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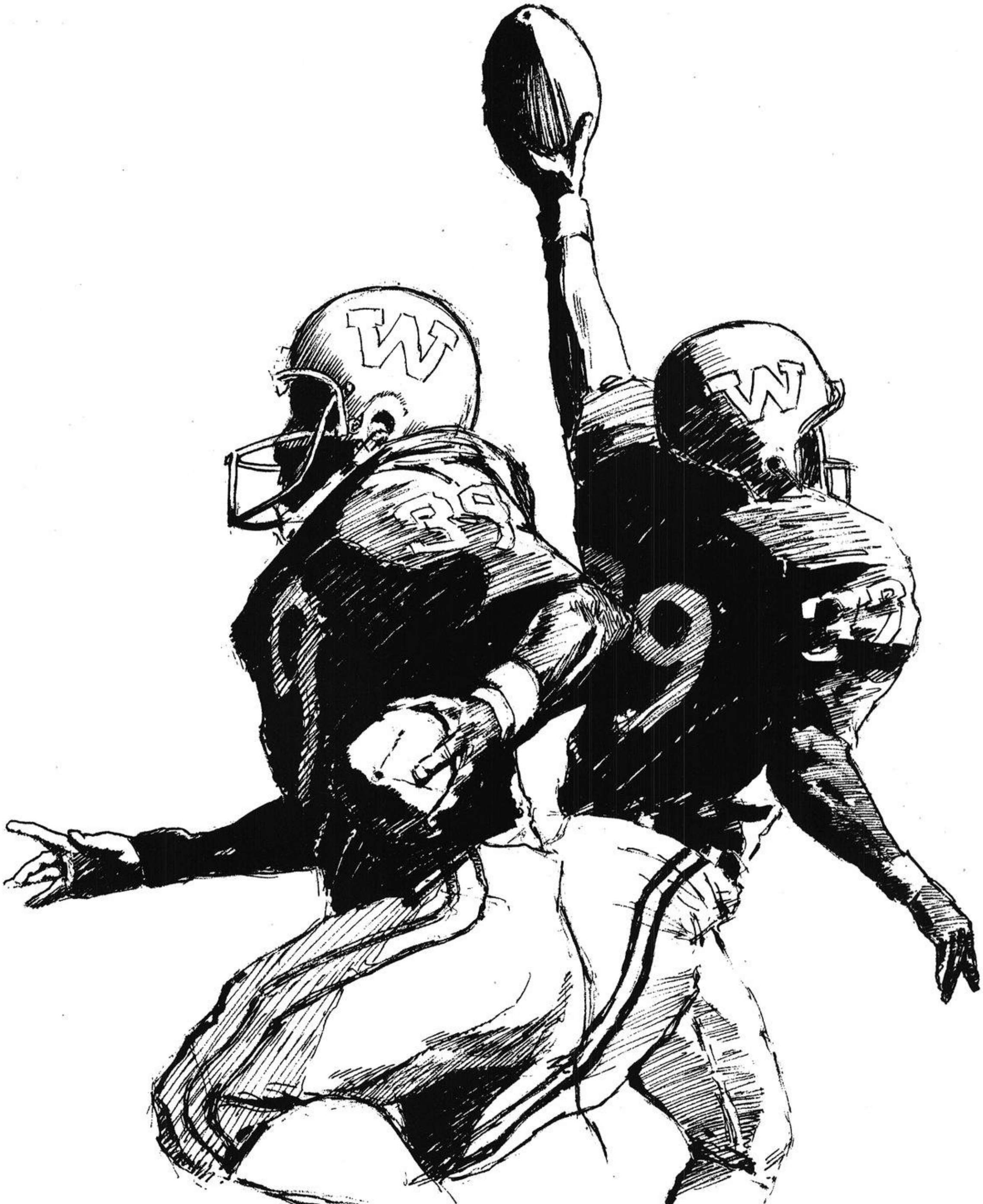
OLUME 77, NUMBER 2 35 CENTS NOVEMBER, 1972

wisconsin engineer



Over half the towns in the United States are forced to dump their wastewater in our rivers. The reason is sad.

Money. Literally over half our towns haven't got enough money to build complete wastewater treatment plants.

And many towns that have complete plants aren't cleaning the water thoroughly because the towns have outgrown the plants. And they can't afford to expand.

So, because of money, towns are forced into polluting our streams and rivers.

Union Carbide has discovered a new wastewater system that costs less. It's called the Unox System. It's the first substantial change in wastewater treatment in thirty years.

Instead of the conventional aeration system that cleans water by mixing it with the air, Unox forces pure oxygen into a series of closed treatment tanks. This forced oxygen technique cleans wastewater in less time, less space and reduces the total cost up to forty percent.

It means a town can boost its wastewater system by simply adapting the Unox System to the existing system. And towns with limited means can now afford a complete system.

A number of cities and industries throughout the country have already chosen the Unox System. And more installations are being planned.

We've discovered a cheaper way to treat wastewater because our streams and rivers can't afford to wait.

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ENGINEERS GUIDE TO COMPARATIVE VALUES

IN ZINC vs. PLASTICS

Unreinforced Plastic vs. Die Cast ZINC*

RATIO OF COSTS FOR EQUIVALENT LEVELS OF VARIOUS PROPERTIES

Material	Tensile Strength at 24°C	Tensile Strength at 80°C	Flexural Strength at 24°C	Tensile Creep (100 hrs.) at 24°C	Un-notched Tensile Impact Strength at 24°C	Flexural Fatigue Strength at 24°C
ABS	2.54	3.46	1.37	12.3	2.78	0.91
Nylon 6/6	4.72	5.40	2.70	85.6	1.64	1.91
Polyacetal	3.09	5.00	2.40	29.0	3.60	1.42
Polycarbonate	3.82	3.60	2.33	20.0	1.70	3.40
Polypropylene	2.00	3.13	1.10	37.7	1.09	0.52

*SAE 903 Die Cast ZINC = 1.0 **Costs as of January 1970, (carload lots or maximum quantity bracket). All calculations are based on these figures.

