Wisconsin engineer. Volume 83, No. 4 April 1979

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

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Volume 83, No. 4 April 1979

wisconsin engineer

The Split Over the Atom

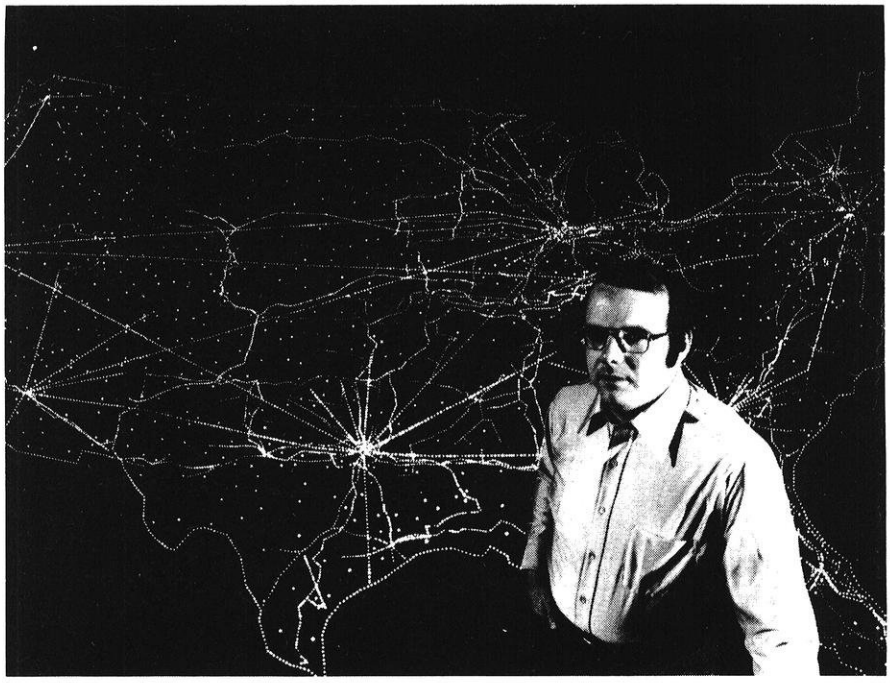
Don Hartman found a "model" way to troubleshoot the network.

The nationwide telecommunications network carries over 515 million phone calls on an average business day. Only a small number of them run into trouble, such as failing to go through the network, getting noise on the line, or being disconnected prematurely. Craftspeople in Bell telephone companies fix most of these problems quickly. But the causes of some can be difficult to find among one-billion-plus miles of circuits and thousands of switching offices.

For several years the Bell System used its computerized Network Operations Trouble Information System (NOTIS) to try to pinpoint those causes by analyzing trouble reports from all over the country. NOTIS was good. But Bell System managers wanted it to be better, more precise in identifying possible trouble spots. And they wanted the data in compact, easy-to-use form.

We assigned a new employee, Don Hartman, to improve NOTIS. Don came to us with a B.S. from the University of Texas and an M.S. and Ph.D. from Massachusetts Institute of Technology. He and his associates developed a second-generation system (NOTIS II) that does the job superbly.

For the new system, Don developed a mathematical model of the telecommunications network, including 28,000 local and long-distance switching offices and nearly a half-million circuit groups. Don also designed the system software and served as a consultant to the team of Bell System programmers assigned to the project.



Each day trouble reports from the entire country are sent to the NOTIS II center in Atlanta. Overnight, the system analyzes the reports, processes them through the network model, and discerns trouble "patterns" which help identify potentially faulty equipment. By 8 a.m. the next day, via data links, analysts at phone company service centers receive information on troubles traceable to circuits or switching equipment in their territories. Result: Better equipment maintenance. And better service.

With NOTIS II up and running, Don has moved on to other projects. Today he's a supervisor with broad responsibilities for planning the telecommunications network of the future.

If you are interested in exploring equally challenging employment opportunities at Bell Labs, write to:

Director of Technical Employment
Center 831 EM
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Murray Hill, N.J. 07974

Bell Laboratories

From Science: Service

wisconsin engineer

PUBLISHED BY THE ENGINEERING STUDENTS OF THE UNIVERSITY OF WISCONSIN-MADISON, APRIL 1979

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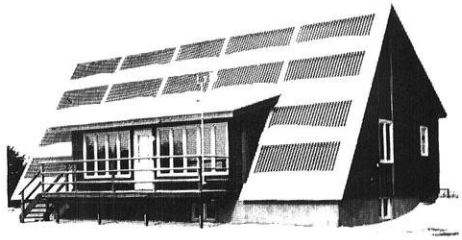

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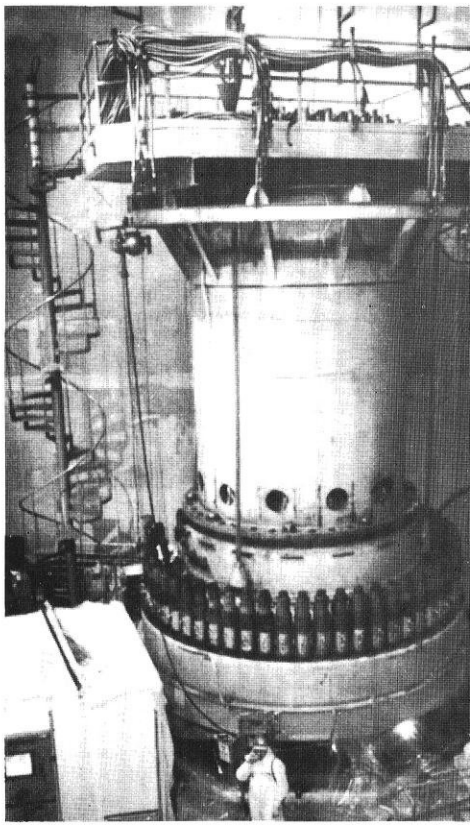
Charter Member of Engineering College Magazines Associated. Chairman: John W. Marshall, University of Southern California, Los Angeles, CA 90007.

Publishers Representatives: Littell-Murray-Barnhill, Inc., 1328 Broadway, New York, NY, 10001 and 221 N. LaSalle St., Chicago, IL 60601.

Published five times a year: Oct., Dec., Feb., April, June, by the Wisconsin Engineering Journal Assn.

Three Mile Island



As we go to press, the Three Mile Island accident is grabbing headlines and making new anti-nuclear converts out of a lot of fencesitters. Perhaps it is stating the obvious, but it is clear that this will be one of the most significant developments for the future of nuclear power throughout the world. The best that the proponents of nuclear power can do is curse the sensational press coverage that the accident is receiving and suggest that the seriousness of the situation has been exaggerated. Meanwhile, the ranks of the anti-nuclear forces are feeling vindicated in their claim that it was only a matter of time before just such an accident would occur.

