Wisconsin engineer. Volume 77, Number 3 December 1972

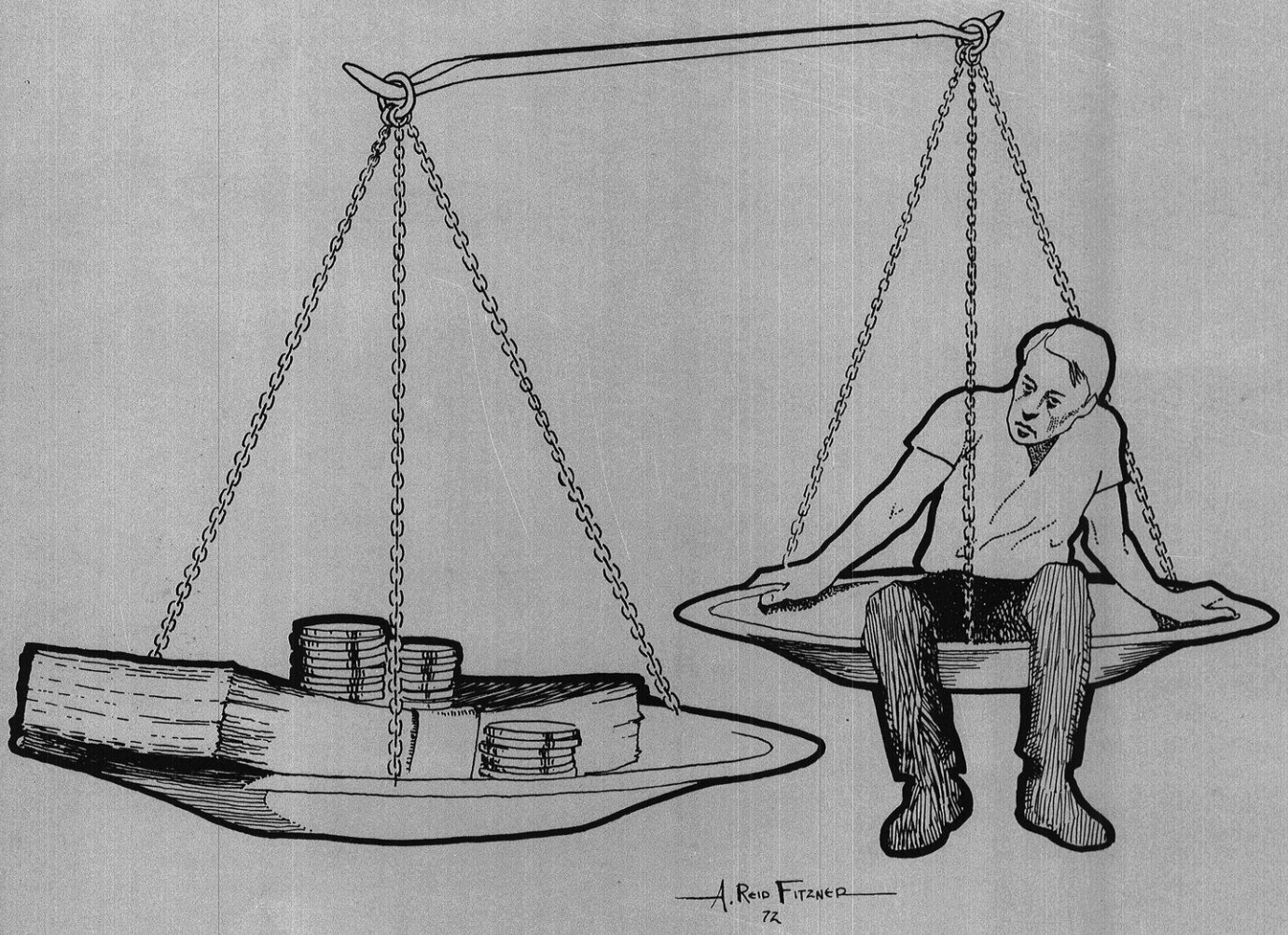
Madison, Wisconsin: Wisconsin Engineering Journal Association, [s.d.]

https://digital.library.wisc.edu/1711.dl/7P3DBZ6M5SIJV8I

VOLUME 77, NUMBER 3

35 CENTS DECEMBER, 1972

wisconsin engineer



How to call a stereo buff's bluff.

A buff will probably tell you you've got to drop a bundle to get a really great stereo system.

Nonsense.

Stereo is all in the ear. It's how it sounds, not how it costs, that makes a stereo system great.

So next time some buff hands you that old line call his bluff. See if he can figure out how much you paid for your Sylvania matched component stereo system. Just by listening.

Pick your favorite record. Put it on the BSR micro-mini turntable. (If tape's your thing, slip one into the 8-track cartridge playback.)

Then balance the bass and treble on the FM stereo FM/AM tuner and amplifier. And let him have it.

Make sure he digs those round low notes from the two six-inch woofers. And those high sweet ones from the two three-inch tweeters. They're all air-suspension speakers, so they sound as good as standard speakers two sizes larger.

Your buff won't have a chance. He'll stand there, surrounded by sound, completely bluffed. Trying like crazy to figure out how much you laid out for a stereo that sounds that great.

But don't tell him.

After all, you just want to call his bluff. Not destroy his ego.

GTE SYLVANIA

Do you keep an eye on the time line?

To gain the competitive edge, the experts in downhill slalom have this advice: "Watch the time line—the fastest course line."

"In the race against time, if a skier slips off and goes too low in the traverses, he'll lose precious seconds."

As you look to your future course, watch for the company whose progress is on a time line with your own.

Ask companies about their expansion and modernization programs (ours is an optimistic $221 million). Find out if you're interested in the markets they're interested in. If they have a position that fits the course you've set. If they promote from within.

Don't settle for salary and status quo. We don't. Pick a time at your college placement office. Let's discuss your future. The Timken Company, Canton, Ohio 44706.

Timken® bearings are sold all over the world. Manufacturing in Australia, Brazil, Canada, England, France, South Africa and the U.S.A.

An Equal Opportunity Employer (m/f).

TIMKEN®
REGISTERED TRADEMARK

THE TIMKEN COMPANY MANUFACTURES TAPERED ROLLER BEARINGS, SPECIALTY ALLOY STEEL AND REMOVABLE ROCK BITS.

Cast it or weld it?

