved by the inhabitants of the countries, perhaps using low-cost methods of earth moving and building to employ greater numbers of people. But there must be a gradual transfer of control of the means of produc-

*". . . man's technological capacity
has far outstripped his philosophical capacity."*

(continued)

The Rich Kitchen, Pieter Bruegel

The Poor Kitchen, Pieter Bruegel



"... many good solutions to hunger have not been implemented on a large enough scale ..."

tion to the user country, otherwise we are pursuing economic colonization, rather than partnership.

At the same time, we must recognize the poor in the midst of us. Some of our resources should be directed toward their care as well as the repair of our environment. Labor-intensive projects of reclamation are as badly needed in our own countries as elsewhere. Perhaps through retracing our steps in this way we can persuade other nations to aim for more desirable goals than ours.

Technology is perhaps best treated as a power tool in the hands of society. Its advantages can be realized only if the goals of our society are altered. It may well be that our individual responsibility lies principally in behaving as thinking members of society, both within our work and outside it.

Bob Coackley, *R&D group leader*
Ken Edwards, *R&D engineer*
Mario Pazzini, *R&D engineer*

HP Ltd., South Queensferry, Scotland

Feeding the world

Before any appropriate steps can be taken technologically to effect a solution to the food production and nutrition standards problem, we must be certain that the problem is properly defined. A proper definition involves not only assimilation of data relating to food-production efficiency versus population growth but also determining what technological "resources" are available from which to choose a plan of action.

Assuming that a satisfactory problem definition exists and that available technological resources have been determined, one or a combination of several directions may be decided upon to expend effort. Some of these directions are: (1) means of increasing the supply and use of agricultural chemicals and fertilizers, (2) ways of modernizing and developing new storage and distribution systems in and between urban-rural areas, and (3) development of low-cost, high-protein food mixtures, and having them gain acceptance on the part of tradition-bound poor.

I believe that success can be achieved in any or all of these directions for several reasons. One is that, for the present, the public does not appear to be aware of, or concerned about, the questions of food production or famine. The fact is, however, that for the first time in years, U. S. food surpluses are nearly used up. When enough widespread concern is generated (which is what had to happen with the various pollution problems) sufficient motivation will be generated to initiate a program. Given enough time, this motivation will become very strong.

Possibly the biggest hindrance to the success of a food-production and nutrition-standards program will be lack of world-wide "political" cooperation rather than lack of technological know-how.

Paul Goldman,
project engineer, Medical Electronics Division

The food production problem is not necessarily technological. In fact I'd go so far to say technology has nothing more to offer. The reason is that technological advance in this realm has been excellent, considering the money invested. Yet many good solutions to present-day hunger have not been implemented on a large enough scale to help.

High-yield grains have been developed for certain underdeveloped countries, and the methods used in their development could be used to develop other grains to meet certain climate and parasite conditions.

Farming of the sea and construction of fresh water ponds have been found to be cheap and efficient means of producing high-protein foods. Yet today there is still widespread world hunger, and even hunger or malnutrition suffered by millions of Americans.

So I'm not saying that technology can't contribute more and better solutions, but if these solutions aren't implemented, then it's almost better that they never came about. Given what small scale use has been made of present technological solutions to food production, I hold little hope for implementation of new advances.

Especially discouraging are the cases where this technology has been used to improve the economic positions of the rich landowners while the poor farmer and the hungry have been adversely affected. In many countries there are cases where the shacks of the poor sit beside huge farms which used to need their labor but no longer do, due to continued mechanization. In this country, many poor live near acres of land now fallow under agricultural subsidy to the land owner.

Economic and political considerations have a greater need of attention than technology in the problem of food production. Even in this country, we still destroy farm products to prevent surplus while people go hungry (the fact that our store of surplus is decreasing is misleading, since we still destroy food). To define the problem in terms of technology is not the answer.

Joe Geck,
project engineer, Medical Electronics Division

(continued)

"We must ask ourselves what are the long-range effects of our work and act so that these effects are beneficial."

Conserving resources

Efficiency, defined in terms of a system, is the ratio of useful to total energy of a system. Energy leaving the system is considered waste energy and does not contribute to efficiency. But if we enlarge our concept of the system, we may find a use for the "waste" energy.