In Madison, opponents of nuclear power were on the streets almost as soon as the news was out, throwing up a picket line in front of the offices of Wisconsin Power and Light (see photos on page 17). That same day saw the pro-nuclear forces that had been distributing leaflets warning about possible misinformation in the film *The China Syndrome* conspicuously absent from the post they had set up in front of the theater showing the film. Everyone has an opinion on the matter, and those opinions are charged with emotion. The consensus seems to be that, "It just goes to show that you can't design for human error. Maybe we're better off spending more money and going with some other source of power."

One thing that is certain is that in the wake of the Three Mile Island incident no electric utility company is going to be able to propose construction of a nuclear power plant without expecting to meet even stiffer opposition. Safety regulations will certainly be tougher. The economic picture for the power companies is surely going to change. By the time the legal and insurance entanglements are straightened out, the price of the electricity that the Three Mile Island plant generated is not going to be considered cheap.

UPI Photos

The infamous Three Mile Island Nuclear Power Plant

editorial

by Bill Bridgers

"Technology is the primary source of human alienation and engineers are the primary source of applied technology."

"Who the hell cares about all this - all I want to do is get a goddamn degree in engineering."

Grafitti from the bathroom walls of the U. W. Engineering Library

A quote from one of the great literary or scientific minds of the century could not sum it up any better. Technology and the profession of engineering are under attack. The engineers and technologists have been blamed for many of the problems that society now faces. Their response has usually been a booming "So what?". However, engineers can no longer confidently shrug off the opposition. The public skepticism about a technologically-produced utopia on earth has grown into a movement that has thwarted some of the technologists best-laid plans.

The debate over the future of nuclear power has become the focal point of the struggle between "high technology" proponents and the "anti-technologists." The war is escalating. As a magazine editor, I am literally bombarded with opinions on the nuclear issue. I am certain that it will be one of the key political issues of the 1980's.

With all of the information and misinformation that bounds on energy matters these days, what light can the *Wisconsin Engineer* possibly shed on the nuclear power controversy? I was somewhat reluctant to join the fray by devoting an issue of *Wisconsin Engineer* to the subject. Yet, we have a rather unique vantage point being located on a college campus that has a reputation for political activism. Within our microcosm, all positions are well represented and the research that is conducted here will determine what technologies and energy sources we will use in the future.

As a catalyst to the debate, the *Wisconsin Engineer* is reprinting Llewellyn King's address to the London Uranium Institute. The *Daily Cardinal,* which has editorialized strongly against further nuclear power development, and the student chapter of the American Nuclear Society were invited to respond to King. The remaining articles are meant to serve as complements to the ideas raised in this debate. Our aim is to provide our readers with information on matters related to the nuclear controversy. The opinions expressed in these articles do not necessarily represent the views of the editors.

I am intentionally refraining from taking a definite editorial stance on the nuclear power debate. While there is undoubtedly a stronger pro-nuclear sentiment on the engineering campus than elsewhere at U.W.-Madison, it is by no means unanimous or without reservations. As engineers, we will be the designers and manufacturers of technology, regardless of what forms it may take in the future. We are questioning and thinking, too. The articles that follow present you with a sampling of the information and opinions we must consider.

Wisconsin Engineer welcomes your response to editorials and stories.

business cents

by Sue Blockstein

I thought I'd use my space this issue to talk about what the *Wisconsin Engineer* staff is doing.

One big event that is coming up is the national Engineering College Magazine Association convention. This year it is being held at the University of Notre Dame. Since it is so close to us, we are taking eight staff members as well as our advisors. The convention includes speakers and workshops on editing, layout, and advertising sales, as well as parties and a chance to meet students from all over the country. Hopefully, everyone will return full of enthusiasm and new ideas.

Another project in the future will be our EXPO exhibit. The magazine goes back to 1896. We have bound copies of every issue since then. Using this information we will do an EXPO exhibit on "The History of the College of Engineering." These old issues are fun to look at. If you are interested in seeing them, stop on up to our office at 460 Mechanical Engineering any afternoon.

We are always looking for people to help with the magazine. Please give us a call at 6-2625, 262-3494 or stop in, if you are willing to help.

polygon

by Nikki Abramof

Once again, the St. Patrick's Day all engineering party was a roaring success At the party, in addition to all of the beer drinking that went on, winners of the "St. Pat was an Engineer" Basketball Tournament were announced. The winners were:

Men's Division: Bernoulli's Boys
Women's Division: SWE

Congratulations teams.

Polygon would like to extend thanks to all of the departments and societies who helped to support the activities. And thanks to everyone who participated – you're the ones who made it a success.

This spring Polygon will be selling University of Wisconsin - College of Engineering jackets. Red windbreakers with the University of Wisconsin - College of Engineering emblem in white on the front will be available through your Polygon representative for $10. Look for them around mid-April.

We're no. 1

Wisconsin tops Notre Dame, USC, Ohio State

Dave McClain would surely like to boast that, but unfortunately it's not football. Nevertheless, we think we have something to crow about. *Wisconsin Engineer* took top honors as the Best All-Round Magazine at this year's convention of the Engineering College Magazine Association. In addition to the top award, WE received five other awards in layout, cover design, and features categories. Thanks to all who worked so hard to make it possible.

ecma

Engineering College Magazines Associated

FIRST PLACE

has been awarded

WISCONSIN ENGINEER

in the Association's annual competition for

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ALL ISSUES

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Annual Convention, April 6-7, 1979

Photos by John Wardale

Sue Blockstein, business manager of the Wisconsin Engineer, *receives our top award (and a little special thanks) from Howard Schwebke, faculty advisor to* Wisconsin Engineer *and executive secretary of the ECMA.*