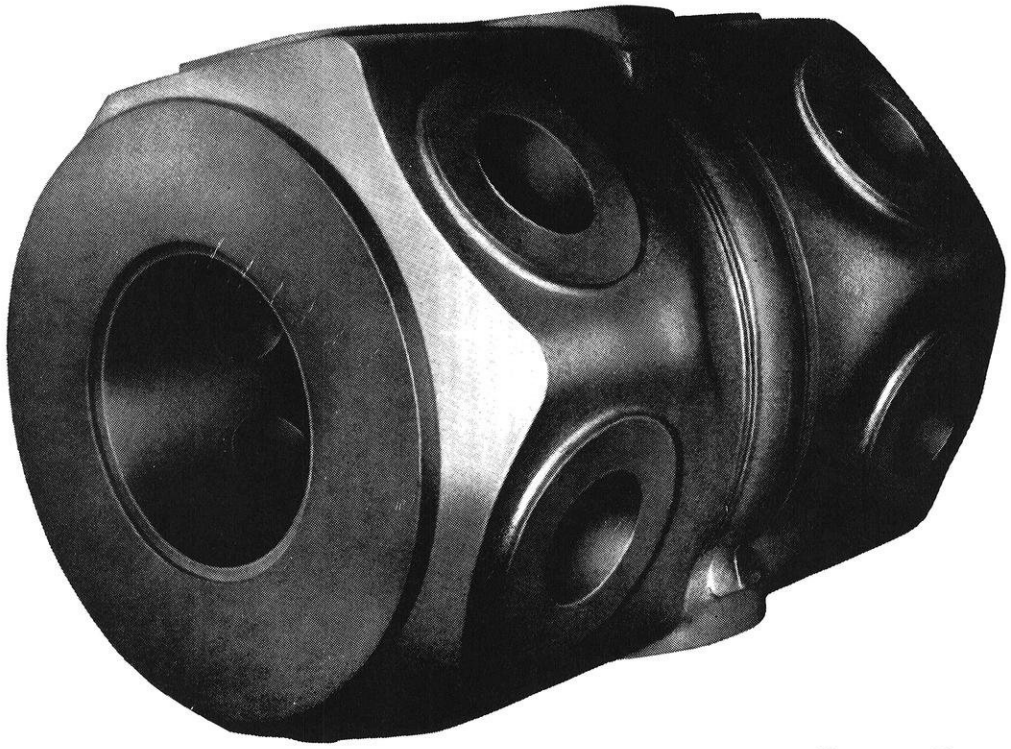
The beauty of *cast-steel* construction is that you can combine the casting process with another production technique, and cash in on the economies of both.

Suppose you had to create a heavy-walled fluid-handling component with complex internal configuration . . . a component that is basically a "twin" design. Can it be made as a single casting? Easy — but how much more economical to split the design into two "chunky" castings (thus minimizing core costs) and then weld the two halves together.

Theoretical? Not at all. We're talking about the 12,000-pound, 7-foot-long compressor cylinder shown . . . Designed for continuous operation at 1150 psi, it must withstand testing at 1800 psi, plus rigorous radiographic and magnetic particle inspections. How else would you make this component? Forge it? Impossible. Hog it out of a solid chunk of metal? Prohibitively expensive . . . By using *cast-steel* the designer got maximum economy, *plus* the extreme dependability and safety which were "must" requirements in this high capacity compressor unit—since he could specify the precise composition needed to meet calculated stress requirements.

Want to know more about *cast-steel?* We're offering individual students free subscriptions to our quarterly publication "CASTEEL" . . . Clubs and other groups can obtain our sound film "Engineering Flexibility." Write: Steel Founders' Society of America, Cast Metals Federation Building, 20611 Center Ridge Road, Rocky River, Ohio 44116.

STEEL FOUNDERS' SOCIETY OF AMERICA



Cast-Steel for Engineering Flexibility

Simon Ramo:

"We work from crisis rather than from planning in the United States, and the crisis is almost here."

TABLE OF CONTENTS:

wisconsin engineer

The Cover —

This thought provoking cover was designed upon inspiration from the article within, "California's Giant Water Hoax: How it was Engineered." by Harlan Trott. Our artist, A. Reid Fitzner, has tried to illustrate the pressures on and responsibilities of an engineer.

MEMBER OF ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Chairman: DANIEL L. GRIFFEN, JR., Iowa State University, Ames, Iowa.
Publishers Representatives: LITTEL-MURRAY-BARNHILL, INC., 2906 Lincoln Building, 60 East 42nd St., New York, N.Y. 10017.

* * * * * * * * *

Second Class Postage Paid at Madison, Wisconsin, under the Act of March 3, 1879. Acceptance for mailing at a special rate of postage provided for in Section 1103, Act of Oct. 3, 1917, authorized Oct. 21, 1918.

Published monthly from October to May inclusive by the Wisconsin Engineering Journal Assn., Subscriptions: one year—$2.00; two years—$3.75; three years—$5.25; four years—$6.50. Single copies are 35 cents per copy. 276 Mechanical Engineering Bldg., Madison, Wis. 53706. Office Phone (608) 262-3494.

EDITORIAL . . .

Engineers Must Tell What They Know

(The location of dams) "is not the faul fault of the water developers. If they think that the Grand Canyon, Yosemite Valley of Heaven itself would make a good storage ressevoir, they are paid to say so. The Public has the responsibility for saying no."

Raymond F. Dasmann, 1966
The Destruction of California

Moreover, today's engineer has to realize his responsibility for saying no—and informing the public accordingly.

A 300-page paperback, soon to be released, summarizes a two-volume, two-year study by Ralph Nader on the California Water Project (CWP). The book raises serious assertions of fraud and broad ethical questions that engineers must concern themselves with.

Our cover story for December is the biographical experience of one man on the Board of Consulting Engineers for the CWP, who raised the same questions during the planning stages. Adolph J. Ackerman of Madison, Wisconsin, filed a dissenting report in 1959, which was overridden.

Having not heard the other side of the story, the *Wisconsin Engineer* cannot do anything but consider the questions that this incident raises. The importance behind the story concerns the professional and moral obligations of the engineer. Engineers have a responsibility that goes far beyond the building of machines and systems. We cannot leave it to technical illiterates or even to literate overloaded technical administrators to decide what is safe and for the public good. We must tell what we know, first through normal administrative channels, but if these fail, through whatever avenues we can find. The growing pressure of political power cannot inhibit constructive criticism. The engineer must develop and maintain the freedom of communications within the profession and carry it to the public.

Furthermore, it is the responsibility of the engineering student and professional publications to accept and print controversial articles. Only through encouraging active debate of controversy, can the controversy be put into perspective. This is why the *Wisconsin Engineer* encourages any interested parties to respond to our cover story, or our editiorial.

Over the years, a civil engineer has had more contacts with the public, as his work directly affects a community. Therefore, the civil engineer, in a consulting and policy-making position, has to have, in addition to his technical ability, an extensive knowledge of constitutional law, economics, budgets, politics and many other fields related to a given project. With increasing specialization in all fields, the need for this type of liberal education is lost sight of. Today and in ensuing decades, all types of engineers will be faced with many more decisions than ever before. Students of engineering must question their cirriculums, and their own personal integrity to make sure tha the educational institutions are not sheltering them from the professional responsibility they will have to take on.