Glass Reinforced Plastic vs. Die Cast ZINC*

RATIO OF COSTS FOR EQUIVALENT LEVELS OF VARIOUS PROPERTIES

Material	Tensile Strength at 24°C	Tensile Strength at 80°C	Tensile Stiffness at 24°C	Tensile Stiffness at 80°C	Flexural Strength at 24°C	Flexural Strength at 80°C	Flexural Stiffness at 24°C	Flexural Stiffness at 80°C	Tensile Creep (1000 hr.) at 24°C	Notched Tensile Impact Strength at 24°C	Flexural Fatigue Strength at 24°C
Gl. Re. Nylon 6/6	1.91	2.68	8.42	8.90	1.82	1.91	20.5	16.7	7.85	3.83	1.96
Gl. Re. Polycarbonate	3.36	2.68	10.0	5.27	2.56	2.05	20.4	3.05	5.46	9.24	2.88
Gl. Re. Polyacetal	4.73	5.40	12.7	11.1	4.20	3.78	26.4	5.04	9.45	20.9	2.81
Gl. Re. Polypropylene	2.83	2.74	5.26	11.4	2.48	2.39	13.1	6.30	6.51	13.2	1.69
Gl. Re. Polysulfone	4.00	3.21	12.7	6.66	3.39	2.78	23.7	5.44	4.83	16.5	3.76
Gl. Re. SAN	1.63	2.14	4.37	2.78	1.70	1.49	9.70	1.84	1.90	10.1	1.14

*SAE 903 Die Cast ZINC = 1.0 **Costs as of January 1971, (carload lots or maximum quantity bracket). All calculations are based on these figures.

ZN-495

These charts are based on information from two extensive engineering evaluations conducted by U.S. Testing Co., for the International Lead Zinc Research Organization Inc. These studies showed that in almost every instance die cast zinc gives you more performance for your money than any of the plastics tested. ☐ For example, the results showed that an unreinforced Polycarbonate rod would cost 3.82 times more than a SAE 903 rod to withstand the same tensile load. Glass reinforced Polycarbonate would cost 3.36 times more than zinc. ☐ Reprints of this "Engineers Guide" are available. Just let us know the quantity you would like.

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Albert Einstein:

"We are drifting toward a catastrophe beyond comparison. We shall require a substantially new manner of thinking if mankind is to survive."

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Dean's Page

Dean Frederick Leidel

Leidel Outlines Engineer Shortage

The request to contribute to the Deans' Page comes at a time when all of us in engineering education are concerned with a national problem of serious proportions. Let me share it with you. Perhaps, if you aren't doing so already, you can help in its solution.

The problem is very simply stated. Since 1969-70, engineering freshman and other new enrollment has decreased so rapidly on a national scale, that during the second half of this decade our nation's schools will fall short of supplying the national need for graduate engineers by at least 20,000 a year. The total national need is estimated by the Manpower Commission of the President to be 48,000 a year. (You should read "Surprise, There's a Shortage of Young Engineers Ahead" in the New Engineer for October, 1972.) The turth is that, unless there is a drastic upsurge in engineering enrollment, we will not graduate enough engineers to make up for normal deaths and retirements in the engineering profession. (Did you see the *Daily Cardinal* for October 31? Even "Boeing is Back".)

I see several reasons for the decrease in enrollment. First the effect of the engineering layoffs due to the cancellation of the SST, and the cutbacks in the space program, have been blown up by the national news media beyond all proportion. That these layoffs were very serious, especially to the families of the eningeers involved, cannot be disputed. One should expect the economy to be affected by so drastic a change in our national priorities. However, the truth is, that at the peak, national engineering unemployment was only 3%. Also, throughout it all, employment opportunities, especially at the Bachelor's degree level, have remained higher for engineers than for almost all othhr college majors. Graduate engineering employment was poor only by comparison wwth past situations of "six job offers for every graduate".

Second, it seems to be the feeling of some that, since many of the world's problems are technological, one way to eliminate the problems is to eliminate technology. As I see it, the blame for today's problems is shared by us all—the consumers and the producers, the lawmakers and the law enforces, the businessmen, governmental leaders. While there are engineers in each of these groups, theirs are not the majority decisions. Our need for technology is a function of our population (the number), the kind of life the population wants, and the technology that is required to support it. So huge and complicated a system changes but slowly.

I see the need for technology as increasing, not decreasing. Our technological problems are being solved by interdisciplinary teams, with engineers an important, influential part of the teams.

Have you seen the new College of Engineering bulletin? There are exciting new courses and curricula that increase the appeal, the flexibiilty, the opportunities, the relevency of engineering. Compare the new bulletin with the old. Go talk with the professors, and get a better understanding of the changes. Find out from them that, even with the ink of the new bulletin barely dry, more new and exciting changes are in planning stages.

Having opened on a note of gloom, I will close on a note of optimism. At this time of low enrollment, to me the future of engineering looks very good. Our student shortage is resulting in an abundance of employment opportunities. There are important sociotechnological problems to be solved. Course and curricular opportunities were never better. If you are good at math and science, and have concern for people—if you would rather solve a problem than talk about it—if you want an education that is relevant and occupationally oriented and rewarding—if you can perform like a winner—if you are worried about employment after graduation—then today's engineering is for you. But don't keep all of this a secret. Share it with your friends.

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Meet the Author

Roy V. Hughson is an Associate Editor of CHEMICAL ENGINEERING. He has been editor of the "You & Your Job" department for over three years. Before that, he edited "Materials Engineering Forum." In addition, he is responsible for editing feature articles. He has a B.Ch.E. and an M.A. from New York University.

Is Technology the Cause of the World's Problems?

Technology does cause problems. It also solves problems, We can't live without technology, and we can't predict what new problems new technology may cause.

ROY V. HUGHSON, Associate Editor

It is an oft-made claim these days that technology is the cause of most of the world's problems. The corollary is that engineers are to blame, too.

But are we? Do the evils of technology outweigh the good derived from it? And, could anyone have foreseen the problems before they occurred?

This last is an important point. Most technology comes into being in an effort to make things better for people. The harm that it may do is generally unforeseeable at the time the technology is introduced, or arises later from abuses.