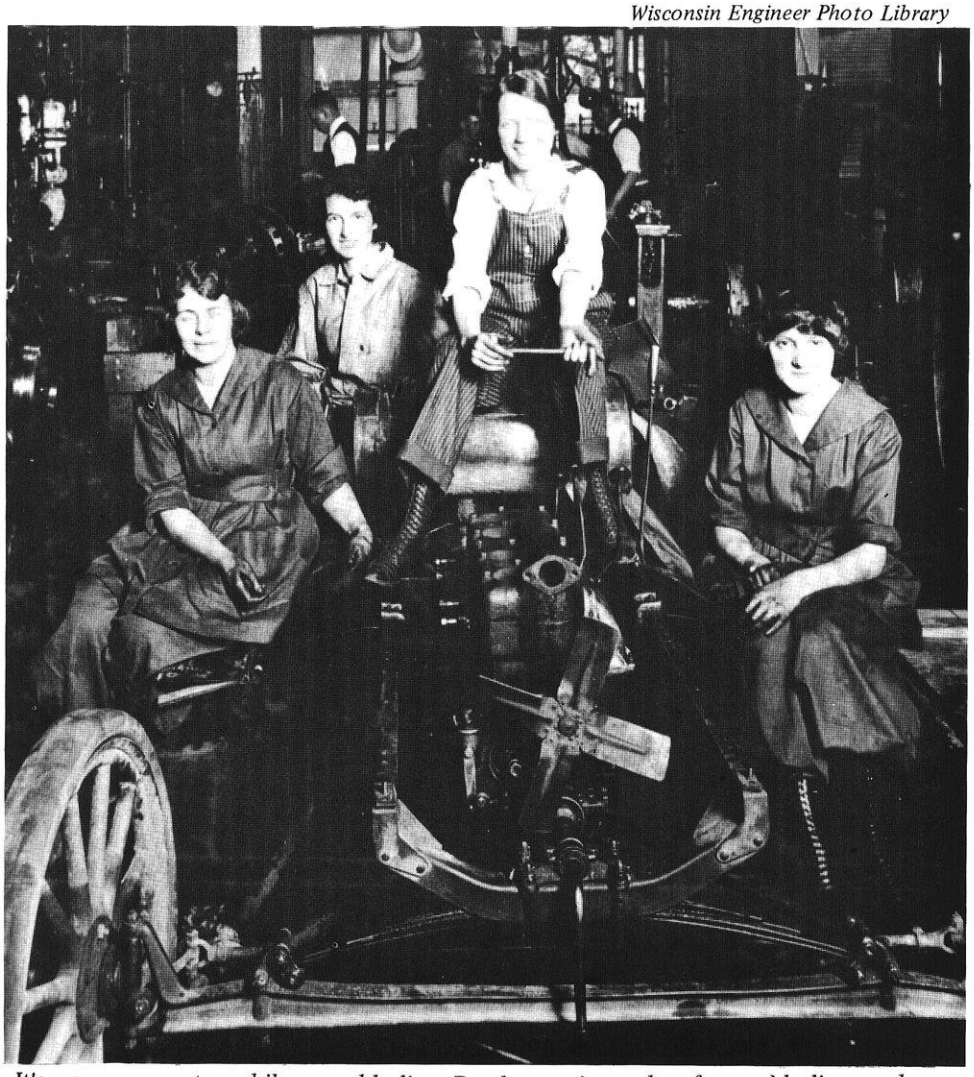
How long has this been goin' on?

the fight against technology

by Don Slavik

The nuclear power debate does not represent the first time in history that there has been public skepticism about the alleged benefits of some advance in technology. Don Slavik, a nuclear engineering graduate of UW–Madison and a regular contributor to the Wisconsin Engineer, *gives us his opinion on the history of resistance to technical advance.*

Wisconsin Engineer Photo Library



Women on an automobile assembly line. Do the routine tasks of assembly line work dull the mind?

The social attitude that is being called "anti-technology" is not a new phenomenon in American society. The impact of "anti-technologists," as well as that of technologists, has been felt since the early nineteenth century. It is the history of this anti-technology attitude, its origins and its present manifestations that are the subject of this article.

Early in American history, mechanization was well accepted here in comparison to the rest of the world. There were several good reasons for this in the early nineteenth century. The first reason was sociological; the American population was mechanically inclined, made up of independent yeoman struggling to improve their lifestyles with any and all available means. Any new technology that aided them was quickly accepted.

Second, there was a serious labor shortage in the United States at that time. Machinery was substituted for human labor wherever possible. Large amounts of capital were invested in labor-saving devices. There was little fear that mechanization would put great numbers of people out of work.

Third, the educational level of the general population was higher in the United States than in Europe. This increased worker's propensity to be innovative, to develop methods or devices which led to increased productivity.

Mechanization in the United States during the 1800's had two unique features when held in comparison to European developments. One was the standardization and interchangibility of parts. This resulted in the ability of non-skilled workers to construct, operate, and repair machinery. This had a great impact on all industries, including agriculture. Farmers could operate and maintain their labor-saving devices by themselves,

increasing their per capita productivity.

The second unique feature of American industry was the assembly line. The first recorded use of assembly line methods was not in Henry Ford's automobile factory, but rather in a hog-processing plant in Cincinnati in the 1830's. The assembly line speeded up the conveyance of materials, introduced mass production, provided for uninterrupted production. It also revolutionized organizational methods, increased the pace of workers and allowed employment of unskilled workers. Although the assembly line may have ignited the American economy, some say it has had a deleterious effect upon the average worker.

During the early period of mechanization in America, there were many critics of the system as it was evolving. Take for instance Sylvester Graham's attack on the bread making industry in the mid-1800's. During the nineteenth century, the production of bread was organized into an assembly line process. In order to obtain greater uniformity, flour was bleached with chlorine, which removed all the vitamins, too. To make the bread rise faster, carbonic acid was injected, which altered the flavor of the product. Advertising was used to make the public accept the new bleached white bread which had a very low nutritional value. Syl Graham was the first to question the adaptation of the new breads and flours for health reasons, worried of the possibilities of widespread malnutrition. He later developed the well-known "graham cracker" to provide an alternative source of nourishment. Graham was one of the first to point out that the relationships between people and organic substances were being altered by mechanization, sometimes for the worse.

Authors have always been quick to point out the changing relationships in our society caused by technology. Steinbeck described the effects of technology upon farmers in *The Grapes of Wrath* in 1939. In a chapter called "Tractoring Off," he describes the plight of a tenant farmer when the landowner goes to large-scale mechanization of the farm. Steinbeck notes the impersonal, sterile relationship developing between man and the soil, along with the demise of the family farm.

Wisconsin Engineer Photo Library

About the time ads like this were appearing in Wisconsin Engineer, *poets and writers were already fearing the destruction of human imagination that machines would foster.*

Fear of machines has been the subject of literary endeavors for centuries. Early literature dealing with the subject includes Icarus' myth, Bacon's mechanical head, and the Renaissance Golem of Prague. However, the proliferation of literary works with a definite anti-mechanization slant can be dated to the industrial revolution.

Adam Smith, in his famous work "Wealth of Nations," written in 1776,

pointed out the negative effects of the division of labor, the danger of destroying a worker's intellect by having him perform repititious operations. This resentment towards technology and assembly lines carried through into Aldous Huxley's *Brave New World,* published in 1932.

A pervasive theme in "anti-technology" literature is the fear of man's physical destruction by his machines. An early example of this is Shelly's "Frankenstein" written in 1817. Poets Stephen Crane and Stephen Vincent Benet used this theme in works published in 1895 and 1935, respectively. Capak wrote a short play called *R.U.R.* in 1921 about the destruction of the human race by servant robots, who actually replaced man by discovering emotions.