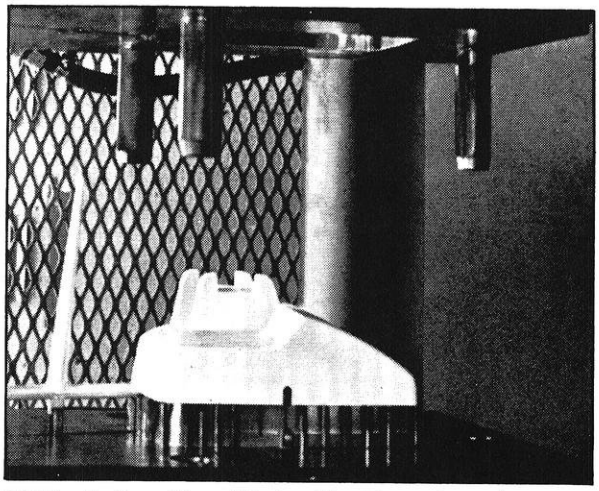
Is the engineering profession deteriorating? In recent years, many impressive scientific and engineering projects have been proposed—but under political domination, completely devoid of financial responsibility, under deliberate censorship of any opposition. Harmful implications are ignored. Yet, some politicans enthusiastically promote such long-range planning; they are eager to make long-term committments supposedly for plausible objectives—but also to maintain their political position. These politicians encroach on engineering independence and responsibilities.

Henry David Thoreau once said, "all change is a miracle to contemplate . . ." Each engineer, bearing a large portion of the responsibility for change on his shoulders, should appraise his individual role in the profession.

In the words of Adolph J. Ackerman, "We are confronted today with a matter of extreme importance in the development of civilization. In place of individual moral responsibility, we are substituting the dogma of debilitating collectivism. Eventually, this can engulf all the professions and reduce their members to technicians and puppets of unscrupulous bureaucrats. In this situation, the engineering profession occupies a critically important position because, in the current scientific revolution, the bureaucracy would be helpless without the supporting knowledge and skills of the engineer."

M.D. Stein

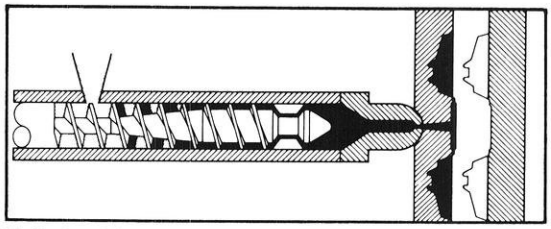
WESTERN ELECTRIC REPORTS



Molding by the millions. Western Electric people produce some 8 million phones a year. Molded plastic is used for housings and many other parts. So there is a constant investigation into the most effective way to use these materials.

$$A^*(z,t) = A_e^*(z) - [(A_f^* - A_i^*)/(1 - e^{-\beta N t_r})]e^{-\beta N t}$$

In developing the model at Western Electric's Engineering Research Center, it was found that melting behavior can be described by this formula which includes terms for shear heating and conduction heating effects. Other models were developed for temperature and pressure profiles.



End of molding cycle. At this point, the screw is stationary and heat is conducted into the plastic on the screw. After the plastic solidifies, the mold is opened as shown. The parts can then be ejected.

Solving the mysteries of molding with mathematics.

Even though plastics have been around for many years, there's still a lot to be learned about these versatile materials and their processing. So they are the subject for continuing studies by our engineers.

Some of their recent investigations have brought forth new and highly useful information about a relatively unexplored area: the melting behavior of plastics in the injection molding process.

One result of these studies is the mathematical formula, or model, above.

The model helps us predict melting behavior along the length of the injection screw molding machine used to mold telephone housings and other parts. Melting behavior is extremely important, because plastic pellets should be completely melted but not thermally decomposed before injection into the mold.

This information on melting is then used to investigate screw designs, operating conditions, machine sizes and plastic properties. All of which is aimed at obtaining optimum processing techniques.

Predictions obtained from the mathematical model have checked out closely with experimental observations. So the resulting screw designs are now undergoing evaluation by engineers at our plants in Indianapolis and Shreveport.

Conclusion: For new designs and materials, the model can help reduce the development cost for new molded parts and materials. For manufacturing current products, operating costs can be reduced.

Perhaps most significant is that we're getting information about molding temperatures not available experimentally. And many other types of information can be obtained without the use of costly, time-consuming experimental work.

The end result will be more efficient plastic molding and therefore a better product for the lowest possible cost.

Western Electric

We make things that bring people closer.

New Electron Microscope Aids University Research

By CATHERINE MANSON
UW Science Writer

MADISON, Wis.—A goliath among electron microscopes has launched Wisconsin biologists on a new journey into an invisible world of life.

Located at the University of Wisconswn-Madison, the 88-ton million volt electron microscope is the eighth of its kind in the world and the first in the United States. It is the first MVEM to be dedicated primarily to biomedical research.

The United States has been slow in developing high voltage electron microscopes but now will pioneer in application of such instruments to biological problems, zoology Prof. Hans Ris, director of the high voltage electron microscope laboratory, said, adding:

"We hope to gain basic biological knowledge and also develop techniques for using the MVEM."

Ris will use the microscope to study chromosomes, microscopic cell structures which carry hereditary information.

"Man cannot cure diseases like cancer without information about the basic body part affected—the cell. With the MVEM, scientists can explore previously inaccessible cell structures."

Among the UW-Madison scientists who will use the new microscope are Rainer W. Guillery, Jack L. Pate, and Eldon H. Newcomb, all members of the MVEM advisory committee.

Anatomist Guillery is optimistic about the possibility of using the MVEM to study how brain nerve cells connect with each other. It will allow scientists to learn more about these connections.

Bacteriologist Pate will study bacteria with the help of the MVEM. He hopes that by understanding how certain unusual bacteria move, man can further understand movement in biological systems.

The structure of chloroplasts, tiny food-manufacturing bodies in the cells of green plants, will be explored by Newcomb, a botanist.

Newcomb said biologists hope to develop ways to examine living cells with the MVEM. Previously, electron microscopes have killed living matter before it has been observed.

The MVEM works much like an optical microscope in which light is focused on an object by lenses. But it uses a beam of electrons instead of light and its lenses are really magnetic fields.

With an electron microscope it is possible to see objects in much greater detail. The MVEM magnifies up to one and one-quarter million times, enabling scientists to see objects one thousand times smaller than those visible through the optical microscopes used in high school biology classes. This is possible because electrons have a shorter wavelength than light.

And the MVEM has an important advantage over other electron microscopes—since it can be used to view thicker specimens, scientists can get good images of three-dimensional objects. With ordinary electron microscopes, specimens can be only one two-thousandth as thick as a piece of paper.

The MVEM's beam of electrons comes from a pin-size tungsten wire which emits electrons when supplied with electric current.

The electrons are accelerated nearly to the speed of light by the million-volt-capacity generator-accelerator before they are shot through the magnetic lenses in the microscope to illuminate the specimen.

Each MVEM lens weighs 1,000 pounds because of the lead and steel insulation required to contain x-rays emitted when electrons hit metal. Such x-rays are produced continuously inside the microscope.

