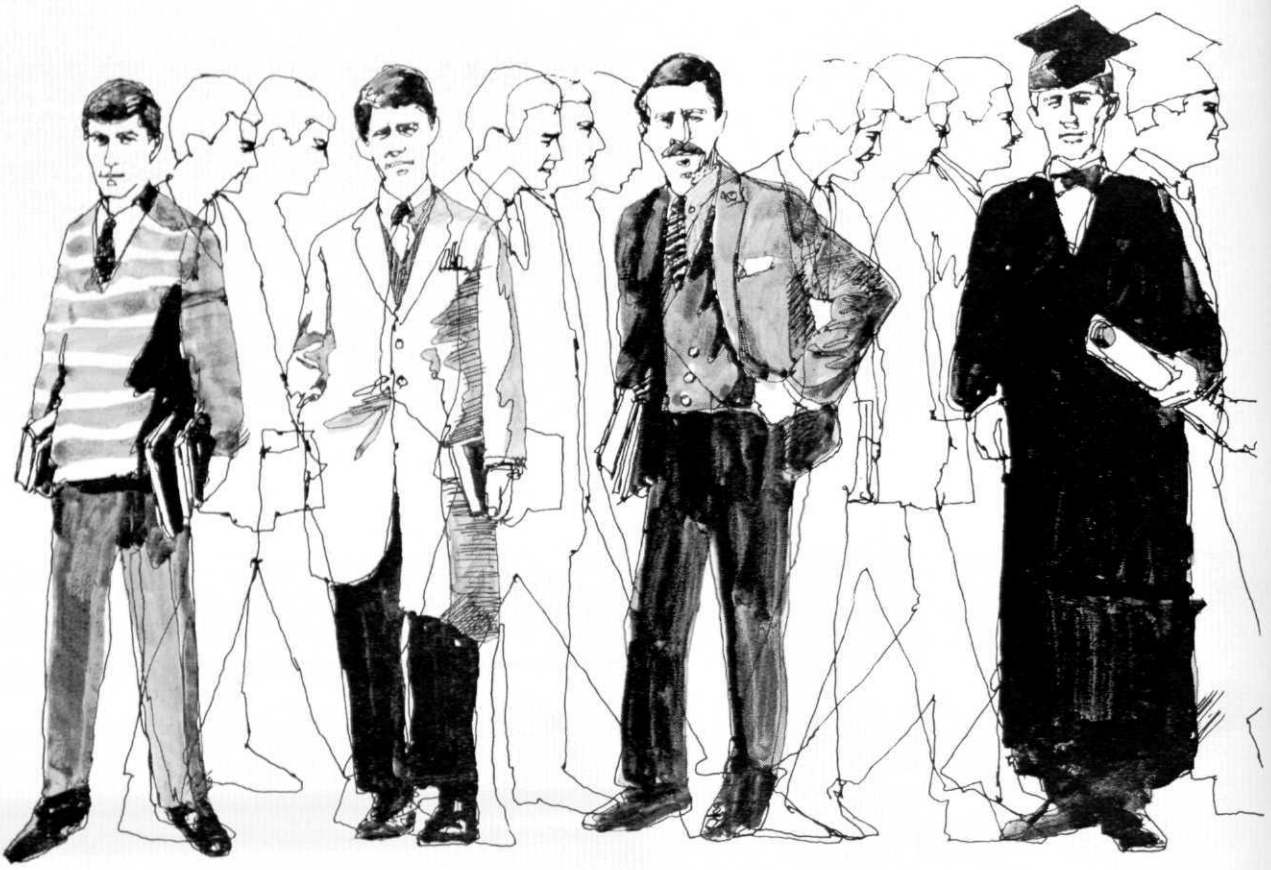
MICHIGAN
STATE
UNIVERSITY
VOLUME 25
NUMBER 1
OCT./NOV., 1971

spartan engineer

The Scientific Ecologically Open Minded Magazine

Member of the Engineering College Magazines Associated



Senior!
While you were in college, Westinghouse built 13 new plants, boosted sales $1 billion, got 2,000 new patents.

Nice growing figures. But maybe the figures aren't as important as the areas we're growing in:

Housing, mass transit, health care, education, crime abatement, urban development, pollution control, nuclear power, oceanography, computer-based information systems.

Talk with our campus recruiter. We're looking for engineers to grow with us. Electrical, mechanical, chemical, industrial. And finance/accounting people.

If you can't wait for the recruiter, write today to George Garvey, Westinghouse Education Center, Pittsburgh, Pa. 15221. An equal opportunity employer.

You can be sure...if it's Westinghouse

This months cover by Milton Horst represents the questionable future of fossil feuls as an energy source for our society's ever expanding need for power.

spartan engineer

The Scientific Ecologically Open Minded Magazine

Member of the Engineering College Magazines Associated

MICHIGAN STATE UNIVERSITY
VOLUME 25
NUMBER 1
OCT./NOV., 1971

FEATURES

DEPARTMENTS

Member, Engineering College Magazine Associated / Chairman: Daniel L. Griffer, Jr. Iowa State University, Ames, Iowa / Publisher's Representative: Littell-Murray-Barhnill, Inc. 369 Lexington Ave., New York, 17, N.Y. / 737 N. Michigan Ave., Chicago, Ill. / Published four times yearly by the students of the COLLEGE OF ENGINEERING, MICHIGAN STATE UNIVERSITY / East Lansing, Michigan 48823. / The office is on the first floor of the Engineering Building / Room 144, Phone 517 355-3520. / Subscription rate by mail $2.00 per year / Single copies 40 cents / Printed by Millbrook Printing Company/.

A statement of policy:

The objective of the magazine is to communicate the exchange of ideas between: students and professors, professors and professors, departments, and colleges within the university. The Spartan Engineer believes that the engineering world can no longer neglect the social interactions of the outside world and is dedicated to initiating programs within its bounds that not only seek to relate the latest discoveries of pure science, but also show a genuine concern for the questions troubling our environment. The Spartan Engineer also identifies with the American ideal of free enterprise and its attempt to perfect the efforts of mankind in constructing a new world through human engineering.

STAFF

energy

The energy to keep straining toward your chosen goal—and even as you attain it, look forward to the ones beyond.

The energy to explore, evaluate, create, bring needed changes.

Energy to burn, figuratively—that wealth possessed by the young, in mind no less than body.

Energy to burn, literally, because ideas—freedom, equality, well-being, conservation of our natural environment—must be turned into realities—food, shelter, warmth, access, economic independence and the physical means to accomplish our goals. Atlantic Richfield is an energy company—in all these ways. One of the nation's thirty leading industrial corporations, and one of the ten companies producing most of our energy needs, with a strong position in diversified chemical products as well as in oil and gas.