The difficulties in foreseeing problems are among the hardest that ever arise. Twenty years ago, nobody foresaw the effect that computers would have on our society. When the telephone was introduced, who guessed that it would change the courtship patterns of the country's youth? At best, an astute observer might have guessed at some of the changes it has brought about in the conduct of business.

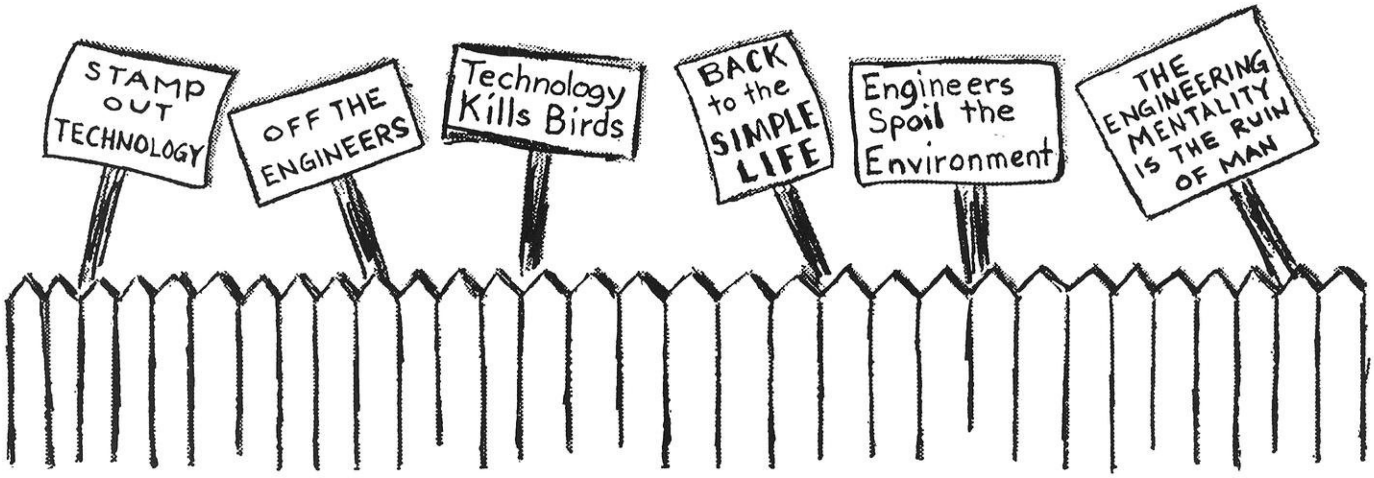
The air conditioner was a boon to the worker who had to spend hot summers in a city office building. Since open windows lead to inefficiencies in the use of air conditioners, architects built structures with windows that didn't open. Such buildings were also cheaper, and stayed cleaner, but without air conditioning, these offices are unbearable in summer. So the electric utilities are forced to increase generating capacity to meet the air-conditioning demand. This inevitably results in more thermal pollution, and probably in greater air pollution. All because we tried to better the worker's standard of living.

Too, in this case, the good may outweigh the harm. Although people with lung disorders are harmed by air pollution, those with heart ailments are generally helped by a cool environment. And certainly the working public in general is better off in pleasant-working conditions.

The Case Against the Automobile

Let's look more closely at the automobile—the machine that has probably caused more social change than any other technological innovation. Presently it is being blamed for two things. First, the air pollution that it causes; second, the number of deaths that occur through automotive accidents.

It has been repeatedly pointed out that the automobile has caused more deaths in the U.S. than have



occurred in all the wars in U.S. history. And yet, when the automobile was introduced, it was hailed as having solved the problem of accidents caused by the runaway horse!

Don't laugh. The runaway horse was a serious accident problem in the horse-and-buggy days. If you've ever read any of the Horatio Alger type stories, you will remember the hero that started on his way to fame and fortune by stopping a runaway horse (which seemed always to have been pulling the carriage containing the wife or daughter of a rich merchant). This was a good fictional situation because the runaway happened so often in real life.

And, of course, nobody really imagined the speeds of modern cars. I remember a Tom Swift story in which the boy genius invented an auto that travelled at the fantastic speed of a mile a minute! Nowadays, few drivers are content with so slow a speed (60 mph.) for highway travel.

There is no question that some of the pollution caused by automobiles could have been (and actually was) predicted. These pollutants include carbon monoxide and nitrogen oxides. But could anyone have predicted photochemical smog? Even today, it's very difficult to investigate this phenomenon in the laboratory because interaction of the chemicals with the container itself ("wall effects") interferes with the experiments.

But at the time of the introduction of the automobile, nobody could have predicted these things because nobody would have guessed that the U.S. would ever have 50 million cars and trucks. One automobile isn't a problem. Even a million aren't really a problem. But 50 million are.

One prediction form the July, 1899, issue of *Scientific American* has been quoted in a recent book.*

"The improvement in city conditions by the general adoption of the motor car can hardly be overestimated. Streets clean, dustless and odorless, with light rubber-tired vehicles moving swiftly and noiselessly over their smooth expanse, would eliminate a greater part of the nervousness, distraction, and strain of modern metropolitan life."

I'm sure that the prediction made very good sense back in 1899.

The Problem Is People

With so many cars on the road, one easy way of cutting down on pollution problems is to cut down on the number of cars being used. One car carrying five people will produce only 20% or so of the pollution caused by five cars, each carrying only a driver.

This concept was tried recently in San Francisco (though the sponsors were trying more to cut down traffic than to cut down pollution). According to the *New York Times* for May 18, 1970, the operators of the San Francisco-Oakland Bay Bridge handed out 12,000 postcard questionnaires to commuters on their way from Oakland to San Francisco. The questionnaire asked whether the driver was willing to take part in a car pool. About 1,200 (10%) of the cards were returned. A computer was used to match people in a vicinity, and lists were sent out of people willing to join pools.

What was the result of all this activity? The bridge operators have learned of a total of *eight* car pools that have been formed.

Obviously, asking people to give up their automobiles just won't work. Indeed, the use of the family car is so much a part of American culture today that it could not exist without such transport. The American suburbs could not exist without the automobile (or its equivalent). And living *is* better in the suburbs than in the cities, which is why so many of us spend long hours in commuting in order to gain this advantage.