Since the human eye cannot see electrons, a fluorescent screen behind the specimen provides the visible image. This image is permanently captured on a photographic plate by a push of a button.

Acquisition of the MVEM by the UW-Madison was made possible by an $855,000 grant from the Biotechnology Resources Branch of the National Institutes of Health.

Dr. Ris explained why NIH provided funds to install the MVEM at Madison:

"A large number of competent biomedical researchers are working at Wisconsin largely because of the state's strong support in the past for the University, something we hope will continue.

"In addition, $270,000 was provided by the Wisconsin Alumni Research Foundation for the wing of the new Animal Science Building which houses the MVEM."

Wisconsin's new microscope occupies three floors. The top two house the Swiss-made generator and accelerator tanks. The microscope column and control panels, made in England, are located below the tanks. The entire instrument rests on a 60-ton concrete block which floats on plastic air bags designed to absorb vibrations.

The MVEM is a national facility and can be used by any competent scientist with the approval of the Wisconsin advisory committee. At present Ris is uncertain of the cost to prospective users but says it will be minimal.

"We are not concerned with money but with making the instrument available. Each scientist should get some free time at first to see if the microscope will really profit his research," he added.

Fellowships

For:	In the fields of:	Benefits include:
Masters, Engineer and Doctoral Degrees	Electrical, Aerospace and Mechanical Engineering, Computer Science, Physics and Mathematics	Educational stipend, dependent allowance, all academic expenses, professional salary, employee benefits and travel allowance. Value of these ranges from approximately $8,500 to $13,000 annually.

Be one of the more than a hundred students to win this outstanding opportunity. You will study at a nearby prominent university through the Hughes Fellowship Program. Work-study and a limited number of full-study plans are offered. You also will gain professional experience with full time summer assignments in Hughes research and development laboratories. You may take advantage of a variety of technical assignments through the Engineering Rotation Program.

Requirements: B.S. degree for Masters Fellowships, M.S. degree for Engineer and Doctoral Fellowships; U.S. citizenship; grade point average of 3.0 or better out of a possible 4.0; selection by Hughes Fellowship Committee.

Hughes is substantially increasing the number of fellowship awards leading to the degree of Engineer.

For additional information, complete and airmail form to: Hughes Aircraft Company, Scientific Education Office, P.O. Box 90515, Los Angeles, California 90009.

HUGHES
HUGHES AIRCRAFT COMPANY

An equal opportunity employer—M & F

Hughes Aircraft Company, Scientific Education Office,
World Way P.O. Box 90515, Los Angeles, Calif. 90009
Please send me information about Hughes Fellowships.

Name (printed): _____

Address _____

City _____ State _____ Zip _____

I am interested in obtaining: ☐ Masters ☐ Engineer ☐ Doctoral

fellowship in the field of _____

I have (or expect) a Bachelor's degree in _____
(Field)

by _____
(Mo., Yr.)

from _____
(Institution)

GPA is _____ out of possible _____

Also have (or expect) Master's degree in _____
(Field)

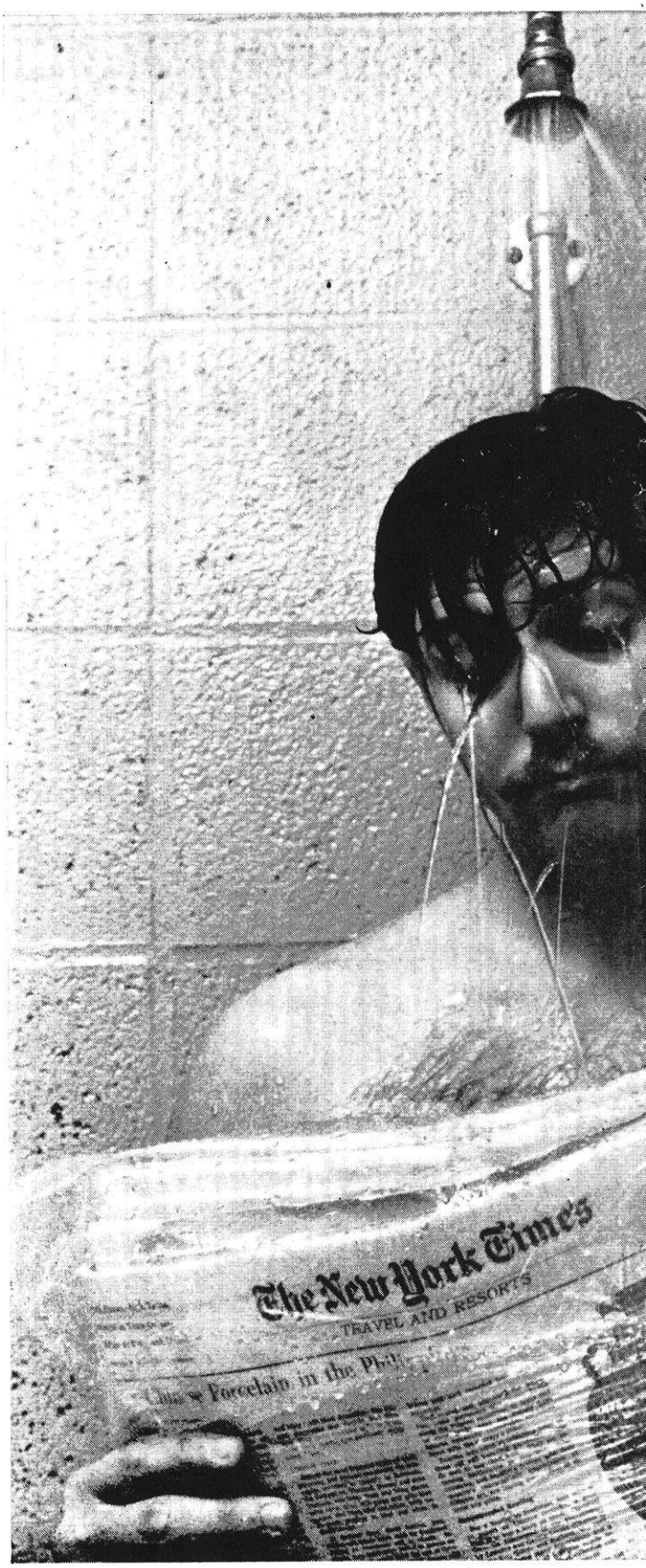
by _____
(Mo., Yr.)

from _____
(Institution)

GPA is _____ out of possible _____

U.S. CITIZENSHIP IS REQUIRED

We keep the news fit to read.



Each Saturday night *The New York Times* wraps up the news.

Then FMC wraps up *The New York Times.*

Thanks to a mechanized system we designed, built, and installed, the country's largest Sunday edition is mailed the world over, carefully protected from the elements by a see-through wrapper.

This is just one of many unusual jobs taken in stride by FMC.

If you want to carry it, warehouse it, package it, or whatever, chances are FMC has handled a similar job.