A young company still extending its boundaries as it joins the efforts and resources of the Atlantic, the Richfield and now the Sinclair Oil Companies. Aggressive and imaginative in management. Flexible in organization and operation. Open to fresh thinking. Responsible in outlook. Offering new opportunities to financial and systems analysts, accountants, auditors, engineers, geologists, geophysicists, sales representatives, agronomists and programmers.

We invite your interest. See our representative on campus or your Placement Director.

AtlanticRichfieldCompany

An equal opportunity employer M/F.

meet the authors

Larry Barazsu

Larry is a junior in Electrical Engineering. Currently SE's Features Editor, Larry was the Humor Editor for last springs issue. His article deals with this months theme, the energy crisis.

Don Willemsen

Don is a senior in Electrical Engineering with special interests in the biomedical applications of the field. He is presently the circulation manager for the SE and will be the editor for the next issue. This is Don's second year on the staff.

Art Baldwin

Art graduated last spring with a degree in Mechanical Engineering. He plans on doing grad work at U. of M. Art was awarded first place for this article in a writing contest sponsored by the Society of American Value Engineers.

FROM THE STAFF

An Open Letter To Our Readers

The **SPARTAN ENGINEER** is striving to serve and to satisfy its readers. To achieve this, the staff wishes to take this opportunity to welcome your comments, criticisms, and suggestions. Forward your ideas to either Room 144 or 210 in the Engineering College.

To offer a breath of freshness, the **SPARTAN ENGINEER** is planning new features.

LETTERS TO THE EDITOR:

All letters must be signed, typewritten, double-spaced, and must not exceed 250 words. The editorial staff reserves the right to edit any letters, which become the property of **Spartan Engineer.**

Deadlines for the next three issues are: December 1, February 1, and April 1.

PUZZLE PAGE:

Beginning with the next issue, a $5 cash prize will be awarded to the first engineering student (Undergraduates only) to complete the puzzle page. Staff members are not allowed to compete.

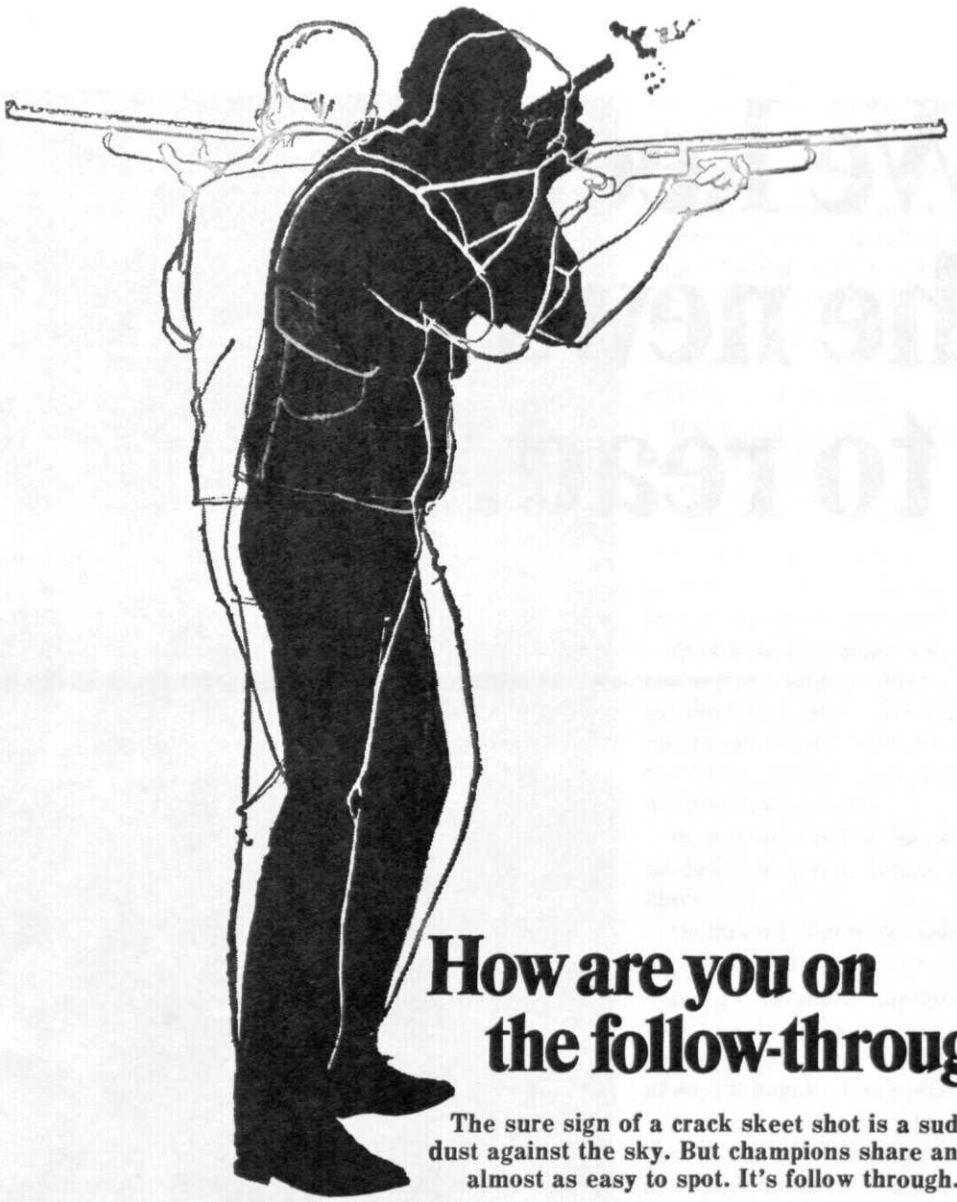
The puzzle page may appear in one issue as a crossword puzzle. In another issue as a set of riddles; or as a group of math.-puzzlers, etc.

Time of answer entry will be recorded by Mrs. Richburg in Rm. 210 E.B.

Solution accuracy, clarity, and logic will be determined by the editorial staff.

AUTHOR PAGE:

We'd like to give more acknowledgement to anyone who writes a feature article for us with a picture-byline recognition. We'd like to make you more of a "somebody."



How are you on the follow-through?

The sure sign of a crack skeet shot is a sudden puff of clay dust against the sky. But champions share another mark that's almost as easy to spot. It's follow through.

Like the top-flight skeet shooter illustrated here, our tapered roller bearing and steel engineers get results because they follow through, too.

How about you? Do you want a company that involves your interest and keeps you involved till the finish? That promotes from within? Are you up to the demands thrown our way by the automotive, construction, aerospace and chemical industries? Do you have your sight set on the future—on a company like ours that has a $221 million expansion and modernization program?

Then write to our Manager of College Relations. And tell him you'd like to take a shot at it. 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.