The Insecticide Riddle

Perhaps closer to the chemical process industries is the problem of persistent chlorinated hydrocarbon insecticides. DDT is the main culprit, of course.

It took some time after the introduction of DDT before it was realized that it was taken up and stored in the fat of animals (humans included). It took even longer before the injurious effects of this accumulation were discovered.

But in the case of DDT, it is very easy to show the good that it has done. It has been estimated, for example, that DDT has saved some 50 million lives since it was introduced; and its effect on raising the quality of human life has been even more important.

DDT kills mosquitoes, and mosquitoes spread malaria. Wipe out the mosquitoes, and you have wiped out malaria. It's as simple as that.

At one time, the World Health Organization (WHO) had hopes of wiping out malaria over the entire globe. These hopes have been dashed, but there are still vast areas of the world where malaria was once a scourge that are essentially free of the disease.

Few Americans are aware of the effects malaria has had on a large part of the world's population. The disease can be fatal, but often it racks its victim with chills and fevers at intervals of two to four days, and leaves him listless in between. In most of the world, DDT has now wiped out malaria. It has indeed been a great boon to mankind.

On the other hand, much of the DDT used in the U.S. is sprayed on the cotton crop. It is impossible to make a case for using an admittedly injurious chemical to grow a crop that must be bought up by the federal government because it has no real market.

When DDT is used for malaria control, its advantages far outweigh its faults. When it is used for growing unneeded cotton, its faults predominate. No doubt there is a problem. But can one really call it a technological problem? Or even a problem *caused* by technology?

Feeding the World

One of the advances in science that has been in the headlines for the past few years is the development of more productive strains of grains—corn, wheat and rice in particular.

In 1968, the Philippines was able to produce enough rice for its population for the first time since 1903! In 1968, Ceylon's rice crop was 13% above the highest in its history. Pakistan's wheat crop beat the previous record by 30%.

For the first time in recent history, people in many lands will have enough to eat. Wonderful, isn't it?

Well, no—not according to Prof. Edmundo Flores, writing in the May-June 1969 issue of *FAO Review* (published by the Food and Agriculture Organization of the United Natons). He claims that this technological breakthrough will lead to rural unemployment and eventual breakdown of the social system in many of the poorer countries.

Flores' point is that the richer farmer, using both the new crops and mechanization, will become productive enough to drive the poorer farmer out of business. And in the countries he is talking about, Flores points out, "He who does not work or has no land does not eat."

This possibility was also noted in an article in the *New York Times* for Apr. 6, 1970. In it, Dr. Robert F. Chandler, director of the International Rice Institute, where high-yield rice was developed, is quoted as saying, ". . . how can it be wrong to increase the amount of food for people who eat and to increase the incomes of farmers?"

Who is right? The next ten years should tell.

Technology Does Good, Too

With all the talk about the damage that technology does to the environment and the quality of life, there is little appreciation of the advantages that it has brought.

I remember listening to a television interview with a student radical who explained that he planned to spend his life in an attempt to overthrow "the system." He was violent in his objections to "technology," which he said was destroying the lives of the people. When asked if he ever intended to take a job, he replied, confidently, "No, I don't expect ever to starve."

What struck me was that is probably the first time in history that a person could reasonably make that statement. The combination of fertilizers, tractors, high-yield crops, food-processing and transportation technology *will* probably keep him from starving. But obviously this never occurred to him.

Consider the unpleasant work that has been eliminnated around the home by the combination of oil-burner, washing machine, and vacuum cleaner.

The flush toilet, which we take for granted, means that nobody has to empty a chamber pot! And piped-water systems mean that no one has to carry water from a well or stream. Efficient transport means that we can eat fresh produce even in the wintertime.

The Phosphate Flap

Take the problem of phosphates in the Great Lakes. They act as a fertilizer that promotes the overgrowth of algae, to the detriment of other plants and animals.

Where does the phosphate come from? Almost all can be traced to three main sources: human wastes (sewage), agricultural fertilizer runoff (rainwater leaching of fertilized soils), and detergents (which use phosphates as builders). They're all the fault of technology.

The concentration of human wastes comes from the concentration of poeple that make industry more efficient. It also is caused by medical technology that has kept people alive and helped to build up the population. And also, the plentiful supply of food adds to the problem (starving people produce less waste). Eliminating the technology will eliminate the problem. The population will be spread out, hungry, and have a high death rate—all of which will decrease phosphate in the sewage.

Eliminating agricultural fertilizers will have a two-fold effect; runoff will be reduced, and a reduced food supply will leave people hungry and may even starve some of them. Again, the result will be less phosphate in the lakes.

Eliminating phosphates from detergents will have little effect except to reduce phosphate in the sewage. Soaps do a reasonably good job of cleaning.

In the case of detergents, eliminating the technology may make sense. In the other two cases (sewage and runoff) it becomes absurd. Here, the obvious answer is more technology, not less.

We'd Be Worse Off Without Technology

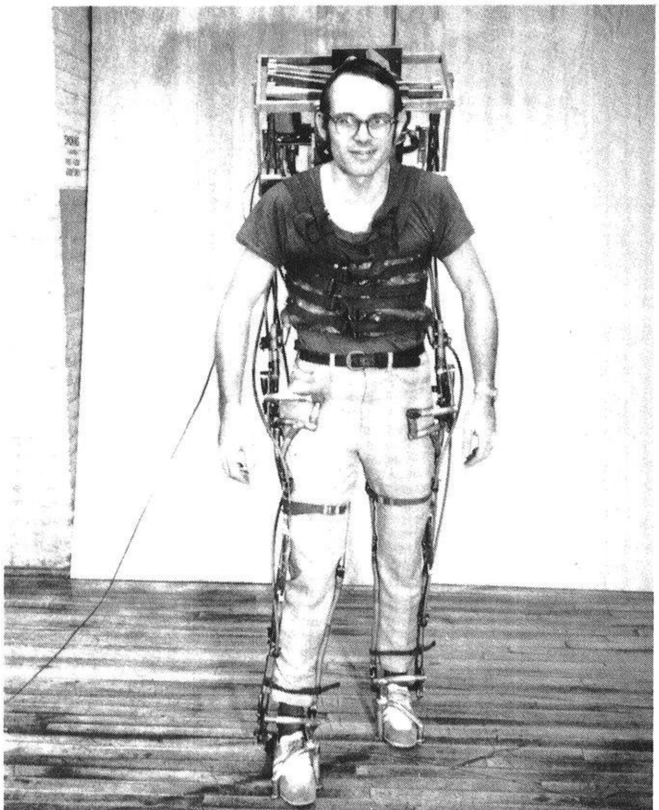
Yes, technology is a cause of many problems. And because it is almost impossible to predict the results of new technology, it will cause more problems in the future.