You may still recall by tomorrow that we're into machinery; but how in the world can we get you to remember that we're also a very large chemical company, too?

Or that we are a major factor in alleviating the world's food problems through our involvement in every phase of agriculture: pumps and irrigation systems, pesticides and fertilizers, food processing and packaging equipment, even seeds.

Or that we're one of the country's largest producers of rayon, acetate, and polyester fibers.

Or that we even make sewage treatment equipment, fire engines and railcars.

Being a diversified company means it's hard to have one all-encompassing image. But it does give our people an unusual variety of ways to improve man's welfare.

If doing worthwhile things is your bag, write or ask your placement director for the descriptive brochure "Careers with FMC." FMC Corporation, One Illinois Center, 111 East Wacker Drive, Chicago, Illinois 60601.

We are an equal opportunity employer.

fmc CORPORATION ®

FMC CORPORATION

You'd be surprised at all the things we do.

California's Giant Water Hoax: How It Was Engineered

State Water Plan: The Largest Special Interest Boondoggle and Biggest Water Steal in History.

By Harlan Trott

"A disaster in the making . . ." is how a public water agency labels the proposed Peripheral Canal, final link in California's multibillion-dollar State Water Plan. Some 30 other public bodies and civic groups are backing the Contra Costa County Water Agency's report on the lethal threat this massive upstream diversion project poses to the economy of the San Francisco Bay delta and its diversified farming, fishery and recreational resources.

The report describes the fresh water streams of Northern California that discharge into the Bay, the Peripheral Canal, and the damaging effects to the Bay area after these streams have been diverted into the Canal for delivery to Los Angeles and points south.

The report says: "A great industrial complex depends on the Bay-Delta System as a source of process water and for movement of water-borne materials. The highly productive farm lands of the Delta require good quality water for irrigation. . . .The stolen Sacramento River, plundered by diversion into the Peripheral Canal, would be channeled 400 miles southward to make possible additional subdivision development in the Los Angeles Basin. . . .The Peripheral Canal is a device that will enable Southern California Land Promoters to carry out the biggest water steal in history!"

These are some of the continuing repercussions that have been growing louder ever since 1960, when Southern California outvoted the North by a narrow margin and committed the State to issuing $1,750,000,000 in general obligation Water Bonds for financing the State Water Plan.

During the past decade more and more people have been asking: "How could such a thing happen to a great State?"

Part of the answer can now be found in a report--POWER AND LAND IN CALIFORNIA (by Robert C. Fellmeth, Editor and Project Director of The Ralph Nader Task Force Report on Land Use in the State of California, and recently released by the Center for Study of Responsive Law of Washington, D.C.). It reveals an almost incredible story about a "second TVA" which has been under construction in California for the past ten years. Here are excerpts from that report:

> "fraud (frod), n., l, a) deceit; trickery; cheating. b) in law, intentional deception to cause a person to give up property or some lawful right."
> --Webster's New World Dictionary

"Five hundred dollars for every man, woman, and child buys California a giant plumbing scheme to transfer fresh water from San Francisco Bay and North Coastal rivers to areas south. This scheme, the California State Water Project, benefits a few corporate farms in the San Joaquin Valley, a handful of landowners, speculators, developers, and water-using industries in Southern California, and the builders. . . .Still being built, our research indicates that the California Water Project may be the largest special interest boondoggle in history.

History

"Despite representations to the contrary, Californians have never voted for the California Water Project as it is now being built. The Burns-Porter Act, which the Legislature passed and Governor Brown signed in 1959, did not authorize the Project. The $1,750,000,000 general obligation water-bonds which the voters approved in 1960 were not meant to finance it. The voters who, in June 1970, agreed to raise the allowable interest rate so the rest of the bonds could be sold on today's market, did not vote for it. What Californians have authorized and approved was something quite different.

"The project that was authorized had the same physical characteristics as the present Project. . . .These physical works will deliver fresh water, which has flowed down the Sacramento River and its tributaries to the Delta, to thirty-two Southern water agencies which have contracted to buy it.

"But physical features alone have no meaning to the ordinary person unless the experts--the engineers, the lawyers, the economists--tell him what they accomplish. And here the real State Water Project begins to look very different from the one Californians thought they were getting. We have

---

HARLAN TROTT has a notable record for factual reporting on controversial issues. For many years he was the San Francisco correspondent of the Christian Science Monitor. Following his retirement from the Monitor staff in 1967 and until recently he served as Publisher and Editor of BUSINESS DIGEST of San Francisco. During the past decades he has repeatedly reported on the Water Plan, and this story on the latest developments fully confirms his earlier observations. He resides in Walnut Creek, California.

learned, however, the following: The Project's 'experts' said this plumbing system would cost $2 billion: the real cost, as they knew, will be closer to $10 billion. . . .The experts claimed that the Project would cost taxpayers virtually nothing: in reality, they will pay about half its economic cost, in their capacity as federal, State, and local taxpayers, and as power users--without counting the cost of generally higher bond interest rates due to the Project's erosion of the State's credit. According to A. Alan Post, the State Legislative Analyst, the State pays approximately one-half percent more interest on its borrowings because of the Water Project. The Project has also probably prevented some areas from selling bonds for purposes such as education.

"The experts claimed that all Californians would benefit: in fact, the only ones who gain a significantly cheaper and more plentiful water supply than they would otherwise have (the major 'benefit' the Project can bring) are a few large landowners, some real estate speculators whose land could not receive other supplies of water, and some water-using industries in Southern California.

"The Department of Water Resources (DWR) frequently claims that 'Project customers will repay about ninety percent of the total project costs.' "

"This statement is false and misleading," says the Fellmeth study group. "As it stands, the statement ignores the fact that State taxpayers will pay a large portion of the Project's cost." (Since the start of construction in 1962 the original project estimates show an overrun of more than $600,000,000.)

"Another instance of deception was perpetrated not by the DWR, but by some independent consultants hired to evaluate the Project's economic feasibility--that is, whether it would pay more than it cost. In 1959, the DWR's own favorable evaluation had come under severe attack from economists and from Adolph J. Ackerman, one of its own Consulting Engineers.

"Ackerman's dissent took considerable courage, since engineering consultants are paid to agree, not disagree--and, if they must disagree with public policy, to do so quietly. Ackerman, however, issued a sharply-worded report highly critical of the DWR's methods and conclusions, and made so bold as to speak of engineering responsibility to the public. As a result, the State hired the Charles T. Main Co., a Boston engineering firm, to evaluate the Project's economic feasibility, and Dillon, Read & Co., a New York investment firm, to evaluate its financial feasibility (that is, whether the State could pay for the Project).