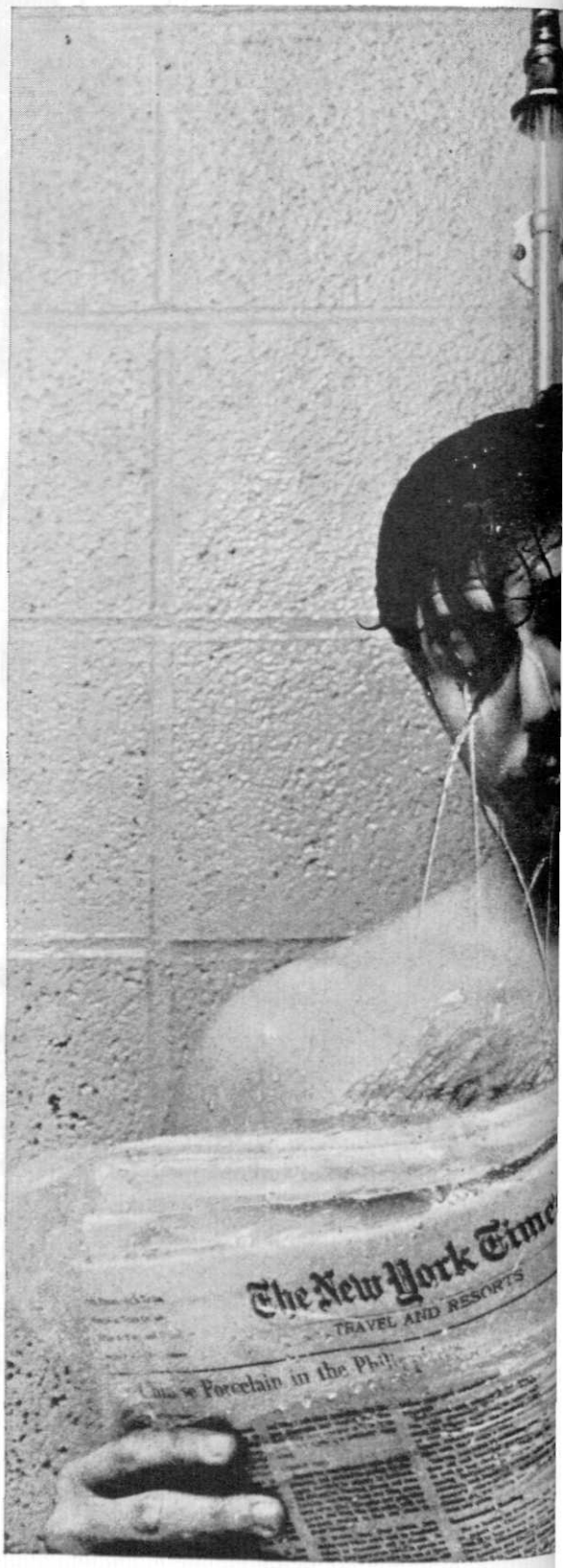
An Equal Opportunity Employer (m/f).

TIMKEN®

REGISTERED TRADEMARK

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

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.

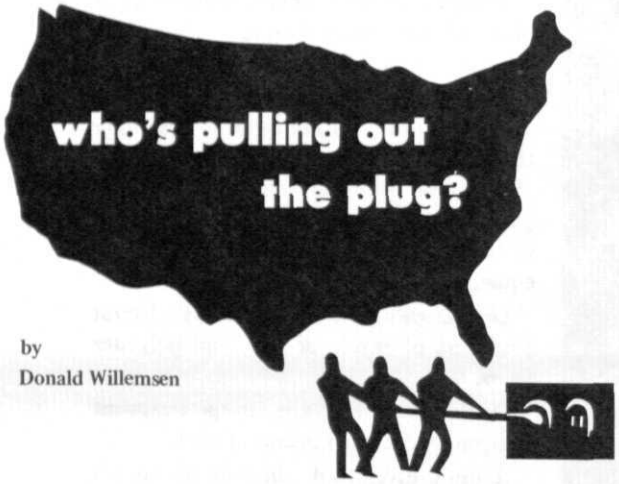
If doing worthwhile things is your bag, write or ask your placement director for the descriptive brochure "Careers with FMC." FMC Corporation, Box 760, San Jose, California 95106.

We are an equal opportunity employer.

fmc CORPORATION ®

FMC CORPORATION

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



by
Donald Willemsen

Who turned out the lights? Many New York residents were asking that very question in November of 1965. The Great Blackout has caused considerable concern over recurrences of power shortages. The apprehension of an elevator stopping between floors or the subways darkened and silent has brought the public wrath down on electric companies, and the federal government is watching and supervising to protect the consumer.

Since 1965 however, there have been numerous blackouts and brownouts mainly in the Northeast and Middle Atlantic states. On June 6, 1967 at approximately 10:22 A.M. power was lost in New Jersey, Pennsylvania, Maryland, and Deleware.[1] See Fig. 1.

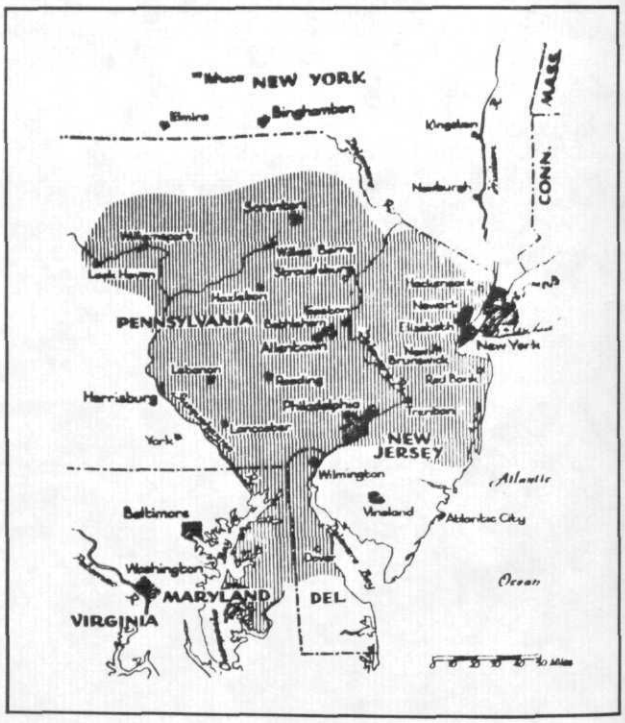


Fig. 1

13 million people were without the rythmic pulse of electricity and once again the mighty East was paralyzed. Power was restored in Philadelphia after two and one half hours, and in Montclair, New Jersey at 7:30 P.M. Ironically the PJM—Pennsylvania, New Jersey, and Maryland, system was unable to handle an overload. Yet, it is supposed to back up Connecticut Edison which furnishes power to metropolitan New York.