Consider electrical power production and distribution, which currently are not very efficient. If we decentralized the generation of power to the neighborhood or home level, the heat which is a byproduct of electricity could be used for heating, cooking and the like. If, in terms of electrical energy, the power plant has the same efficiency as a large central plant, in terms of total useful energy the smaller unit would be far more efficient.

Sometimes a global view of efficiency may lead to questioning the need for an activity. For example, travel consumes a good deal of energy; in addition to making travel more efficient, why not try to eliminate some of it? There is a good deal of travel for purposes of communication—notably business and educational trips. What if we had an electronic communications system so natural that you would feel as if you were sitting across the table from the person on the other end of the phone? Classes and business conferences could be conducted without the huge expenditure of energy which are part of automobile or airplane transportation.

As technologists we must not take the narrow view. We must ask ourselves what are the long-range effects of our work and act so that these effects are beneficial. We are in a unique position to do so—anything less is an abdication of responsibility.

Jim Kasson,
R&D engineer, AMD/ATS

The depletion of our fossil-fuel resources and the pollution of our environment have one common base—the demand for electrical power. Finding ways to reduce, or at least limit, the growth of that demand will have a direct bearing on the preservation of resources and environment.

Since the use of electrical power is a characteristic of all of HP's products, it's one that R&D can directly influence. I estimate that all of the products manufactured by HP in 1970 would consume 12 million watts if turned on at the same time, enough to supply a fair-sized community. By giving priority to reducing power dissipation in our new product designs, we can bring about a great reduction in our contribution to this problem.

Employment of low-power circuitry is one obvious design technique. Typical vacuum tube designs require about 1 watt per stage, while transistor and standard integrated circuits require only 10 to 100 milliwatts per stage. Low-power IC's and MOS circuits dissipate about 1 milliwatt per stage, and complementary-symmetry MOS logic can be as low as 1 nanowatt per stage, static dissipation. Thus, a substantial reduction in power dissipation should be practical as our older products are replaced or redesigned.

Another point of attack is the power supply regulator. Recent developments in the HP 2100A computer have shown that the efficiency of switched regulators can be about 70 percent, or about twice that of traditional designs. If both low-power circuits and high-efficiency regulators are employed, a cooling fan in a new design should be considered an admission of defeat!

A third consideration is the duty factor of our products. Many of us will leave electronic equipment on all day just so it will be "warmed-up" and ready to use on demand. A better solution would be equipment that did not require a warm-up, and would be turned on only when needed.

The above suggestions are but a starting point, an attack on a small part of the overall problem. They are also specific actions that we can begin today, and every solution must have a beginning.

Dick Moss,
R&D section head, AMD/ATS

Living with computers

"Look, the computer just sent us a bill for \$120—instead of \$12!" How many times have people been frustrated by the computer? Is it all worth the effort? Look at what computers have done: they've invaded our privacy, holding myriads of data on each citizen; they have reduced us to a number, thereby dehumanizing us; they have displaced people in their jobs; and they have overcharged us on our telephone bills. What justification do they have for existence in our society?

The computer itself must be considered an amoral tool, much like a whittling knife. In the hands of an artist, it can be a creative tool, while in the hands of others a destructive weapon. The computers from HP so far have been grasped mostly by artists. They are being used in conjunction with medical equipment, in pollution-monitoring, analyzing and control systems, and in computer-aided instruction (CAI) systems furthering the education of our children.

In the future, the public will hopefully abandon their distrust of the computer, and welcome it as an indispensible tool improving the quality of life for the individual. Mass-information transmission, for instance, will eliminate the need for most of business travel, saving not only time, but the environment from pollution of the air. In effect, we will be realizing the efficiency of moving electrons in information transmission as compared to moving people; we will be conserving energy.