Another common theme found in much of literature of the past two hundred years is the loss of work caused by industrialization. Early in the nineteenth century, a political group called the Luddites rebelled against machinery by going into factories and destroying the "devil's tools." Lord Byron discussed the situation in his maiden speech before Parliament. Robert Frost satirized the Luddites in his poem "The Egg and the Machine." Kurt Vonnegut, in "Player Piano" written in 1952, describes a futuristic Luddite uprising.

Dehumanization has been a constant theme of "anti-technology" literature. Edgar Allen Poe in 1829 in "Sonnet to Science" viewed science as a force which could destroy human imagination. Mark Twain comically described in "My Watch" the problems associated with the repair of a simple timepiece in 1870, and how we are at the mercy of technicians who are divorced from our relationships with materials. Harvey Swados wrote a short piece in 1937 about the dehumanizing conditions on an automobile assembly line. Also in 1937, George Orwell produced a work called "The Road to Wigam Pier." In it, he contends "like a drug, the machine is useful, dangerous, and habit-forming." Carl Sandburg, the great American poet, condemned men "too comfortable to think about tomorrow."

Skepticism about the benefits of high technology has not been limited to the authors of novels and plays. Political and social movements of the early 20th century reflect a certain anxiety about the advance of technology.

The Progressive movement was not really a reaction of the people against the industrial trusts in the first two decades of this century. Rather, it was a movement by scientific experts of the period to attempt to control the national economy through the efficient management of natural resources. Large corporate interests backed the movement in order to obtain secure, sustained, predictable markets and to eliminate cutthroat competition. Progressivism in conservation of forests and waters was in behalf of big business.

Other preservationists, alarmed at this merging, organized in order to save their wilderness areas. The Sierra Club became active in a fight with the Departments of Agriculture and Interior. Gilford Pinchot, the government's chief conservationist during the era immediately preceding World War I, opposed the preservationists' wish to create more National Parks. He wanted to create national forests to be used on a sustained yield basis. Early in this century, therefore, we find the first major clashes between federal policies of preservation of natural resources. The fight over use of federal lands continues today in California between motorized fun-seekers and preservationists.

In the Twenties and Thirties we find a growing resentment toward industrial methods such as assembly lines. Charlie Chaplin satirized the situation well in his film "Modern Times." The Depression had put many people out of work, and the newly-formed labor unions felt that automation was only aggravating the situation.

The benchmark for the growth of both pro-technology and anti-technology views, was World War II. Previously, the scientific community had tried to isolate itself from national policies and goals, accepting little or no funding from the Federal government. When the United States was drawn into the war, it was apparent that technology skill in weaponry was more important than the numbers of men in the field. This resulted in a fusion of the scientific community and the Federal bureaucracy. Basic science became a tool to serve government purposes by the control of massive funding.

During the War, scientists were employed in crash programs to develop new weapons. The Manhattan Project was proof to the public of what technology could do if it went all out to fulfill a national goal. The resulting attitude adopted by both the government and the people was that almost any socio-technical problem could be solved by scientific means, quickly and effectively.

The problems that have put the future of nuclear power in question began right after the war. The post-War scientists predicted nuclear power would be too cheap to even meter. Technical problems were dismissed by government officials as being easily solved with adequate funding and manpower. The public believed all this and looked forward to a "free lunch." However, the atom bomb - nuclear power link still plagued the mind of the public, as it does today. The shock of the destruction wreaked by the first bombs, and the subsequent H-bomb tests caused the mistaken belief that nuclear power plants might explode. The failure of the Fermi reactor, along with the SL-1 accident and concurrent bomb tests instilled fear in the minds of the public that is still alive today.

Since the war, the public's fear of technology has grown and multiplied. Usually the public's anger has been directed toward government policies concerning certain industries, but some technical devices have been viewed as evil themselves, such as nuclear power. George Orwell in his novel *1984* predicted the loss of personal freedoms stemming from the growth of government bureaucracy and as a consequence of high technology falling into political hands. Rachel Carson in *Silent Spring* correctly alerted us to the dangers of pesticides, which were once hailed as the technical fix which would eliminate starvation in

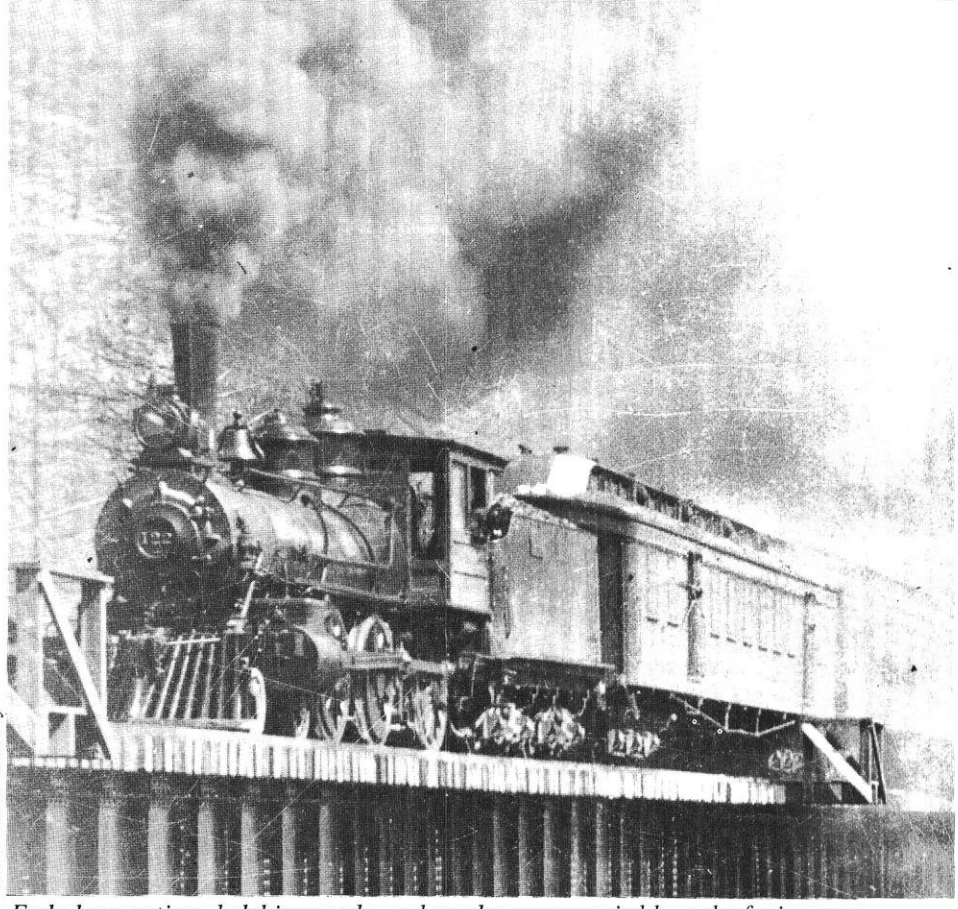
the world. Paul Ehrlich in *The Population Bomb* forecasted the downfall of humanity due to the increasing birthrate in developing countries caused by improved medical care and food supplies. Meadows and Meadows in the book *Limits to Growth* used a technical tool, the computer, to forecast a future world-wide catastrophe due to the scarcity of natural resources in light of increasing populations. Barry Commoner has expressed a common theme in all his writing: that technology has been misdirected and is therefore not the helper of mankind that it should be, but a hinderer.