In September of 1970 blackouts were reported in Maryland, New Jersey, Deleware, and Pennsylvania.[2] Brownouts, which are caused by cutbacks in power output are still common on hot summer or cold winter nights in the megapopulus of metropolitan New York.

Electric companies are striving to alleviate Blackouts and brownouts but are being hampered by the public, states, and Federal government. Connecti-

cut Edison has had inumerous problems with environmentalists and the Federal Power Commission. First of all, to satiate the avalanching need for power Connecticut Edison has interconnected with other electric power systems to acquire reserve power during peak load periods. Although not a solution, the intersystem connections reduce power shortages, and new plants are under construction to meet consumer needs.

Construction of a nuclear power plant on the Hudson River at King's Mountain have been suspended due to public fear of radioactive emissions into the river.[3] The same type of public harassment has caused suspension of construction on many nuclear power plants. If the ecologists would look at the Atomic Energy Commission's report on nuclear plants they might realize the plants are not so harmful afterall. Atomic Energy Commission regulations state a nuclear power station may emit no more than .5 rad./hr. of cesium. The actual discharge from power plants is one thousandths .5 rad./yr.[4]

Consumers Power of Michigan has gone so far as to monitor the temperature of water discharged from its Lake Michigan plant to prevent excess heat from harming marine life. Many people fear radiation because, they are usually subjected to literature showing adverse effects caused by overdose. Have you ever had an X-ray? You are being subjected to radiation there too.

Nuclear plants are also cleaner and easier on the environment in comparison to the out moded coal and oil burning, sulfur dioxide emitting, power plants. They are also cheaper in the long run, which is an added bonus by saving the consumer from exorbiant rate increases necessary to build and operate large coal and oil plants.

Many other electric companies have taken strides to form a grid of power interconnections in different areas of the country. The major systems are shown in Fig. 2.[5]

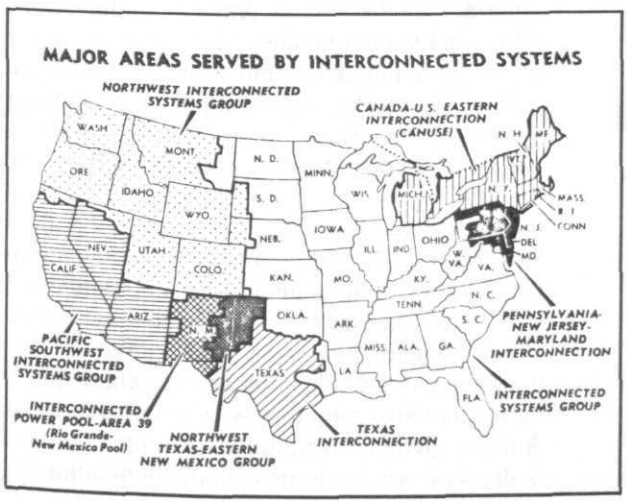


Fig. 2

Detroit Edison and Consumers Power have created the Michigan Electric Power Pool Control Center, MEPPCC. The essential operation of the pool is carried out by two General Electric computers located in Ann Arbor, the pool's headquarters. The computer monitors 260 critical points in power plants, at interconnections, and at terminals of key transmission lines. These points are scanned every second, and unusual conditions are instantly reported to the center. The pool controls

- individual generators
- power supply systems of the two member companies estimating daily load requirements
- regulating energy transactions between the members of the pool and accounting for such transactions.[6]

Although new plants and power pools will probably eliminate power shortages there is still work to be done.

According to Robert Sherrill in his article "Power Play" in **Playboy**, May 1971; The ultimate power capabilities of the nation are untapped, and with a national power grid less failures would occur. The system would require interstate flow of electricity. Operation of the system would follow the procedure of present power pools with the West supplying electricity during peak loads in the East and vice a versa. This is easily accomplished because, the West has a 27% surplus when the East is loaded down.

Since power companies make their greatest profits when equipment is running at its maximum, plants could be run at maximum unless overload is feared, and then reserves could be called upon to relieve the strain. With a national power grid nights could be getting brighter!

REFERENCES

1. N.Y. Times. June 7, 1967, 1:2.
2. **Ibid.** September 23, 1970, 1:1.
3. **Ibid.** November 18, 1965, 53:1.
4. **Chemical Engineering.** February 23, 1970, 57-58.
5. N.Y. Times. February 8, 1970, 61:1.
6. Michigan Electric Power Pool Control Center, Mimeographed copy, p. 4.

THERE ARE 30,000 "UNINVITED GUESTS" ON THIS BOAT.

Barnacles. They're uninvited—and expensive. So a new hull is being tested that could keep them at bay. And nickel's helping make it happen.

Shrimp boats are a-comin'—out of a harbor at S
Juan del Sur, Nicaragua. And one of them is unlike a
other work vessel in the world.

It has a new kind of experimental hull designed
fend off barnacles and other drag-producing mari
growth *permanently*.

The Copper Development Association, sponsor
the project, estimates that the new hull material cou
reduce fuel consumption by as much as 15 to 20 perce
And, by totally eliminating hull scraping and paintin
could slash maintenance costs up to 80 percent.

Most impressive of all, though, may be the savin
that come through improved efficiency. At present,
example, a slowdown of even one knot because of botto
fouling can cost a big tanker as much as $4,000 a mon
And the loss of five profitable working days for a layo
in drydock can mount up to $100,000 or more.

The new hull is a time-proven marine alloy of cop-
per and nickel. It's the copper, really, that's anathema
to the barnacles. The 10 percent of nickel is there to
make the metal easier to weld and form, to give it the
necessary strength, and to help protect it from pitting
and corrosion.

Just as our metal is a strong helper, one that im-
proves the performance of other metals, so International
Nickel is a helper.

We assist dozens of different industries all over the
world in the use of metals. We offer technical informa-
tion. And the benefit of our experience. Often, Inco met-
allurgists are actually able to anticipate alloys that will
be needed in the future, and to set about creating them.

This kind of helpfulness, we figure, will encourage
our customers to keep coming back to us.

And that helps all around.

The International Nickel Company, Inc., New York, N.Y. The International Nickel Company of Canada, Limited, Toronto. International Nickel Limited, London, England.

Test boat with copper-nickel hull.

INTERNATIONAL NICKEL HELPS

notes & news

Do corporations care?

Of course they do. WE certainly do! We have to operate profitably—that is, *successfully*—or we'll go broke, which would not be good news to more than 120,000 employees or their families. But there's a lot more to it. For example: caring for employees' health and safety; protecting the environment; hiring, training, and seeing to the progress of minority group members; contributing to civic betterment. It's good business to be a good corporate citizen.