"These Consultants released their reports," Fellmeth's group records, "just before the bond issue election. The Los Angeles Times headlined: PROJECT GETS SOUND RATING IN TWO REPORTS. The San Francisco Chronicle put a different interpretation on it: STATE WATER PLAN CALLED IMPOSSIBLE. What happened? Quite simply, Charles T. Main, Inc. engaged in a deliberate shell-game with the terms "economic and financial feasibility." Both reports used the tactic of stating in clear language what their employer wanted to hear, that the Project was OK. At the same time," the Fellmeth account continues, "they both so defined and qualified their terms, in unquotable technical jargon, that they really ended up saying the Project would probably stink, thus preserving their professional 'reputation.' Main defined 'economic feasibility' to mean whether or not the State could pay for the Project (rather than its real meaning, whether or not Project benefits would exceed Project costs).

"When we asked the DWR's 1959 Director, Harvey Banks, why the statement of costs omitted interest, he told our task force that engineers always defined 'cost' in this way. The omission of $250,000,000 inflation cost from the original cost estimates was at Governor Brown's request, and consisted merely in stating the costs in terms of 1959 dollars. The engineers can't help it if people think 'Project customers' means 'water users,' when it really means, substantially, California property taxpayers.

This is a simplified map of how the California Water Plan will work. The North Coast Development would stop-up the natural flow of all the major wild rivers in the area (as has already been done around the Oroville Dam). The flow of water down into the Sacramento River will be controlled, and below Sacramento, instead of flowing into San Francisco Bay as it naturally has, 82% of the water will be pumped into the California aqueduct toward Los Angeles. Along the way some of it will irrigate farm lands in the San Joaquin Valley, and then the poisoned water will collect in the San Joaquin Drain and then in what I have called "Poison Lake." No one has determined what will be done with this poisoned water but one idea is to dump it in San Francisco Bay. As for the good water, it will go-towards servicing an expanded population and industry East of Los Angeles, thus making life down there still worse than now.

THE STRUGGLE FOR WATER
MAP AND TEXT from
Raymond F. Dasmann,
The Destruction of California, 1966

Once the waters of California flowed without hindrance to the sea. But man could not adjust his ways to their seasonal pattern of flood and low water, nor could he be content to settle in places where water was abundant. The picture before dams and drainage is shown here.

Today only a few small streams run unhindered to the sea. Some of the old lakes and rivers have disappeared. Dams, reservoirs, canals, and aqueducts dominate the California landscape. *Source: Bureau of Reclamation and California Department of Water Resources (including projects under construction)* **Dasmann, ibid**

*** EDITORS NOTE: The Magnitude of the project includes: 22 major dams and reservoirs, four principle aqueducts (including 11 brances and divisions), seven power plants, 21 pumping plants, and an agricultural drainage system.**

All map illustrations taken from *Environmental Studies* **— California Water Project; Volume 1, No. 2, 1972, courtesy of Margaret S. Kelley, Teaching Assistant, University of Wisconsin — Madison, Department of Journalism.**

"As to the consultants," the Fellmeth report continues, "Mr. Banks did concede that they had been pretty deceptive, but he noted that Charles T. Main, Inc. had never done a water project before. It perhaps epitomizes the state of engineering standards that Mr. Banks could say, when we asked him how the DWR could claim the Project would produce more economic benefits than costs, 'You tell me what benefit-cost ratio you want, and I'll get it for you, without straining my conscience.' " (Since he left the DWR Mr. Banks has joined the fraternity of engineering consultants.)

"Since engineering standards allow engineers to reach any results they want in evaluating projects without jeopardizing their professional reputations, it is a rare engineer who, like Adolph J. Ackerman, refuses to produce the answers his employer wants.

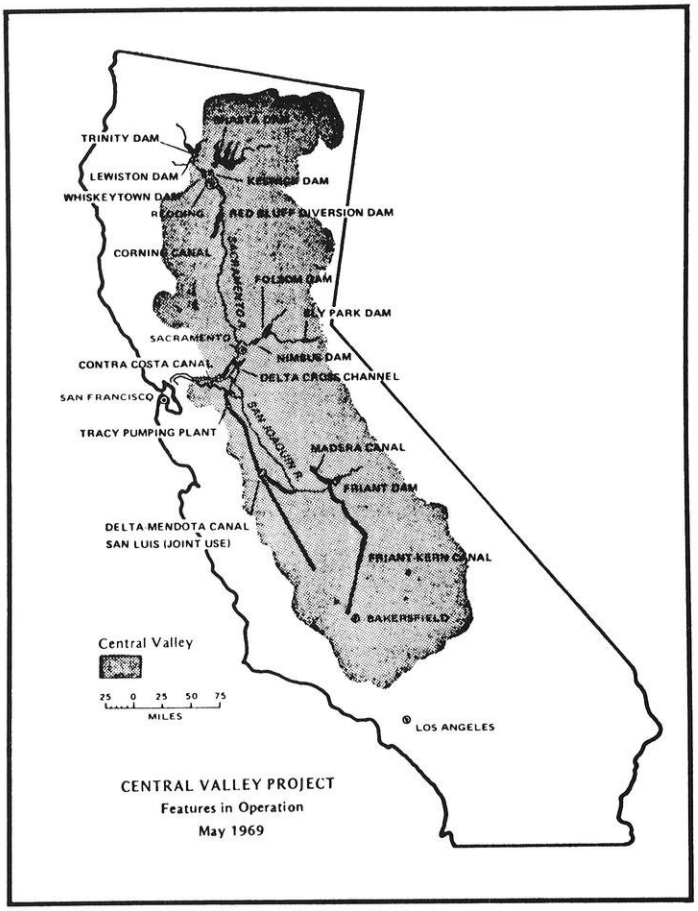
STATE WATER PLAN FINANCE

"The most basic problem with the DWR's cost figure arises from its definition of the word 'cost,' " the task force asserts. "The common and economic idea of 'cost' is represented well enough by Webster's definition: 'the amount of money, time, labor, etc. required to get a thing; price; expenditure.' (Webster's New World Dictionary, College Edition, 1957.) But, as Harvey Banks put it, 'engineering cost' represents something entirely different. It represents the amount of money which must be granted or borrowed to build a project--the capital expenditures. It omits the single largest expense of any major construction project--the expense of obtaining this capital. As a statement of what the public understands as cost, therefore, the DWR's figures are about as accurate as though it assumed the materials would be donated, or labor contributed for free; actually, since the cost of money is considerably higher than either of these, the DWR's figures are even more deceptive.

"The DWR's false financial calculations have, of course, been crucial to public acceptance of the Project. In 1959, Governor Brown demanded a project 'costing' less than $2 billion because he didn't think anything more would be acceptable, and even then, despite vast publicity expenditures by Project promoters, the voters approved the bond issue by only the narrowest margin.

"Actually, the analysis here does not reveal the full deception practiced in 1960," the investigators remark, "in that the DWR has subsequently corrected several 'errors' it made at that time. The most significant of these errors was a failure to include in the statement of costs any allowance for inflation--although the Department had itself calculated that cost at over a quarter billion dollars, at 1959 inflation rates! Harvey Banks, the Department's Director at the time, explained that Governor Brown had ordered him not to include this cost, and he, being a 'good German,' obeyed.