In the Sixties and Seventies, many have turned against government policies of supporting some of the higher technologies and opted for a return to more simplistic methods and policies supporting human needs. Hence the demise of the space program, the SST, and advanced nuclear reactor designs.

The advance of technology has not been a smooth and continuous process. There is a history of resistance to technical advance. In the light of that, a few observations can be made. First, it is clear that people fear what they don't understand. There is a nagging fear of nuclear power today because it is so complicated and difficult to completely comprehend. The bombs dropped in World War II have instilled a fear of the terms "atomic" and "nuclear."

Second, it can be seen throughout history that as technologists, we have at times neglected human needs. Whether it was bread-making, automobile assembly line production, or pesticide use on farms, technology has often ignored the subtle social problems associated with what appears to be a useful and profitable idea. Today, projects are undertaken according to a benefit-cost ratio. However, some of the "costs" of a dam, a power plant, or a change in assembly line methods cannot be accurately measured in dollars and cents.

Of course, "benefits" suffer similar calculational problems. As engineers and scientists, we must look more toward social needs and policies before implementing any particular technology. If we use more care in original designs and goals, we won't be dragged, kicking and screaming, by federal bureaucrats into the drafting room to adjust our designs to meet some new criteria correcting our previous poor assumptions.



W. E. Photo Library

Early locomotives, belching smoke and sparks accompanied by a deafening roar, were perhaps the first symbol of the dirty detrimental side of the technological age.

As engineers we must be reminded that what is good for the United States technologically is not necessarily, or even very often, good for another country or culture. Many of our present foreign policy problems stem from imposition of our technical methods and devices upon Third World countries. Most of our industry and economy is capital intensive. Developing countries are almost all capital poor and labor pool rich. For them, "appropriate" technologies are necessary. To best help those nations, we should help them develop industries that would employ their many unskilled workers, rather than just a few highly trained technicians. Once such countries have reached a relatively high level of employment and have begun to generate capital, then higher, more complicated technologies will be useful to them, such as nuclear power plants, advanced farm machinery, and automobile factories.

Finally, the "appropriate" technology view has taken root in the United States, too. Thomas Jefferson's "noble yeoman" view of the average American is increasingly popular. Such an attitude encourages people to be self-sufficient, less dependent upon the government and large technical industries to live a good and fulfilling lifestyle. The push for a solar economy, the Proposition 13 tax revolt, the turn towards conservatism on college campuses point in this direction. As engineers and scientists, we must be aware of social attitudes and incorporate such wishes into the work we perform and the devices we design, or else, the anti-technology prophets of doom may be proved accurate in their predictions.□

In addition to the sources specifically cited in the article, Gideon's Mechanization Takes Command *proved a helpful guide in synthesizing the above history of "anti-technology."*

Nuclear power in crisis

the new class assault

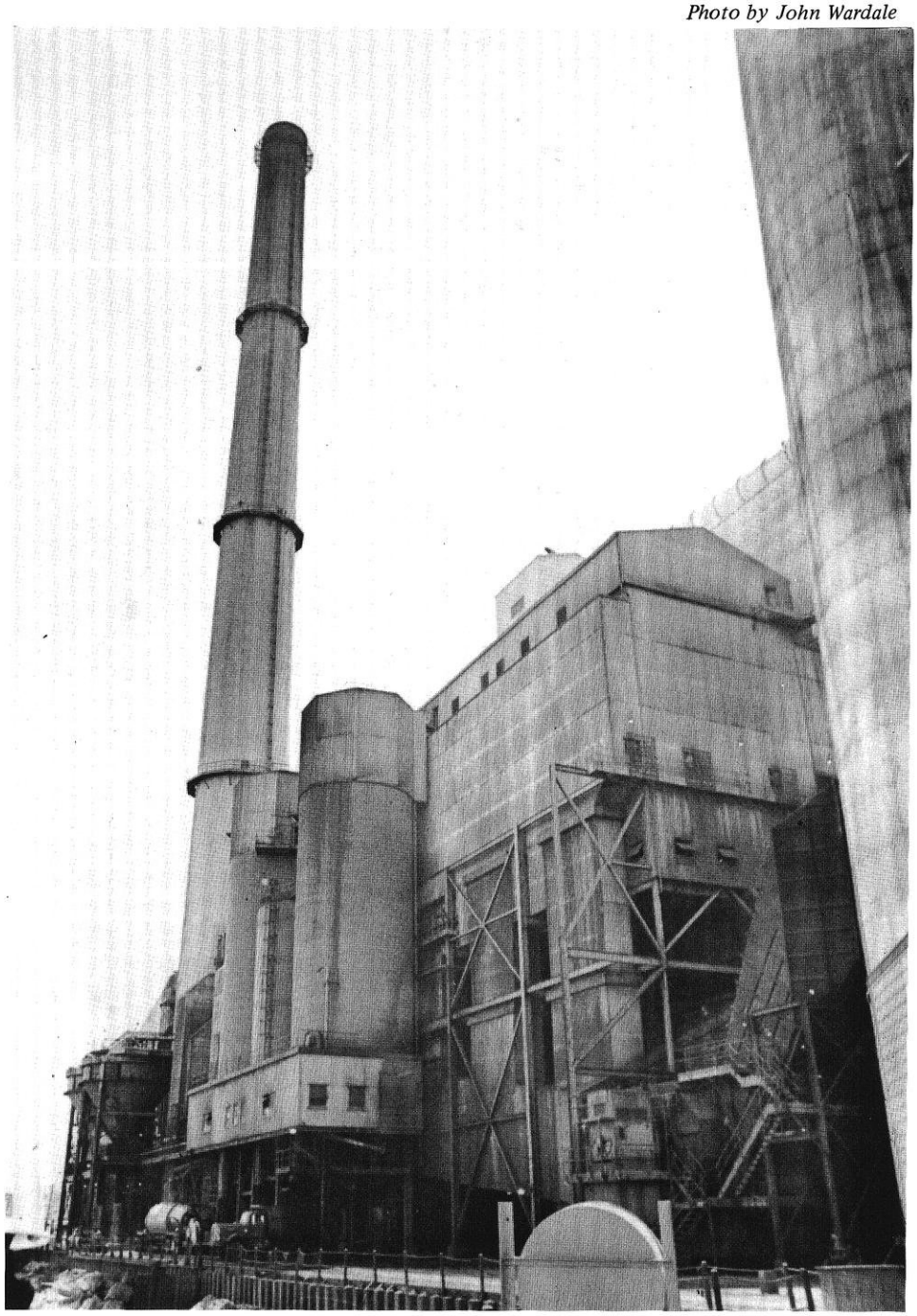
by Llewellyn King

The following is the text of an address given by Llewellyn King at the third annual meeting of the Uranium Institute in London in July, 1978. It is reprinted with the permission of the author from The Energy Daily *of July 14, 1978. Mr. King's characterization of the opponents of nuclear power as anti-technologists, "a new class in America [which] sees the enemy as all that is big," is indicative of the new hard-hitting position nuclear power proponents are putting forward.*