The alternative to technology is an immediate reduction in population and a lower standard of living. Somehow it doesn't seem much of a choice.

Everyone Should Walk

by Steve Sanborn

Jack Grundmann is shown below wearing the walking device he constructed.



During the 1971 Engineering Exposition people on this campus were exposed for the first time to a device constructed under the guidance of Prof. Seireg of the Mechanical Engineering Department.

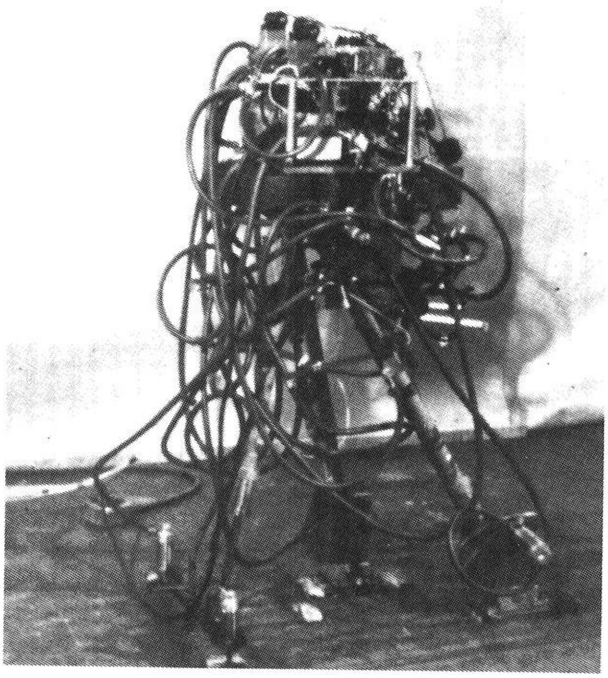
This device was a three legged robot powered by compressed air. Actually it was not a complete robot but only the walking portion, just the legs.

The mechanism was constructed to be a model, a mechanical analog of a walking human. It could have been built with only two legs rather than three, but since it weighed 260 pounds it would have damaged easily if tipped over. The third leg provided extra stability.

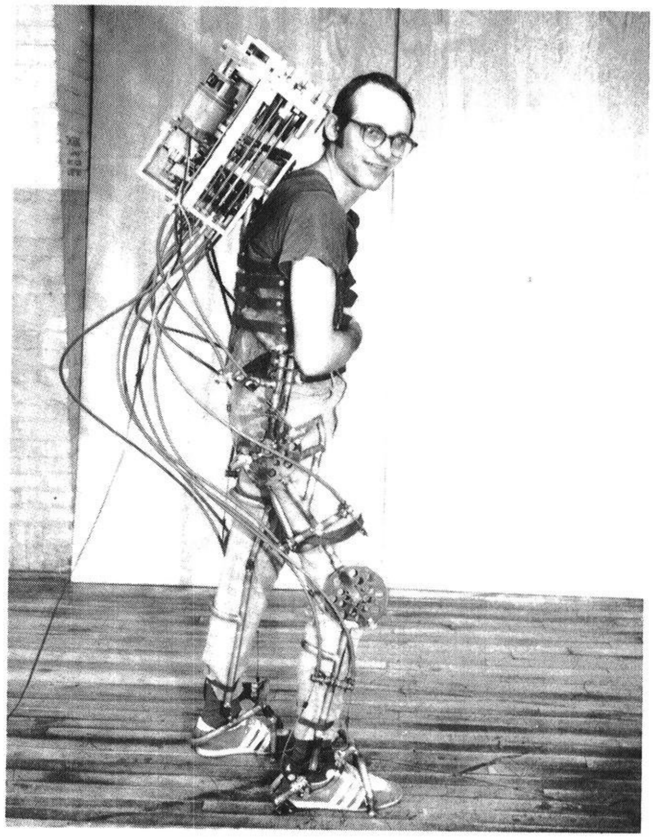
Since this original prototype was constructed, a new two legged model has been built. The new model differs considerably from the prototype in many respects. The two legged model is powered by AC current rather than compressed air. Unlike the prototype, the present model is actually worn by a human. This was the goal of the design project, to create a device that would give a person that was unable to use his legs, the ability to walk again.

The project is by no means completed. More work has to be done in designing and constructing the third model. Presently Jack Grundmann is testing and altering the second model so as to incorporate new ideas into the third mechanism.

As was mentioned, the first prototype was operated with compressed air. This model was consequently bulky and awkward. Model II is operated by what is described as a puppet system. Cables extend from cams, located in a pack, down the body to the individual joints in which they control. The pack is mounted



Shown above is the original three legged walking machine.



This side view shows the long cables extending from the cams in the pack to the joints of the device.

on the shoulder of the person wearing the mechansim. Supports extend from the frame of the mechansim to the pack so that the heavy weight of the device is not felt by the wearer. Within the pack are the six cams that pull the cables causing the person to walk. These cams were designed to cause the joints to move almost exactly the way a normal human moves.

Ultimately it is desired to make a system that will allow a person that can no longer use his legs to walk forward, backward, turn, sit, stand and walk up and down stairs. Also, the device should be cosmetic. This means that it should be possible to cover the mechanism and its suspension system with normal clothing apparel.

Model II can only walk forward, Model III will be able to preform all these tasks. Model III will not be supported by bulky metal braces and tubes as were previous models. Instead, plastics and fiberglass will be incorporated as structural supports. To replace the bulky joints, electronic servo mechanisms will be employed. The use of electronics will allow a number of mini-programs to be place in a very small computer, carried by the person using the device. Each program would cause the mechanism to move, initating the motions a human makes. The programs would be turned on and off by the person wearing the device. There would be one program for each sequence of movements such as walking or for sitting.