The Fellmeth narrative continues: "Of course, there was a more genteel way of saying 'omit the cost' than saying it directly; Governor Brown requested that Project costs be stated 'in terms of 1959 prices.' Naturally, any citizen was free to



calculate for himself what the inflation cost would be, when armed with this information. The Department omitted another $100 million of costs in 1960 by somehow forgetting about interest charges during the construction period. Mr. Banks admitted that this was just a plain mistake on the Department's part.

CONSULTING ENGINEERS: QUIS CUSTODIET CUSTODIES?

"As the State Water Plan (SWP) took shape in the Fifties, numerous independent consulting engineers escorted it along the way to public acceptance. These consultants were chosen for their credibility--large, dignified, and reputable professional firms, individuals of high personal attainment, and academicians with impressive credentials. Their prestige and their financial independence from the project at hand made them seem ideal as independent checks on the DWR.

"In 1957, the Department appointed another group of consultants, a Board of Consulting Engineers under the Chairmanship of Ralph Tudor, a top San Francisco engineer. This Board succeeded another equally prestigious Board which had offered an inconclusive report in 1957 and disbanded. Then, after the Legislature had approved the Project in 1959, but before the public voted on the bond issue in 1960, two new consultants were hired: the Charles T. Main Co. to report on the Project's economic feasibility; and Dillon, Read & Co. to report on financing.

Considering the prestige of these firms, their positions of trust and responsibility, and their presumed financial independence from the State, the Fellmeth study calls their collective performance on the SWP "unfortunate at best. We believe that it raises serious questions about the role of such consultants in the arena of public decision-making."...

"The Tudor Board's final report was such that one member, Adolph J. Ackerman, took the unprecedented and personally costly step of dissenting. Ackerman issued a clear and stinging dissent from the Board's report, the gist of what was that,

> 'No conventional demonstration has been made of the financial feasibility or justification for the project, and no clearly engineered concept has been presented which may be considered as valid and in the public interest. Any inference at this stage that the project has had the benefit of a complete engineering study and represents the best product of the engineering profession in which the public can repose its full confidence is, in my opinion, wholly unwarranted.'

"Strangely enough, the details of Ackerman's criticisms were corroborated by the Board's own report. The basis for his dissent was not technical disagreement, therefore, but the manner of statement. For the Board, while agreeing with Ackerman that the Project's desirability remained, at best, unproved, nevertheless issued its report in such a form that the public could and did believe it supported the Department's recommendations. By a subtle manipulation of words and definitions, therefore, the Board misled the public which relied on its expertise."

When the Board's report was delivered to State Director Harvey Banks he promptly informed the press that this confirms "our conclusion that the project will pay for itself and will not be a financial burden on those who receive no benefits from the project." In naming the Members of the Board in his official release he conveniently omitted any reference to Ackerman and his dissenting position.

"To understand what the distinguished chairman, Ralph Tudor, and his colleagues did," the Fellmeth team says, "the reader must remember that Bulletin 78, the subject of the Board's deliberations, was designed to perform two separate functions. One was to select the Aqueduct's final route--a function chiefly of technical interest to the MWD of Southern California. The MWD hardly needed the Board of Consulting Engineers to help it assess the Bulletin's job in selecting this route.

"The other function, however, was entirely a matter of public interest: namely, a determination of the Project's economic and financial desirability. For this, both the public and potential investors in Water Project bonds relied wholly on the consultants as their independent check.

"As Ackerman said:
'Both the stature of the engineering profession as well as the public confidence in the profession are under severe test. It may well be said that never before in engineering history have such great responsibilities been entrusted to a board of consulting engineers. With respect to the planning of public works, a board of professional engineers has the primary obligation of safeguarding the public interest. The public has developed a great trust and faith in the integrity of the engineering profession and this serves as a powerful challenge to merit such confidence in the future.' "

The Task Force findings show that "the Board of Consulting Engineers followed the same approach as the Stanford Research Institute before it, and the Charles T. Main Co. after it.

"At the risk of repetition, it is important to mark that pattern. First, it clearly and forthrightly declares its support for the Project--by virtue of defining its task to include only those aspects which it can clearly and forthrightly support. But to maintain a punctillious and technical kind of honesty, the Board later admits, in convoluted and highly unquotable phrases, that the Project has serious problems. While remaining technically accurate, therefore, the Board does everything in its considerable power to promote a Project which it actually believes highly questionable. Of all the consultants the State hired to examine the Project, only one had the integrity and courage to tell the public in clear language what he really thought of the project, and what the public HIRED him to find out. That was Adolph J. Ackerman.

"After studying the performance of 'independent consultants' on the State Water Project, it is impossible to again hold the illusion that their nominal independence makes them a trustworthy check on calculations purporting to justify public works. Quoting from Ackerman's report:
'In recent years the DWR has been under great political pressure to formulate a Water Plan and policies which would be acceptable to the State Administration. As a consequence, there has been a gradual drift towards the exploitation of professional disciplines to serve political ends.' "

In Retrospect

The foregoing brief review of the Fellmeth-Nader Report shows what can be committed by this new combination of "professional engineering expertise" and political power. The self-appointed planners, Engineer Harvey Banks and Governor Pat Brown, manipulated this power with great skill as they lowered their massive "Water Plan" on the people of California. (The Governor had repeatedly assured the voters: "The Water Project will not cost the taxpayers a sou-markee!")

Only one last step remained for election day on November 8, 1960, and that was to get the people to the polls and to vote "Yes" on "Proposition No. 1." Just four days earlier, on November 4, full-page ads appeared in most of California's big newspapers with this appeal:

Vote "YES" on Proposition No. 1
It's as simple as turning on your faucet!
California must have water.
Now it's up to you!

Proposition #1 means (1) abundant water, (2) more jobs, (3) growth for California

These organizations agree:

(A list of some 118 organizations, County Boards, newspapers, etc. – "only a partial list")

Missing from the ads was the fact that Proposition No. 1 would authorize the Governor to issue $1,750,000,000 in General Obligation Bonds!