Mindful mining

Mining and quarrying operations must be conducted in a manner mindful of Environment as well as Efficiency. We've always been an industry leader in modern technology and worker safety; today, similar attention is lavished on reclamation, conservation, reforestation, and waste water treatment. This is no idle boast; doubters are regularly invited to tour our mining operations.

Continuing education

At last report some 3,100 salaried employees of Bethlehem Steel were taking or had taken college-level courses at company expense under our Educational Assistance Program.

Ships ahoy

From Sparrows Point to San Pedro to Singapore it's full speed ahead for Bethlehem's Shipbuilding Department. We're at work on the largest shipbuilding basin in the U.S.—to accommodate vessels of up to 300,000 deadweight tons; we have orders for 120,000 deadweight ton tankers; we recently completed the country's biggest drydock, in San Francisco.

Don't belittle benefits

An average U.S. worker gets "fringe" benefits worth about 25% of his regular pay, according to a recent survey. Bethlehem is a leader in this area, providing life insurance; disability benefits; Blue Cross, Blue Shield, Major Medical; minimum of 9 paid holidays; liberal vacation and pension plans, and more!

Computer quiz

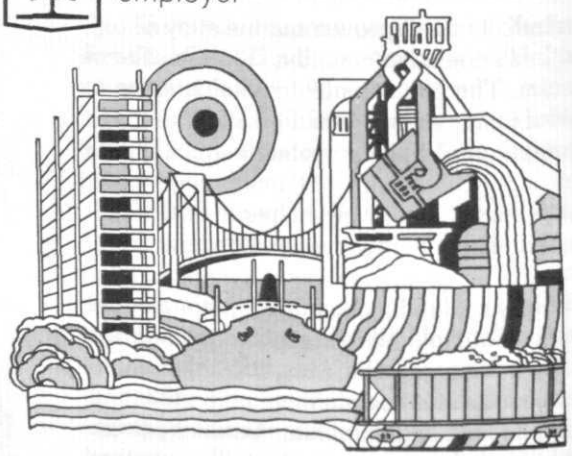
How many computers do we operate? Answer: Currently, about fifty, operated by 1,300 data processors.

Study up

A wealth of information appears in our booklet, "Bethlehem Steel's Loop Course." A copy is available in your placement office. If what you read appeals to you, sign up for a talk with our representative when he visits your campus. Bethlehem Steel Corporation, Bethlehem, PA 18016.

BETHLEHEM STEEL

an equal opportunity employer



Essay Contest:

PRIZES AND PUBLICATION

by Alan G. Hoffman

Writing essays is a distasteful experience for many engineering students. That may explain why so few write for **Spartan Engineer**. Yet writing is such a practical way to influence people.

Writing is a craft; it can be learned. It takes practice and patience. Patience in the sense of painfully cutting out the gobbledygook.

Spartan Engineer would like to give you the chance to practice writing and to earn money at the same time. We'd like you to enter our contest.

The conditions are: (1) only engineering undergraduates may enter; no staff member of **Spartan Engineer**, faculty member, or graduate student may enter an essay; (2) the essay must not exceed 2500 words; (3) each entry must be typed double-spaced; (4) each contestant must include their name, address, telephone number, and signature on **three copies** of the submitted essay (zerox is okay); and (5) the essay must deal with any one of the following topics; (a) The Engineer and Society; (b) The Professional Engineer—A New Image for a New Age; (c) Engineering Education and Professionalism.

The **contest deadline is November 23** (Tuesday), 5:00 p.m. in Rm. 210 Egr. Bldg. (Mr. Hoffman's office).

The first place winner will be awarded $50.00 and have his essay reprinted in the December '71 issue.

The second place winner will be awarded $35.00 and have his essay reprinted in the February '72 issue.

The third place winner will be awarded $20.00 and have his essay reprinted in the April '72 issue.

A panel of three faculty members, to be chosen by the **Spartan Engineer** editorial staff, will judge all entries with a standardized ballot constructed for this contest. Weighted scores will be used for content, expression, and documentation. The minimum score possible is 18, with a maximum of 72.

In the event of a tied score, the faculty advisor for the **Spartan Engineer** will cast an additional ballot to decide the winner.

Material must be original and unpublished, as all essays submitted become the property of **Spartan Engineer**.

Fundamentally, good writing is the result of clear thinking. Unfortunately, too many of us cloak our thoughts in obscure expressions. According to educator, Jacques Barzun, the common man has sought to dignify his work and social status by acquiring complex terms to describe rather simple things. This has led to a decline in his ability to communicate. There is no quarrel with a specialized vocabulary which states precisely what is meant. Precision makes for clear communication. So the basic question remains: "Will the words I used achieve the communication I desire?"

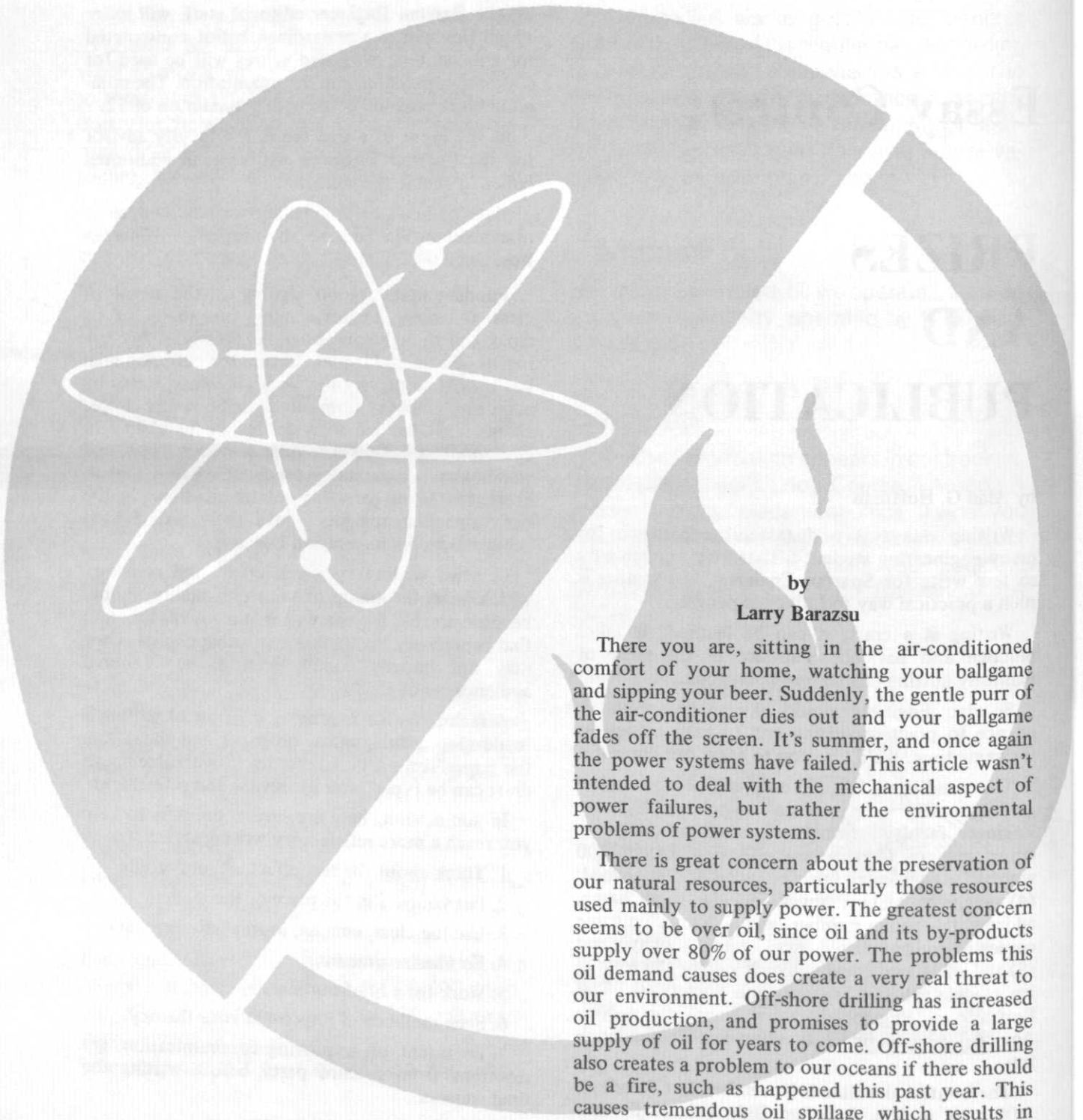
Creative writing (personal effort and revision), which bears the stamp of your personality, should be pleasureable for the writer and his reader. And that is precisely the weakness of using cliches. They may not impede communication, but a bored audience is not alert.