In the 1950s and '60s, the best young legal and technical minds in the United States sought employment in the nuclear industry. It was, as former congressman Craig Hosmer once described it, "the new frontier." Successive presidents had endorsed civilian nuclear power as holding the key to an energy-rich future for the United States and for the world. It was, of course, oversold, and in hindsight some of the expectations were plainly excessive. Such projects as the nuclear airplane, the stimulation of natural gas with nuclear devices and the irradiation of food and lumber for indefinite preservation now seem to have been the products of wild imagination.

But the basic yeoman function, the generation of electricity, has been surprisingly successful, low in environmental costs and without human fatalities. There have been technological problems, but they have been no more insoluble and no worse than those affecting other industries. On the face of it, nuclear power has been a boon to those utilities which committed themselves early and which

Photo by John Wardale



The Oak Creek Nuclear Power Plant, Wisconsin

rely heavily on it, such as Northeast Utilities in New England and Commonwealth Edison, which serves the Chicago area.

Yet nuclear power is the source of a bitter national controversy which extends from picket lines at nuclear power plants all the way to the President of the United States. In many families it divides fathers from children; and so deep is the emotional feeling, and so widespread the opposition, that, on the basis of today's climate, nuclear power cannot be considered a serious contender among the United States' future energy options.

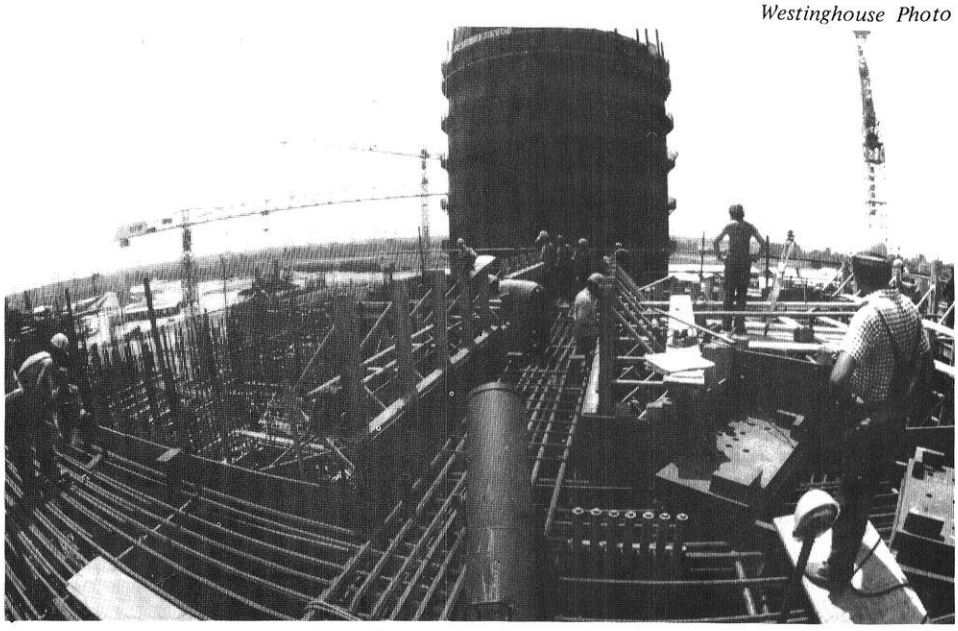
In theory, the Department of Energy and the Administration support a vigorous light-water program; but ambivalence on the part of President Carter and open hostility from many of those whom he has brought into the Administration make the theoretical support of light-water reactors an empty promise. The nuclear industry is surviving on a backlog of orders, but it has retrenched its sales staffs, and few utilities are expected to order new units in the near future.

The industry is beleagured and despondent, unable to comprehend what it perceives to be the injustice of its situation.

The opposition to nuclear power did not appear overnight, but has grown steadily for a decade, picking up converts and developing its own expertise in opposition as it goes. The greatest coup for the opposition, though, was not really of its making; it was the election of Mr. Carter, who is sympathetic to those who oppose nuclear and who has given key decision-making jobs to some undisguised opponents of nuclear power. These individuals and their allies have worked hard to frustrate the Department of Energy and its declared policy, particularly in the area of licensing reform.

I have been watching the nuclear controversy for more than eight years and was, if anything, initially sympathetic to the opponents of the atom, because at first reading their arguments are simple and appealing. They trade on a host of idealistic yearnings, particularly among young people, and they are clothed in

Westinghouse Photo



Construction proceeds on the Krsko Nuclear Power Plant in Yugoslavia

staunch moral legitimacy. However, the opposition is a movable feast, and it has ranged over the years to all kinds of subjects, from the health effects of low-level radioactive emissions, to pressure-vessel integrity, to emergency core cooling, to terrorism and nuclear weapons proliferation. Obviously, to those opposed to nuclear power, the hatred of the technology is pervasive and the resolution which will satisfy it is nothing short of a prohibition on nuclear development.

A favored argument of the anti-nuclear forces is that of waste disposal. But 97 percent of the waste in the United States today is derived from the weapons program; and a permanent repository for this waste has to be found no matter what the civilian future for the atom. Nonetheless, the waste argument succeeds in inculcating public fear as nothing else has done. At parties, on radio programs and in debates, I am questioned more often about waste than any other aspect of nuclear power. However, those who fan the fear of waste disposal are also, in their blind hatred of the technology, those who may make it impossible for a permanent repository to be located in an ideal geographic area. They have already indicated that they will incite local communities to oppose harboring the repository. This means that the nation will probably have to settle for a less complete solution in the form of engineered storage on government reservations where the wastes are already housed.