Very little has been done in the past three centuries in the area of prosthesis. The plastic leg of today is nothing more than an adaptation of the wooden leg of the seventeenth century. It is unfortunate that the technology of today has not been applied sooner to help paralized people walk again.

This attempt at the University of Wisconsin College of Engineering requires the encouragement and support of all people concerned with restoring the ability to walk to those who can not.

Hybrid Computer Lab

A New Tool For Science

by Daniel Greco
Ken Kuehl

The Hybrid Computing Laboratory (HCL) on the University of Wisconsin Madison Campus combines the speed of a digital computer with the capabilities of the analog computer to provide new avenues of research in various areas of Science and Engineering.

The HCL, introduced in 1965, is located in room 1101 of the Engineering Research Building where it is used primarily by instructors and graduate students.

Scheduled for completion in December, the Remote Terminal System will enable users throughout the state to have access to the HCL facilities via telephone wires (See Fig. 1). Plans are also being made to link the HCL to the Univac 1108 in the Computer Science Building thereby upgrading the capacity of the system.

The advantages of the HCL can be seen in its uses and capabilities. The machine lends itself to simulation or modeling of complex systems. It can be used for solving simultaneous differential equations and date reduction. Recently, the HCL has been used to model bio-medical functions and environmental systems.

The versatility of a Hybrid computer is due to its composite structure utilizing two interconnected computers; the digital and the analog. The digital computer is bascially a counting device capable of performing all of the basic math functions of addition, multiplication, and division, etc. It works very rapidly, but step-by-step in a sequence of discrete bits. Information such as a number is represented by the absence or presence of electrical impulse. This makes the amplitude of the pulse unimportant. The machine can store, or remember many bits of information being able to manipulate stored bits in virtually any desired way. However, it cannot show relationships between stored bits at the instant they are being generated.

The analog computer segment measures pulses. The amplitude of the pulse determines the numerical value of the information. Also, all data is fed into

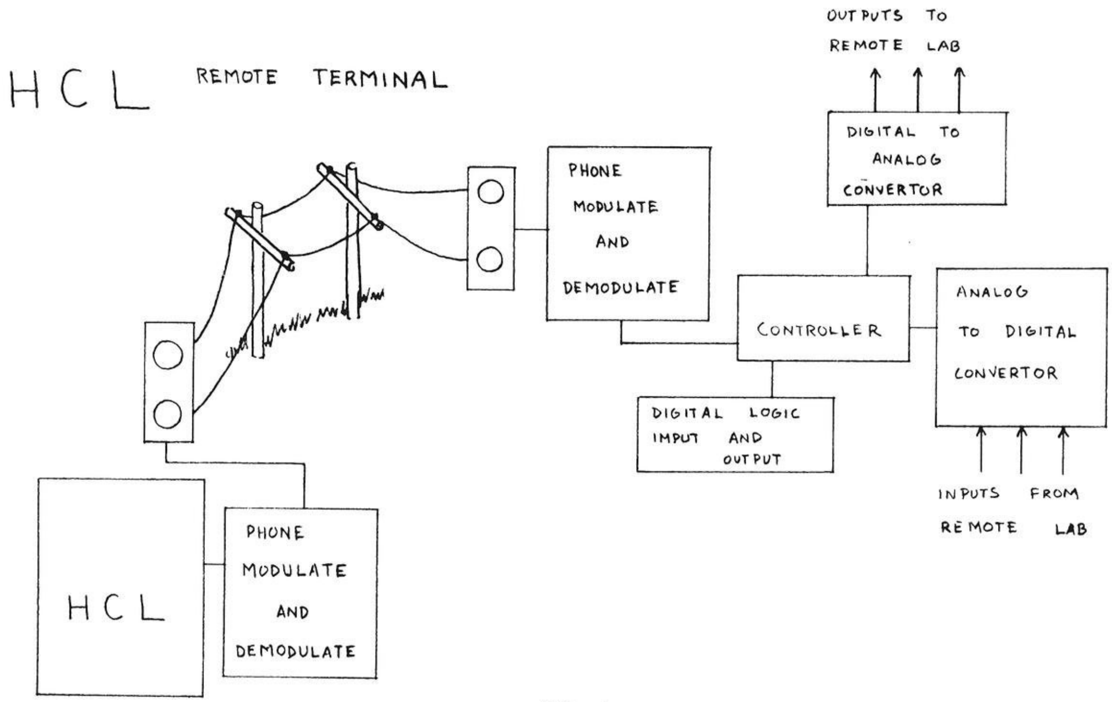
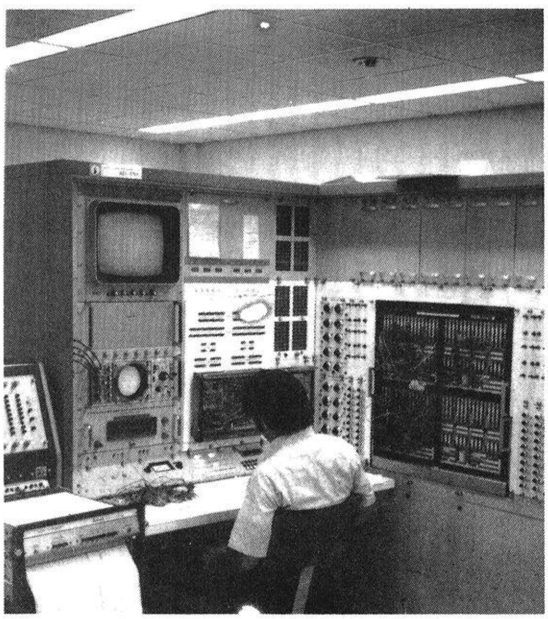


FIG 1



The analog patch bay is being used to program the analog portion of the hybrid.

the machine and used simultaneously. This is necessary so that changes in parts of the data can be compared and related. Physical changes, such as the rotation of a gear or shaft, are coordinated mathematically as variables in differential equations. Since the analog computer is well suited for solving these equations, it can immediately show the effects of physical changes, as they are occurring. This is called real-time operation. Finally, the results are fed into the digital computer through an interfacing. The interfacing converts the analog solutions into binary (pulsed) form so that the digital computer can either proceed with further computations or store the answers. As an integrated team, the two computers make up for the shortcomings inherent in each. (See Fig. 2).