A technique for improving the flow of writing is to develop a full outline on paper and then "talk the paper" into a tape recorder. A workable rough draft can be typed later for review and refinement.

In summation, here are several pointers to help you reach a more satisfactory writing style:

1. Think about the real effect of your words.
2. Put yourself in the place of the reader.
3. Use the clear, concise, journalistic approach.
4. Emphasize precision.
5. Work for a brief outline.
6. Seek methods of improving your fluency.
7. Be intent on improving communication; get reactions from a third party before writing the final version.
8. Avoid worn-out expressions.

OUR TROUBLED RESOURCES



by

Larry Barazsu

There you are, sitting in the air-conditioned comfort of your home, watching your ballgame and sipping your beer. Suddenly, the gentle purr of the air-conditioner dies out and your ballgame fades off the screen. It's summer, and once again the power systems have failed. This article wasn't intended to deal with the mechanical aspect of power failures, but rather the environmental problems of power systems.

There is great concern about the preservation of our natural resources, particularly those resources used mainly to supply power. The greatest concern seems to be over oil, since oil and its by-products supply over 80% of our power. The problems this oil demand causes does create a very real threat to our environment. Off-shore drilling has increased oil production, and promises to provide a large supply of oil for years to come. Off-shore drilling also creates a problem to our oceans if there should be a fire, such as happened this past year. This causes tremendous oil spillage which results in damage to the wildlife of the area.

COST VS ECOLOGY

Another treat to wildlife comes in the form of the Alaskan pipeline. Conservation officials fear this pipeline will cut the migratory path of the caribou. A rupture in the pipeline could send millions of gallons on to the tundra, destroying everything on these frozen plains. Damage such as this seems unnecessary, considering there is another route for this pipeline, which doesn't cross plains that are susceptible to earthquakes. Ecologists support the new route, since it is safer. The oil companies feel the excess cost makes this route impractical.

A solution to this might be to save the oil in Alaska, and increase import quotas of foreign oil. Then when a real need for this oil arises, it can be put to use.

Natural gas, a by-product of oil production, is another major source of power. It is clean burning, which means there is almost no pollution resulting from it. There is enough of it to insure its use for years to come. But a fuel such as this, is not without its drawbacks.

The major drawback is transporting the gas. Many gas companies won't even attempt to utilize new sources of natural gas, unless the field is guaranteed for at least five years. The cost to pipe it out would be prohibitive unless the field is able to supply gas for this period.

Another problem is natural gas is difficult to store, unless it can't be kept above ground. Another problem is that it varies greatly in quality. This means that not all large natural gas supplies can be utilized fully if it is poor quality gas.

COAL, AN ECOLOGICAL HAZARD

A leading supplier to power of the fossil-fuels is coal. Coal also varies in quality, and is found virtually all over the world. Experts estimate that there is enough coal on the earth now to meet the needs of people for thousands of years. But the use of coal results in the production of large amounts of air pollution. This is, perhaps, the main reason that coal is undesireable as a source of power. But if an effective system of filters for smokestacks could be developed in order to insure a minimal amount of air pollution, caused by the burning of coal, this would make coal a most desireable fuel for power.

One problem which is just starting to emerge concerning coal, is the use of strip-mining. This method of mining destroys the landscape of the area mined, by digging holes several miles wide and several miles deep. This destruction of the landscape aids erosion, which in turn leads to a barren, sterile, wasteland. Imagination must be used to restore this scenery after the mining has been completed. Such things as artificial lakes, parks, and winter ski slopes, have risen from the remains of strip-mines. But it takes money and effort to restore such areas. Without this concern, many mines will be left as huge scars on our landscape.

Hydroelectric plants are another source of controversy. Conservationalists dislike the idea of dams in areas such as the Grand Canyon. When the water backs, the covered land is lost, and so is some of our natural beauty. However, the need for electricity is so great, one has to sacrifice something. If not a hydroelectric plant, then fossil fuels. But fossil fuels are guilty of air pollution. To avoid these one has to turn to a completely new source of power, nuclear power.

IS NUCLEAR POWER THE ANSWER?

Nuclear power plants have the potential to supply the power needed, while at the same time keeping pollution problems to a minimum. Although not without its problems, it does seem to be the most promising with regards to the environment.

Thermal pollution was the first problem to be attacked, and somewhat successfully. The hot water from the plants cannot be disposed of by dumping it back into the stream or lake it was taken from without serious damage to aquatic life. Devices used to solve this problem are cooling towers. They use a closed cycle to recirculate the water. The design is aided by meteorological date of the area to minimize the effects on the atmosphere caused by the towers. Such effects are fog, and drift, small droplets of water. This doesn't seem quite as bad as dirty air, and this could possibly be controlled even more.