Likewise, the same self-fulfilling prophetic approach has been used in proving that nuclear power is uneconomic. In the United States it takes as long as 14 years to license a plant, thus vastly adding to its costs through the expense of carrying charges, an expense that has been contributed to enormously by the delaying tactics of the opponents and their protracted litigation of every possible issue. The opponents profess environmentalism as their cause, but increasingly the evidence is that they are motivated by some other deep-seated hostility to high technology that is only marginally associated with the environment. The only logical substitute for nuclear power in the United States is coal, and its price and environmental damage in human life is infinitely higher than that for a nuclear-based electric supply system. The United States is the world's largest oil importer and is endangered economically and strategically by that fact. And, while nuclear power cannot alleviate dependence on oil, it could, in time, bring considerable relief and provide a domestic and therefore stable basis for electrical generation.

The apparent wisdom of going to nu-

clear power has not been wasted on most of the world but neither has the opposition to it gone unnoticed. The United States represents a great *de facto* propaganda machine. Its ideas, fads, music, movies, television programs and prevailing ethics flow around the world in a continuous stream that no foreign national identity nor government policy can dam. Consequently, in the great nuclear struggle, ideas germinated in the United States have been exported to Western Europe and even to Japan. Today opposition to civilian nuclear power is entrenched in many nations, but nowhere is it as sweeping nor as effective as it has been in the U.S.

Opponents of nuclear energy have found in the United States hundreds of opportunities to frustrate its development. They are greatly aided in this by the openness of the licensing system – originally designed to further public understanding – and by the wide provision for court review of administrative decisions. The United States is the most litigious nation in the world, and every nuclear power plant is subject to a variety of court proceedings.

Another aspect that has aided the legal and political warfare directed at nuclear power is the very presidential system which distinguishes the U.S. from, say, the United Kingdom. Continuity in parliamentary democracies is assured to some extent by the permanent civil service and by the fact that cabinet ministers and members of the shadow cabinet become acquainted with complex issues of national policy as they proceed up their respective career ladders. In the United States, high office can be thrust on a man or a woman who is not familiar with the intricacies of a program, simply because he or she is appointed or elected. Hence, the first two years of any American government often embody a period of intense familiarization with long-standing programs. It is my belief that the Carter Administration came into office committed to dramatic reforms but with little knowledge of the precedents established for it by previous administrations. They took over the ship of state without regard to its previous course or present location.

Nowhere was this more clear than in the new Administration's policy on proliferation, where brilliant but uninformed men set out to change long-established free-world policy, without regard to how that policy had been established nor why it was regarded as vital by those who had been party to its creation. Observers watching the State Department under Carter have been able to see the President's team modify its stance in direct relationship to its increasing knowledge of nuclear technology and political realities.

Unfortunately, there is no evidence that such enlightenment has been universal in the Carter Administration. Outside the State Department, prejudice and bigotry over nuclear technology continue to thrive, clothed in righteousness and unassailable motives.

It is why there is this bigotry against the technology that fascinates me, and I have spent some years trying to analyze and explain it.

My conclusion is that it is a symptom of a much wider sociological phenomenon in the U.S. national character and that it is intimately involved in the history of the post-war period.

Those who oppose nuclear power are nominally known as environmentalists; sometimes they are joined by so-called consumerists. They are dedicated, articulate, well-educated, middle-class and upper-middle-class Americans, many of whom learned the art of public protest during the Vietnam war, who believe that the industrial political axis which has nurtured the development of peaceful atomic energy is cynically foisting a dangerous and unnecessary technology on a gullible American public. In their fight against the technology, they have used the tools which come easily to them as a result of their education and social position: litigation, media manipulation and quasi-scientific propaganda. Additionally, they are now penetrating the political structure as they have done at the California Energy Commission, and are waging a relentless and committed fight at a grass-roots level against which the nuclear industry is almost powerless.

Why?

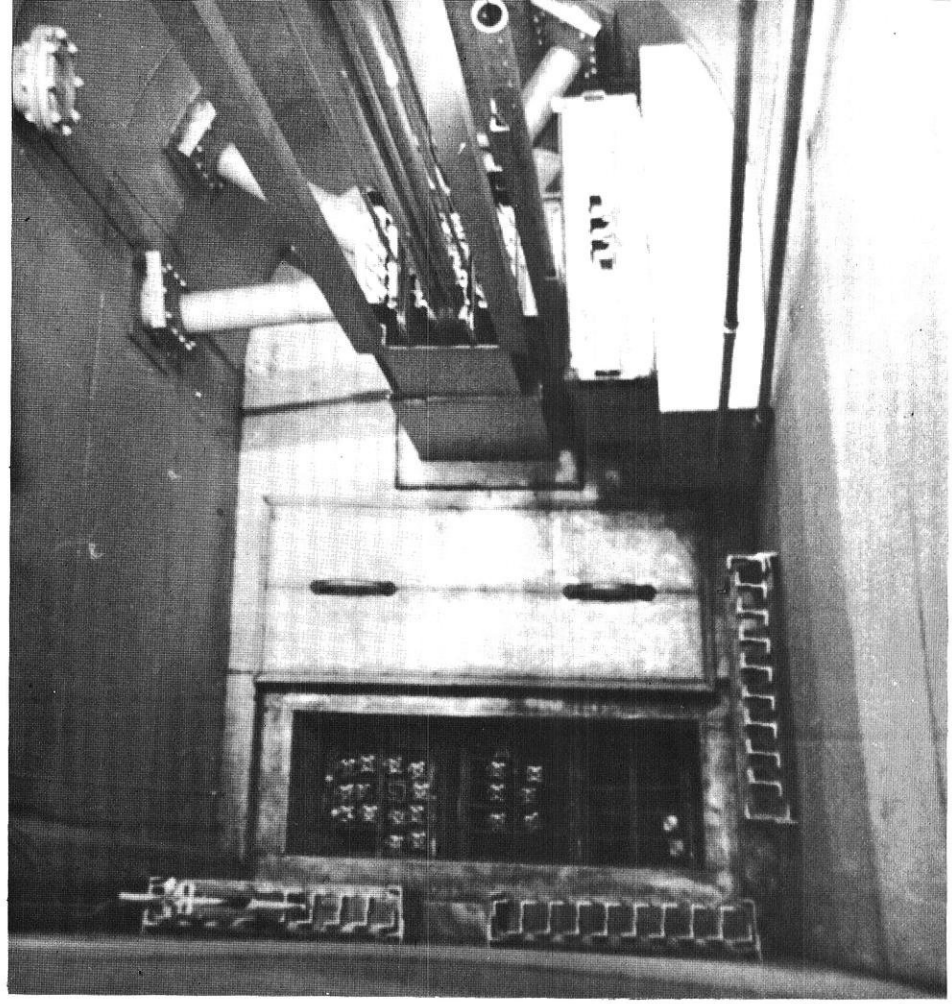
It is not easy to measure and understand popular movements, but some major factors are now becoming apparent. In the past fifteen years, the United States has been rent by four traumatic events that have produced a stratum of society with a different set of priorities and a different expectation for the future of the United States than anyone had previously contemplated. First, the civil rights movement awakened the nation to its accumulated sins of racial discrimination and set off in the American psyche a flow of guilt that has not yet been assuaged. Second, the Vietnam war presented thoughtful Americans – particularly those of college age – with a moral dilemma at odds with the nation's previous experience of war, when decisions were made as a simple choice between good and evil. Third, the environmental movement, born of necessity, raised the American consciousness as to the cause and effect of industrial and commercial life and the survival of the ecology. And, finally, the Watergate scandal cemented in some Americans a fundamental distrust of established institutions and the machinations of their own government.