The computer will be used more heavily to help solve complex social problems by reducing mountains of otherwise meaningless facts on social conditions to statements of social

"... one might envision a sterilization lottery similar to the present draft lottery."

trends, which can be acted upon intelligently to affect needed changes. The scholar will be able to use the computer, as he has done traditionally, to enable dramatic advances in knowledge. The scientist will be able to use the computer as an "intelligence amplifier" to allow him to accomplish more in his lifetime. The medical field will use computers even more extensively than now. Large medical data banks will keep current inventories of donated organs available for transplant, available blood, and case histories. They will also perform mechanical tasks such as routine checkups, to enable the doctor to concentrate his efforts in healing rather than acquiring data.

Technology has met the challenge of providing us with the power of the computer. Now we must meet the even greater challenge of directing that power toward bettering the quality of life of each individual in our society.

Fred Coury, Bert Forbes, Jim Katzman, Chuck Leis, Dick Toepfer,
R&D lab members, Cupertino

Halting the baby boom

One of the many paradoxes of the population growth problem is that more money is being spent on technology that worsens the problem (research increasing longevity, safety, etc.) than on solving the problem. In addition, although the problem seems critical, it is conceivable that overpopulated countries can continue marginally to support their present rates of population growth as long as the developed nations continue to expand their agricultural technology at its present rate of growth. Thus the cause of concern should not be with world starvation, but rather with the effect that an ever-increasing population will have on man, his society, and his environment.

Since increasing the death rate is unlikely to be a popular solution, man's efforts must be directed toward decreasing birth rates. It has been pointed out that social-pressure-induced "voluntary" population control would have the long-range effect of evolving a species without social conscience. On the other hand, laws regulating family size will work only if adequate deterrents are found. For example, population control could be realized through sterilization. Thus one might envision a sterilization lottery similar to the present draft lottery. A more palatable approach would be the random application of short-term birth-control agents in water supplies or in basic foodstuffs. This would reduce the birth rate without denying anyone the choice of raising a family.

The problem of population growth takes on an air of urgency when one notes that the population density required to sustain a living and complex society seems to have an optimum value—a lower density cannot sustain it, and a too-high density stifles it. Thus man will cease to be a viable species unless his population growth is halted.

Mac Juneau,
R&D engineer, Loveland

The new education

Formal education from grade school through college can best be characterized as training and instruction for some form of future employment. Thus, today's education meets the demand of our firmly structured society, and serves the needs of corporations, governmental and military bureaucracies and educational institutions. We limit ourselves essentially to the development of the manual and intellectual skills required to make a living.

However, only one-half of our life's time has to be spent practicing those skills. That's where we are locked in. The other half is left to ourselves, to our involvement with the family and the community we live in.

Yet it is apparent, on the local as much as on the global level, how unprepared we are to live with each other: The divorce rates are staggering, children are alienated from their parents, and many of our contacts with others are superficial. On top of that, we have not yet learned how to accommodate ourselves with nature and her resources, how to take care of a growing population, and how to eliminate war.

It is certainly necessary to draw upon all our technological knowledge to help solve these problems. But that will not be sufficient to provide long-term solutions. A completely new form of education will be needed, one that develops our ability to live with each other in a responsible way.