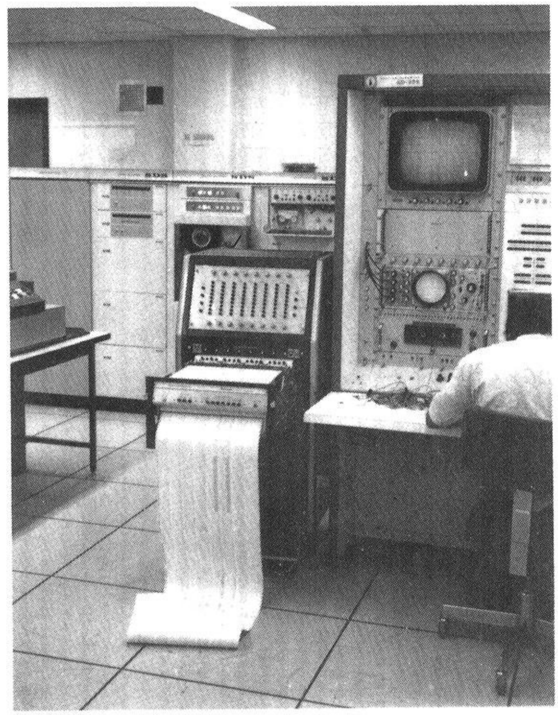
One example of Hybrid Computing in systems modeling is a project recently completed by Professor Vincent Rideout. With the help of NASA, the Wisconsin Alumni Research Foundation, and the U.W. Engineering Experiment Station, Professor Rideout modeled the cardiovascular-respiratory (cv-r) system of the human body, using approximately 120 differential equations. The equations mathematically simulate the human heart, circulatory system, lungs, and the control systems present in the cv-r system. Valuable research is facilitated by the models, enabling researchers to reconstruct the bodily reactions when testing hypotheses regarding control mechanisms in the cv-r system. Further expansion of this system is to include a model of the body's muscular system thus bringing this project a step closer to becoming a tool which will provide medicine with more information about the functions of the human body.

The intitial need for a hybrid computer first arose in the 1960's in the then fast-growing aerospace industry. Investments by the government and other industries concerned with the space effort, gave the financial boost necessary to bring the hybrid computer into the field of science. Since then it has been recognized as an important tool with application in all fields of science.

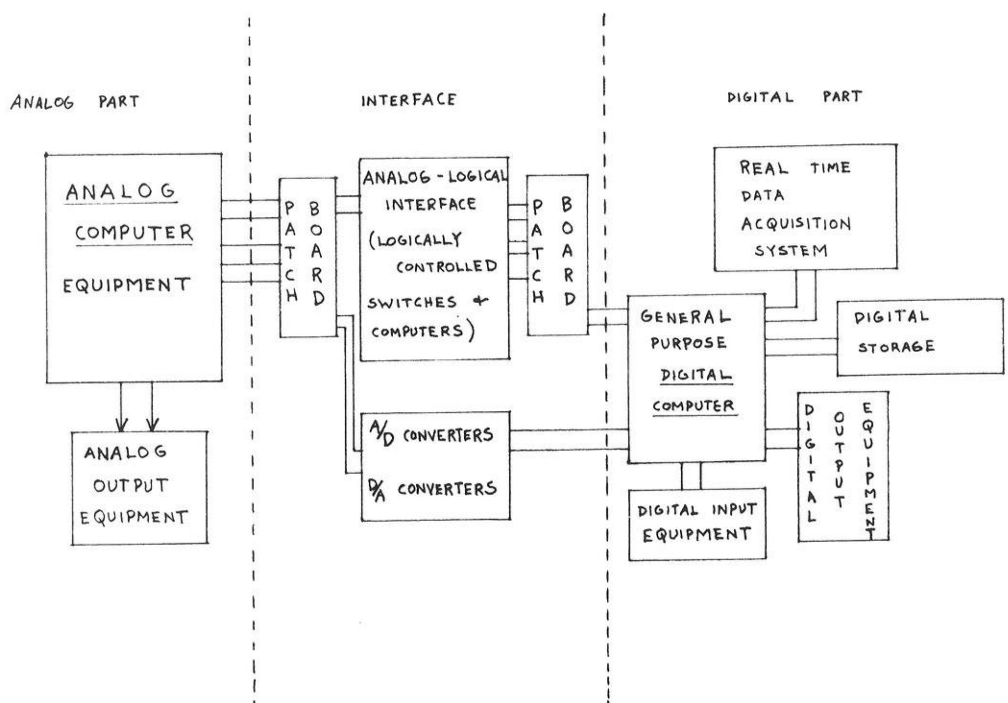
Since 1965, the HCL has been updated by the installation of more modern input and output equipment increasing its versatility and capacity. The present equipment includes an analog and digital computer connected by various interface equipment and input/output devices. This input/output equipment consists of an 8 pen strip recorder from which about 80% of the output is obtained, a CRT, a voltmeter, a magnetic tape drive, a card reader, and a magnetic disc drive.

The Hybrid Computing Laboratory on this campus was made possible through the efforts of Professor Rideout, who was granted funds for the initial cost of the laboratory, and $500,000 from the National Science Foundation. The HCL is maintained by the University as a service organization under the U.W. Engineering and Experimental Station. The current staff consists of Professor Bollinger, the director, and Professor A. A. Frank, his assistant.

The Hybrid Computer facilities are open to anyone with an applicable problem. Currently, 37 projects are being handled by the HCL, again illustrating its versatility and its ability to work in different areas simultaneously.