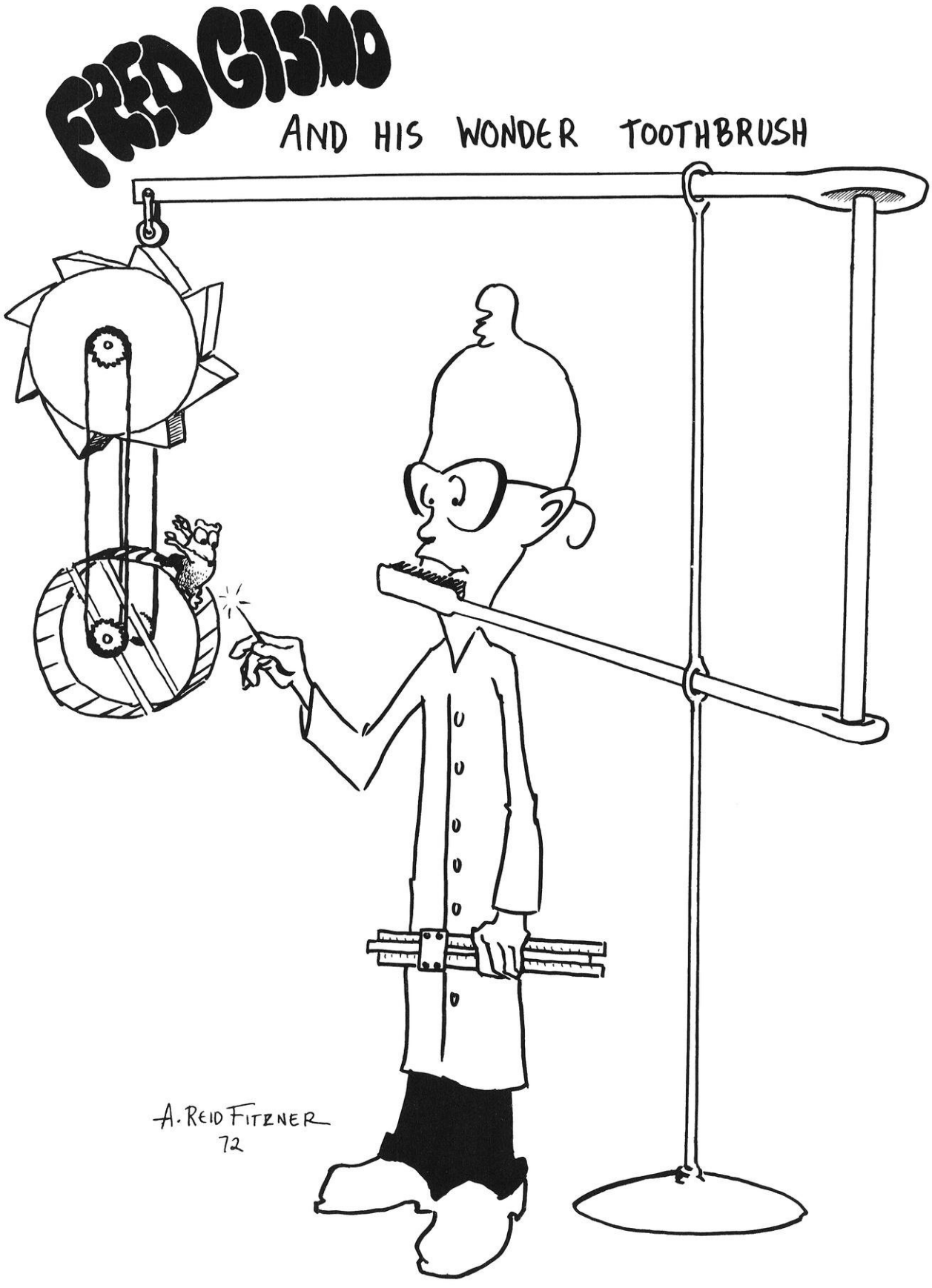
The vote count was YES – 3,008,000; NO – 2,834,000; Blank – 641,000.

The AYES had it!

Adolph J. Ackerman (SM'49) was born in New Ulm, Minn., on April 21, 1901. He attended Martin Luther College, and received the B.S. E.E. and C.E. degrees from the University of Wisconsin, Madison, in 1926 and 1933, respectively.

His experience in the planning and construction of power plants includes a six-year assigment in Brazil, where he was in charge of designing and building a million-kilowatt power program, including the first large underground hydropower plants in the Western Hemisphere. For a number of years he served the World Bank, making feasibility reports on power developments located chiefly in South America and India. With the advent of the new technology of atomic power he has paid particular attention to the planning and design of underground atomic power plants, and during the past thirteen years has maintained a comprehensive review of atomic power developments in the United States. Since 1952 he has been an independent consulting engineer on electric power and water resource development.

Mr. Ackerman is a member of the American Institute of Consulting Engineers, American Society of Civil Engineers, American Society for Mechanical Engineers, Eta Kappa Nu, Tau Beta Pi, and Chi Epsilon. He is a registered Professional Engineer in Pennsylvania, New York, Tennessee, California, and Wisconsin.


FRED GISMO
AND HIS WONDER TOOTHBRUSH
A. REID FITZNER
72

...and thanks an awful lot for visiting us!

Five years ago companies were hungry for graduating engineers. Last year graduating engineers were hungry for jobs.

Now it's easier both ways. You have choice. We have choice. Honesty can prevail. We can part friends if we see we weren't meant for each other. Maybe a little self-description here would save time:

- Only very rarely does Kodak hire a manager. We hire workers, and some of them grow into managers. We consider engineers workers. A young engineer who lets on that his engineering is only temporary until he becomes a manager makes us uncomfortable. Yet we have some surprisingly young managers.
- We prefer engineers who know the difference between engineering and science. An engineer is a person who has learned a lot of science, not for the purpose of creating still more science, but for getting things done. (We also happen to need scientists.)
- Take, for example, a newly minted E.E. who shines in circuit design. Impressive talent. Hired. Could be put to work in that specialty but is lured instead into manufacturing engineering, a real action area. Expected there to be happy and productive spending 15% of time designing circuits and the rest on a tool design project befitting a mechanical engineer. At the same time we have mechanical engineers doing some chemical engineering. Also vice versa.
- Engineers tell the factory what to do. How can you tell somebody what to do if you've never done it yourself? Since our factories do things nobody else knows how to do, it would be a while before you really earn your keep.

But we're interested in *you*. If you are interested in us, you can write us something about *your* hangups, but tell us more about your strengths. **Eastman Kodak Company, Business and Technical Personnel, Rochester, N.Y. 14650.**

Kodak

An equal-opportunity employer m/f

HOW CAN A SHINY PIECE OF CRYSTAL HELP GIVE LIFE TO A DYING MAN?

That's no ordinary crystal. It's ultra-pure germanium. The purest substance on earth.

General Electric researchers and engineers first figured out how to refine germanium to such a pure level. (Less than one atom of impurity in a trillion.)

That was a major technical achievement. But that's not the reason it's important.

Ultra-pure germanium is very sensitive to certain radioisotopes. So it's making possible a revolutionary new sensing device for studying the brain. Conceived at the NYU Medical Center's Institute of Rehabilitation Medicine, this system is intended to give doctors their first 3-dimensional look at the entire brain.

A patient, wearing a helmet containing germanium sensors, will be given a radioisotope. As the isotope flows through the brain, the sensors will feed signals to a computer, resulting in a complete mathematical picture of the brain's blood-flow rates.

That information could be invaluable in treating hundreds of thousands of people with brain damage resulting from strokes or accidents.

For example, take an auto-accident victim with critical head injuries. Without fast treatment he could easily be a dead man.

Within 15 minutes this new system could pinpoint the size and location of trauma in his brain. That's something no existing system can do in any amount of time.

It's a pretty clear example of how a technological innovation can help solve a human problem.

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