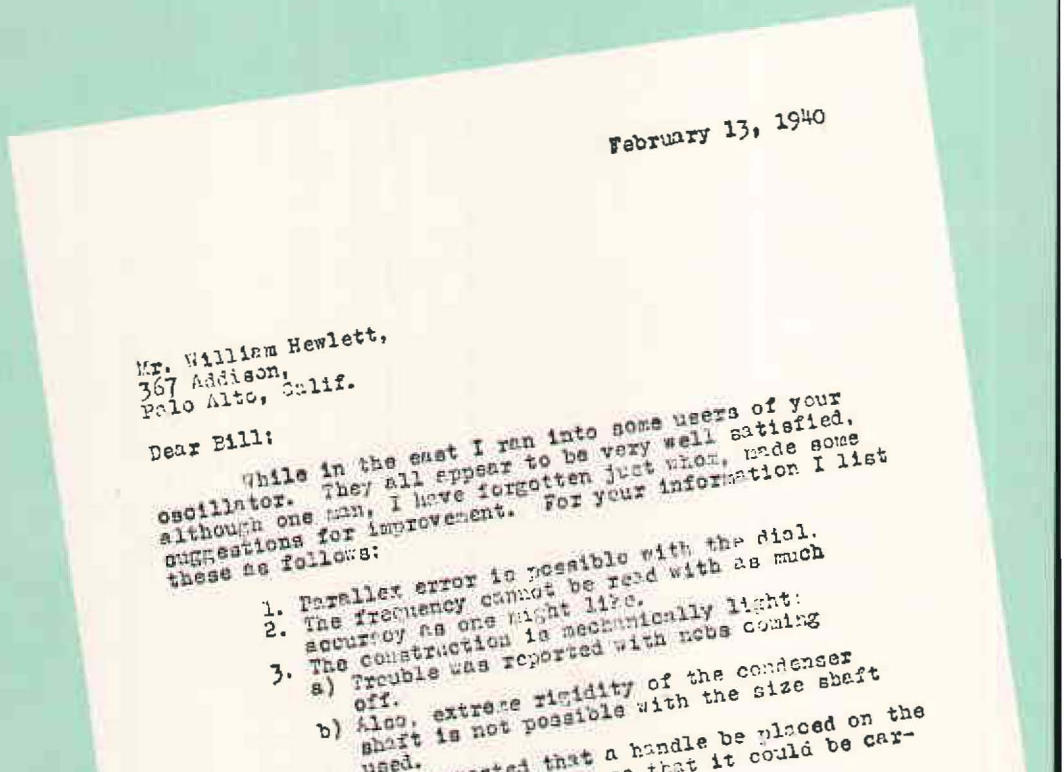
Where are the schools today which teach the excitement and joy of learning, to be intuitive and creative? Where do we learn to be sensitive to another person's feelings or even our own? Where do we learn to resolve our angers and hurts without destroying one another?

All life is interrelated. The awareness of this has to be the basis of the new education.

There is hope that the training which allowed us to develop our technology can also teach us a profound lesson on how to live with each other: Sir Francis Bacon said 400 years ago, "The only way to command nature is by obeying her."

By observing nature meticulously and following all of her laws, we were able to put man on the moon. By observing the laws which determine human relationships and obeying them, we will keep a place for man on earth. These laws are imbedded in all of the world's great religions. Today we have to rediscover them and translate them into contemporary terms.

Siegfried Linkwitz,
R&D project manager, Microwave



February 13, 1940

Mr. William Hewlett,
367 Addison,
Palo Alto, Calif.

Dear Bill:

While in the east I ran into some users of your oscillator. They all appear to be very well satisfied, although one man, I have forgotten just whom, made some suggestions for improvement. For your information I list these as follows:

1. Parallex error is possible with the dial.
2. The frequency cannot be read with as much accuracy as one might like.
3. The construction is mechanically light:
   a) Trouble was reported with nobs coming off.
   b) Also, extreme rigidity of the condenser shaft is not possible with the size shaft used.
4. It was suggested that a handle be placed on the top of the oscillator so that it could be carried by one hand.

I have no comment to make on the validity of these criticisms and rather feel that some of them are not warranted in an instrument of this class, but thought you would like to have them for your own information.

F. E. T.

From the president's desk

I don't often indulge in nostalgia, but every once in a while something comes to light that really jogs the memory about the early days of the company. Several weeks ago I called Prof. Ralph Smith at the Stanford EE department to get some information about a seminar I had taken as a graduate student. In going through my file he came across a letter that Prof. Terman had sent Dave and me shortly after we started business. Prof. Smith also turned up a copy of the original specifications sheet for the 200A oscillator. It was this sheet, mailed out to prospective buyers, that produced the first sales for Hewlett-Packard.

I thought you might enjoy reading the letter and the specifications. What I particularly like is that bit at the end of the spec sheet—"Price complete with tubes—$54.50."

Bill Hewlett

THE RESISTANCE-TUNED AUDIO OSCILLATOR
Model 200a

We offer an exceptionally fine audio frequency oscillator which operates on an entirely new principle. The frequency is determined by a resistance-capacity network. Inverse feedback makes the frequency independent of tube characteristics and line voltage variations. A unique balancing circuit controls the distortion and keeps it at a low value under all conditions. All of these features combine to give ideal characteristics in this audio oscillator which is small and light in weight, yet will supply one watt of undistorted audio-frequency power over a wide frequency range.