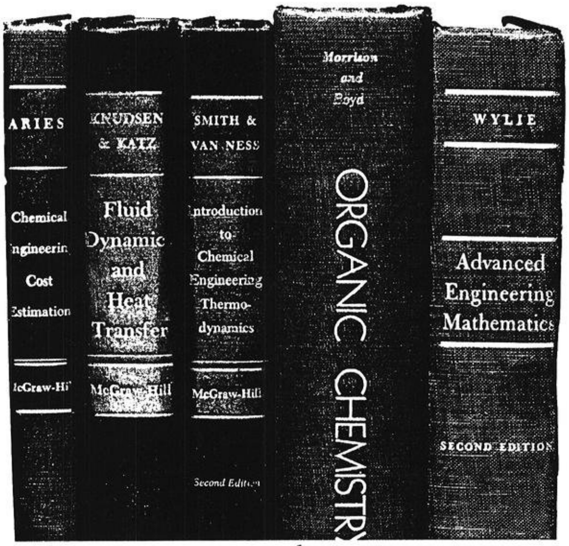
Eight channel strip recorder shows output from cardiovascular project.



HYBRID COMPUTER COMPONENTS

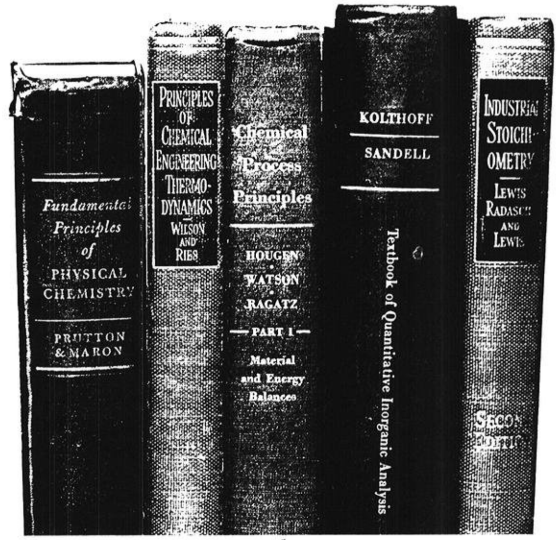
FIG. 2

B.S.Ch.E.



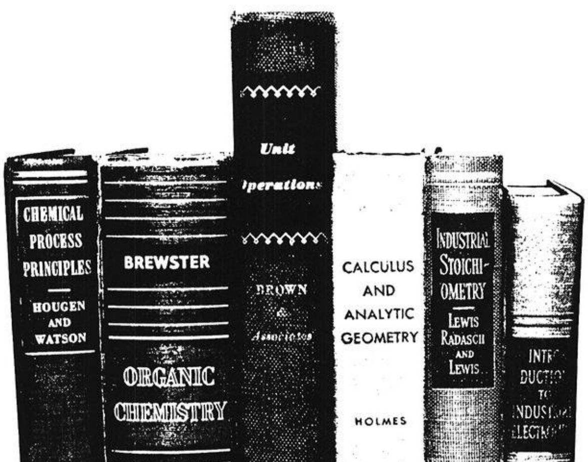
... then

1. Photographic development engineer
2. Field sales representative
3. Sales development staff
4. Administrative assistant to sales manager
5. Group manager, marketing research and analysis



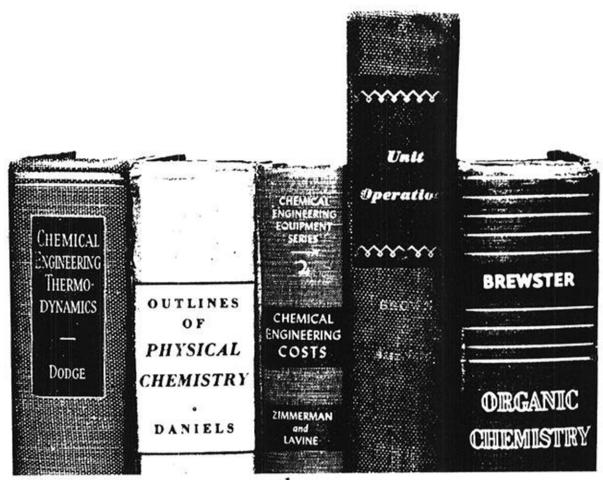
... then

1. Research and development in papermaking pilot plant
2. Consulting engineer, Office of Environmental Conservation
3. Acting Engineer-in-Charge, Office of Environmental Conservation



... then

1. Pilot plant development engineer
2. Math simulation/computer consultant
3. 1-year academic assignment for M.S. in engineering
4. Design engineering supervisor
5. Acting assistant director of engineering division
6. Maintenance supervisor responsible for 500 people



... then

1. Process development engineer in chemical production
2. Development engineer on new polyester process
3. Product development engineer on coatings
4. Staff assistant to production superintendent
5. Supervisor of development group
6. Assistant superintendent of production division

We have prepared this advertisement from four personnel files for the information of the undergraduate engineer who wants to be in a position to influence industry and wonders what to study. Eastman Kodak Company, Business and Technical Personnel, Rochester, N.Y. 14650.

Kodak

An equal-opportunity employer m/f

Principle illustrated above applies also to mechanical and electrical engineers.
Brings in the kind of person who takes pains to lay a good foundation.

HOW CAN A 5" WIDE TUBE HELP KEEP AN ENTIRE CITY FROM GRINDING TO A HALT?

What you're looking at is a cross section of a new kind of cable . . . part of a revolutionary new system being developed by General Electric engineers and researchers.

It works on the theory of cryogenics. What's it got to do with keeping a city running? Plenty.

Put three of these cables inside an underground pipe, then cool them with liquid nitrogen to −320°F, and you've got an electric power line that could carry as much as 3,500 million volt-amperes.

That's about ten times more power than any conventional underground transmission line can handle.

This is important because of the soaring need for electricity. Demand may double in the next 10 years alone. Some electric transmission lines are already loaded to capacity. And land for more lines, particularly near the big cities, simply isn't available any more.

But a single cryogenic line could deliver enough power to keep a city of a million people running. And it could be buried beneath the ground where nobody would see it.

It's a clear example of how a technological innovation can help meet people's needs. A lot of times the effect of technology on society can be rather direct.

That's why, at General Electric, we judge innovations more by the impact they'll have on people's lives than by their sheer technical wizardry.

Maybe that's a standard you should apply to the work you'll be doing. Whether or not you ever work at General Electric.

Because, as our engineers will tell you, it's not so much what you do that counts. It's what it means.

GENERAL ELECTRIC