There is another problem, that of radiation leakage, and what to do with the radioactive waste. First, radioactive leakage is not as terrible as it seems. The power plants are strictly regulated by the government, and any plants emitting excessive radiation will be made to correct the situation before it becomes serious. The problem of disposing of radioactive waste is more difficult. The waste can remain dangerous for several hundred years, and is usually buried deep in the earth. In order to avoid this, we will have to develop a nuclear power plant that can utilize more of its radioactive source.

It seems that the solution to saving our environment lies in developing nuclear power. The others seem to put too much of a strain on our resources, resources which we will need for the future to help maintain the quality of life we now have.

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.

ST.JOE
MINERALS CORPORATION

250 Park Avenue, New York, New York 10017, Tel. (212) 986-7474

CREATIVITY IN VALUE ANALYSIS

by Art Baldwin

As stated by Von Frange (7), "creativity stems from discontent with the present." Having worked approximately 16 hours per week, for the past 3 years at St. Lawrence Hospital in Lansing, I have had an opportunity to witness and feel such a discontent with the exorbitant health care prices.

Last spring, a private room at St. Lawrence cost $35.00 per day, just for the room (5). With drug and treatment fees, the hospital bill can easily range from $60.00 to $125.00 per day (5). By the year 1980, the Reader's Digest projects that bills could reach $200 per day. Note that these quoted figures exclude the doctor's independent fee. One example of the exorbitant prices is aspirin. In the hospital a patient is often charged $1.00 for two aspirins (5). Normally this amount would buy 100 aspirins. Equipment also costs unseemly amounts. A set of 18 surgical clamps and scissors costs $1,000 (2). And an X-ray machine which ten years ago sold for $10,000, today costs approximately $45,000, both performing the same function (3). In general, however, the major factors for hospitalization costs are due to five factors:

I. DOCTOR'S FEES:

a) The fees could be lower if trained assistants performed some of the minor tasks that the doctors now do. In the emergency room, for example, it is the procedure for an M.D. to spend part of his time suturing minor wounds which an attendant could perform equally well. A typical emergency room suturing of a child's forehead could result in a bill which reads (5):

E. R. charge –	$12.00
Doctor's fee –	40.00
Total	$52.00

An attendant could perform the same 20 minute task for $10.00. The first doctor's attendant program has recently opened at Duke University, teaching the minor doctoral details. This program would free the M.D. for more productive employment of his time.

b) The fees assessed by doctors could be lower if his fees were listed, creating a more competitive environment among community physicians. At the present time, patients are given little prior information about the amount of a hospital surgical bill. He is merely presented with a "Permit To Do

Surgery" a few hours before his scheduled operation. This signed permit is an agreement to pay all fees. On occasion, some doctors do not even inform their patients of their plans in surgery—he is too busy for such details. As a result the patient is left uninformed and in a predicament. What can he do? He is ill and has no idea of which doctor would give him better service for the money. The fee predicament then could be solved by increased competition through listing of fees or by public pressure to reform their billing practices.

c) The fees assessed by doctors could also be lower if nurses were allowed more freedom to administer aid or if standing orders were allowed. Currently, nurses must waste time trying to contact doctors to see if a patient can have even the simplist services like food, aspirin, shower, enema, etc.

II. DRUGS:

The prices of drugs are partially controlled through the government and pharmaceutical firms. Mark up is made in the hospital for extra profit.

III. EQUIPMENT:

a) Too much emphasis is placed on modernization of equipment rather than on function. For example:

Item	Cost	Year	Functional Change
X-ray Machine	$10,000	1960	Current
X-ray Machine	45,000	1970	None

The item above exemplifies replacement of functionally identical equipment, replaced only to keep current with minor technological changes.

b) More emphasis should be placed on competitive buying of equipment. St. Lawrence has bought wheel chairs at the price of $250. Surely chairs with wheels can be manufactured at lower costs. Every metallic part on these chairs is heavily chrome plated even though the parts have no contact with body **salts or moisture**. Most patients have expressed a desire to cut corners on the "chrome" in the hospital and save on the hospitalization expenses.

IV. THE BUILDING ITSELF:

a) Less of a prestige approach should be taken in hospital administration. People need medical care. Esteem value, in the form of the "largest" or "most modern" or "most beautiful" or "entirely professional staff" which are motivation factors to hospital administrators, is not needed to attract patients.

b) St. Lawrence Hospital was originally built on a small restricting lot within the confinements of the city. Now the administrators are considering destroying the original structure in order to build a larger more accomodating building within their limited ground area. If foresight had been used to anticipate present needs, the destruction of a structure with twenty years of useful service left, would not be necessary.

Original Cost of Structure	$1,000,000
Accrued 50 years	
New Thirty Years Old	
Loss to Structure	400,000 (1)

V. HOSPITAL PERSONNEL:

a) The largest single apparent factor of cost is a gross waste of time. From my observations, a nurse, technician, nurse aid, or orderly can complete their work in 2½ hours. The remaining 5½ hours is idle time—about the same ratio that existed 40 years ago but with modern costs and wages—quite unlike the manufacturing industry which has partially offset rising costs with increased production per man hour through better scheduling, smoother flow or assembly products and ever faster machines. In hospital nursing, however, scheduling and productivity have not changed. The current 24 hour work schedule in three 8 hr. shifts, 7:00 a.m. to 3:00 p.m., 3:00 p.m. to 11:00 p.m., and 11:00 p.m. to 8:00 a.m. is:

8:00 a.m. to 10:00 a.m.	Pass medicines Give patients baths Change bed linen Change water pitchers
8:00 p.m. to 10:00 p.m.	Pass medicines Straighten Beds Change water pitchers
Night Shift	Miscellaneous patient care

One reason for the above schedule is to accommodate visitors who visit from 11:00 a.m. to 8:00 p.m. at St. Lawrence Hospital. If alternating visiting hours could exist for patients who receive baths and linen change in the afternoon and evening on a new work sequence could exist:

8:00 a.m. to 11:00 a.m.	Pass Medicines Change water pitchers
12:00 a.m. to 3:00 p.m.	Change bed linen for group No. 1
3:00 p.m. to 6:00 p.m.	Change bed linen for group No. 2
7:00 p.m. to 11:00 p.m.	Pass medicines, straighten beds, and change water pitchers

Note that the above work schedule provides for three times the number of working hours. This implies that approximately 1/3 of the personnel staff is needed, accomplished by dividing the patients into two groups, spreading the work throughout the day, and having alternating visiting for morning, afternoon and evening. In this way, the private work on patients can be accomplished without cutting their visiting hour time.

Currently the personnel wages are:

Registered Nurse	$3.80 per hr.
License Practical	2.80 per hr.
Technician	2.30 per hr.
Orderly	2.10 per hr.
Nurse Aid	1.80 per hr.