Specifications

FREQUENCY RANGE - 35 cps. to 35,000 cps.

CALIBRATION - Direct reading, accurate at all times without need for zero setting.

STABILITY - ±20% line voltage variation changes frequency less than ±0.2%. Normal temperature variation changes frequency less than ±2%.

OUTPUT - One watt output into matched resistance load of 500 ohms. Output voltage constant within ±1 db. from 35-20,000 cps. 25 volts on open circuit. (Special output impedances can be supplied on order.)

DISTORTION - Less than 1% distortion on full load at all frequencies above 40 cps.

HUM VOLTAGE - Less than 0.1% of output voltage.

TUNING SCALE - Three ranges give an excellent logarithmic frequency scale. Each range covers 180 degrees on the 4-3/4" dial. Equivalent scale length about 20".
Range 1 - 35-350 cps.
Range 2 - 350-3,500 cps.
Range 3 - 3,500-35,000 cps.

POWER SUPPLY - 115 volts 60 cycles 50 watts

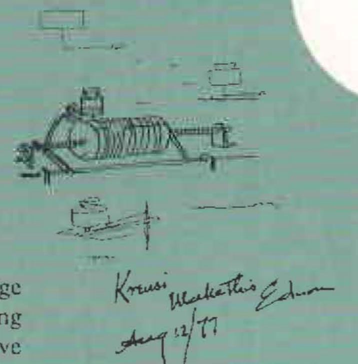
VACUUM TUBES - 1 6J7, 1 6F5, 1 6A5G, 1 6F6, 1 5Z4

SIZE - Length, 14"; Height 8"; Depth, 10"; Weight, 22 lbs. Steel cabinet mounting finished in durable light gray wrinkle enamel.

The Model 200a Oscillator gives laboratory type performance with extreme simplicity of operation. There are only three controls on the panel, the main frequency dial, the range switch and the output voltage control; no zero setting is required. These features make the Oscillator unusually suitable for both laboratory work and production testing. In the laboratory the small size and ease of operation will facilitate work, while the accuracy of calibration and low distortion meet the requirements of almost every type of measurement. In production testing, the Oscillator will give excellent service not only because of its simplicity and accuracy, but also because of its high power output and sturdy construction. Each Oscillator is warranted to be free from defects in material and workmanship for one year.

Price complete with tubes - $54.50 net, f.o.b., Palo Alto, California

HEWLETT-PACKARD CO.
367 Addison Ave.
Palo Alto, Calif.



They said "no"

As apostles of the practical and the rational, engineers by and large are "can do" people. Some of them go so far as to say that if something can be imagined it can be made to happen. On the other hand there have been some noteworthy exceptions, such as:

Thomas Edison

"Americans require a restful quiet in the moving-picture theater, and for them talking . . . on the screen destroys the illusion. Devices for projecting the film actor's speech can be perfected, but the idea is not practical."

from The New York Times, 1926

Henry Ford

"The Edison Company offered me the general superintendency of the company, but only on condition that I would give up my gas engine and devote myself to something really useful."

from My Life and Work, Doubleday, 1922

H. G. Wells

"I do not think it all probable that aeronautics will ever come into play as a serious modification of transport and communication . . . Man is not an albatross."

from Anticipations, 1902

U. S. Rear Admiral Clark Woodward, 1939

"As far as sinking a ship with a bomb is concerned, you just can't do it."

from Report on Erroneous Predictions, Library of Congress

Samuel F. B. Morse

"On the opening of the third session of the 27th Congress, Mr. Morse, the telegraphic celebrity, asked for an appropriation of $30,000 to make an experiment by erecting a line of telegraph from Washington to Baltimore . . .

"The bill came up, and was considered . . . Congressman Cave Johnson . . . moved that one half the appropriation be expended in experiments in mesmerism, which was sustained by 20 votes. Another member moved that (the money to be spent) in trying an experiment to construct a railroad to the moon."

from Public Men and Events, Nathan Sargent, 1875

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