On the new work schedule, the hospital could save $960 per day, based on St. Lawrence's current staff level.

b) Currently the hospital provides no wage incentives. If wages incentives were provided by encouraging personnel to learn a broad range of minor tasks in different departments, promotion to higher level jobs could be made. This would lower the high training costs due to a large turnover, which is rooted in low wages.

c) If the building were circular in the patient care sector, a closer contact could be kept with the patients with fewer personnel.

d) Efficiency could be increased if an overlap of minor skills between technicians, nurses, attendants, and house keepers existed to compensate for momentary load fluxes that sometimes place heavy demands on service.

SUMMARY

When approaching a social organization like medical care rather than industry, the value analysis applications are not so clear, i.e., functional value and esteem value become human quantities. For example a patient may want to have his bath in the morning rather than in the afternoon or evening. If creativity can be applied to staff scheduling, equipment, and costs in general, possibly the exorbitant prices can be reduced without undue inconvenience to the patients. The health care industry has for a long time been wasteful, largely because it had no need to be efficient—people always needed medical care and sacrificed the money to cover expenses regardless of the range. Now, this hog-like industry needs some creative control. It represents very much a challenge to human creativity and engineering value analysis.

Editor's Note: The above award-winning essay by Art Baldwin was edited to meet planning and cost constraints for this issue of **Spartan Engineer**. Great care was exercised in not making any substantial changes in the content or attitudes of the original author.

BIBLIOGRAPHY

1. Ackley, Clark A., Architectural Consultant.
2. Dr. Meade, St. Lawrence Hospital.
3. Miles, Lawrence, **Techniques of Value Analysis and Engineering**, McGraw-Hill Book Company, New York, 1961.
4. Osborn, Alex F., **Applied Imagination**, Charles Scribner's Sons, New York, 1963.
5. St. Lawrence Hospital accounting records.
6. The Reader's Digest.
7. Von Frange, Eugene K., **Professional Creativity**, Prentice-Hall, Inc., Englewood Cliffs, N.J., 1959.

A woman wrote the International Revenue Service asking if birth control pills were tax deductible. Their reply: "Only if they didn't work."

In an effort to sell his new invention, a totally ominiscient computer, the young engineer told his prospective buyer that it could answer any question he could dream up. As a test the skeptical businessman punched out the following question: "Where is my father right now?" Instantly, the computer read out the reply: "Your father is fishing in Canada."

Why this computer is a fake," replied the businessman, "My father has been dead for over five years." Positive his computer could not make a mistake, the engineer told the client to rephrase the question. "Where is my mother's husband," typed the man. "Your mother's husband has been dead for five years, but your father's just caught a three pound trout," replied the computer.

"I don't want any callers this afternoon," said the chairman of one of the university departments to his secretary.

"If they say their business is important, just tell them that's what they all say."

That afternoon a lady called and insisted on seeing him. "I am his wife," she exclaimed.

"That's what they all say," replied the secretary.

Then there was the engineer who started out on a shoestring and worked up till he got slapped.

The orator had held forth for a long time, his talk puntuated only by an occasional pause for a drink of water.

A man near the front commented, in a loud whisper: "First time I've ever seen a windmill run by water."

Over 100,000 accidents happen in the home every year.

Let's promote their prevention . . . Join planned parenthood today!

Next to a beautiful girl, sleep is the most wonderful thing in the world.

The day after finals a disheveled M.E. walked into a psychiatrist's office, tore open a cigarette, and stuffed the tobacco up his nose.

"I see you need help," said the doctor," startled.

"Yeah," agreed the M.E. "Got a match?"

Two mice were sent into orbit from Cape Kennedy.

First mouse: "I'm scared. This space travel is awful dangerous."

Second mouse: "Yeah, but it sure beats cancer research!"

A Mechanical Engineering Professor and a fine arts Ph.D. were chatting at a recent faculty tea. Said the arts professor, "I had a weird day Wednesday. I asked the class who wrote 'The Merchant of Venice' and one of them replied, 'It wasn't me, sir!' "

"Ha, ha," laughed the Engineering professor. "And I suppose the rascal had done it all the time."

M.E. "I'm grasping for words."

Coed: "I think you're looking in the wrong place."

He: "Please?"

She: "No."

He: "Oh, just this once?"

She: "I said, definitely not!"

He: "Oh, it won't hurt."

She: "I said definitely not!"

He: "Oh shucks, Mom, all the other kids are going barefoot."

Prof: "Well, is the theory clear to you now?"

Student: "Yeah, just as though it had been translated into Hindustani by Gertrude Stein and read to me by a tobacco auctioneer."

EE: "How can you keep drinking that coffee?"

ChE: "I take a spoonful of Drano every week."

Never milk a cow during a thunderstorm. If she gets struck by lightning, you'll be left holding the bag!

Selectee: "They can't make me fight."

Draft Board: "Maybe not—but they can take you where the fighting is and let you use your own judgment."

The whole truth of the matter is that women have cleaner minds than men because they change them so often.

You've got to hear $99.95* to believe $99.95.

Everybody's ads try and tell you their hundred dollar stereo sounds like a million bucks.

Don't you believe a word you read.

There's only one way to tell how any stereo sounds. Go listen to it. If it sounds like a million, your ear will tell you.

Take our hundred dollar stereo, for example.

Looks nice in the picture, right? Nice walnut grain feeling. Plenty of controls. Separate ones for bass, treble, stereo balance, and loudness. Headphone jack if you ever get into the headphone thing.

What you can't see is nice, too. 40 watts of peak music power. BSR automatic turntable. Diamond needle. But best of all, two 4" full-range air suspension speakers that really pour out the sound.

That's the Sylvania MM12WX.

But how do you know all this isn't just a lot of words? You don't. Until you go and hear it.

Once you hear it, you'll believe it.

GTE SYLVANIA

*Manufacturer's suggested retail price, Model MM12WX, $99.95.

HOW CAN A FOUR-INCH CERAMIC CYLINDER HELP PREVENT A MUGGING?

By itself, there's no way the cylinder we're talking about could prevent a mugging. Or any other crime.

But if you build a light bulb around it, it can. And has.

A few years back, General Electric engineers built a light bulb with a ceramic filament called the Lucalox® lamp. Then they built a streetlighting system to use it.

Purely as a feat of engineering, that was pretty good. Because it's the most efficient source of white light ever invented. It gives off twice the light of the best mercury system... without any extra electricity.

But, engineering aside, it's even better. When Lucalox went up in four of the highest crime areas of Washington, D.C., the crime rate went down for the first time in years. Down 32%. And we expect to hear similar figures from the more than 90 other cities now using Lucalox.

It's a clear example of how a technological innovation can help solve a social problem. A lot of times, the effect of technology on society is 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