The distrust of institutions, many of which could be blamed for the perceived betrayals that I have just mentioned, extended to a distrust of those things which are peculiarly in the purview of big institutions. These are: high technology; the manipulation of society through the goods and services sold to it; and capitalism itself, which, it may be argued, was the engine driving the assault on the environment. It was, too, the benign accomplice of racial discrimination and the enthusiastic ally of Lyndon Johnson's war in Asia.

Simply, everything that went wrong had been either perpetrated or encouraged by big business or big government or by those elected with the support of the commercial sector of American society. But there is no mechanism for an attack directly on the offending institutions, only mechanisms for oblique as-

sault on their facilities. Nuclear power in particular has borne this antagonism. It represents the planning of a discredited generation of American leadership, the ultimate toy of the environmentally insensitive electric utilities. In the minds of those opposed to it, it is the triumph of ruthless technology against human values and, as important, against doing things on a human scale. Its dangers can be awesome, the longevity of its waste boggles the mind, the threat from proliferation offers the ultimate doom of *homo sapiens.*

In this frame of mind, the opponents of nuclear power have escalated their dissatisfaction from specific aspects of safety, environment, etc. to a much grander disaffection: a conclusion that the technology itself is immoral and that it should be expunged. To support this thesis, they have concluded that Americans can live a better life, with a lower standard of living, but what is called a higher quality of life. This line of thinking has developed such momentum that it is now presented as representing a serious political and philosophical choice for the future of U.S. society, and, by extrapolation, for the world.



John Wardale

The core of the U.W.-Madison research reactor located in the Mechanical Engineering Building showing the rods

The phenomenon of the attack on nuclear power is not confined to that industry although it is at its most coordinated, most emotional and most sophisticated in opposing nuclear power plants. A similar assault has been in progress for some years against the American food industry, although *prima facie,* the American food industry has done a superb job; the abundance of food in an American life is something to be marveled at. And, Americans live longer, grow taller and are healthier than they have ever been. But the food industry, though vilified, hardly has to fight for its life.

The nuclear industry, in contrast, *is* fighting for its life; and, as I stand before you today, I can tell you that it is not winning.

Those of us who have tried to codify and understand the nature of the nuclear opposition have gradually come to the conclusion that we are dealing with what amounts to a new class in American Society, one that is unfettered by fear of shortage, privation or disaster. It is a class whose traumas have been external and national and not personal. It is a class of men and women who, paradoxically, are seeking to hobble the American economic machine when they themselves are the products of its bounty: well-fed, well-housed, and well-educated – a class that has been brought up in a cocoon of personal well-being in the comfort of a good home, the security of good schools and the luxury of university education. Their class perception of American society is of a good thing gone wrong; of venal capitalism astride the stallion of technology violating the wholesomeness of America.

But unlike those in Europe and the rest of the world, the intellectuals of this new class do not seek to reform the United States with drastic political change such as communism or socialism. They are, in my opinion, too informed to believe in the simplistic protestations that are appealing on the factory floors of Europe. The new class in America sees the enemy as all that is big and finds the concept of big, centralized government abhorrent.

Its political solution, therefore, is the decentralized society; its weapon for capitalistic excess is regulation, not nationalization; its means for decentralization are technological and not political. The cutting-edge of this agenda – turning the United States from an industrialized, centralized society into a decentralized, semi-agrarian nation – is to put a tourniquet around centralized energy development, in particular nuclear power, and to bring about, through the dispersal of energy sources, a dispersal of decision-making and to return power to the people in small, local units. This agenda, though not new, has been given considerable intellectual legitimacy and rhetorical cohesion by *Amory Lovins,* an engaging renegade technocrat and techno-social

philosopher.

The present indications are that this great assault on growth and the traditional goals of the industrialized world will not work. However, the assault on nuclear power has been highly successful. The danger is that in the future we will have neither the utopian world of Mr. Lovins nor enough energy for the industrialized world that we know today and anticipate for tomorrow.

As the assault on nuclear power has increased in velocity, it has spread beyond the specific new class advocates of a modified society to most of the left wing of the Democratic Party.

When Jimmy Carter was seeking the highest office in American public life, he not only identified with the new class, but was persuaded by many of its arguments. As President, he has succeeded in massively damaging the prospects for a nuclear-based electric economy. A President with a combination of new class values and old-fashioned political ambivalence has tainted nuclear power more than its most devout opponents could have hoped. He has furthered the public impression that it is dangerous by saying that it is. Worse than that psychological damage, he has closed down the breeder demonstration project at Clinch River; and he has refused to allow the back end of the fuel cycle to be closed. He has antagonized United States allies and set off, in my view, a new imperative for nations, once prepared to rely on the United States for their nuclear expertise, now to acquire their own. And, in so doing, he has set up the possibility of many nations eventually being equipped to produce weapons.

The crisis for nuclear power in the United States is replete with a number of ironies. For example, although opposition to nuclear power has produced a climate in which its expansion is almost impossible, most nuclear plants have been cancelled or postponed because of other factors, principally the poor economic health of many of the utilities, as well as the chaotic load forecasting situation which has resulted since the Arab oil embargo of 1973-74 because of changed growth patterns and energy conservation.

Despite the current gloom which I have expressed about nuclear power in the U.S., it is wrong to conclude that the industry will disappear. There now are 71 reactors producing 12 percent of the nation's electrical power, and according to the nation's electrical power, and according to the Atomic Industrial Forum, a further 105 reactors will come on line between now and 1986. But projections for the year 2000 for installed nuclear generating capacity are down from a high of 1,200 gigawatts to 380 gigawatts. The question is how long the four reactor vending companies – General Electric, Westinghouse, Babcock & Wilcox, and Combustion Engineering – can survive, particularly as the new export law casts a major shadow over the ability of these organizations to compete internationally. Mercifully, in the United States the will of the government is not absolute, and the concerted opposition to nuclear power from many elements of the current Administration will be crippling but not fatal. Nuclear is not alone as the victim of the new class assault on energy and technology. It appears today that the 1977 amendments to the Clean Air Act may ultimately prove more lethal to the direct combustion of coal than anything that has befallen nuclear. The problems for nuclear power are social and political.

It is my expectation that, as the limits of coal and the greatly oversold expectations for solar power are realized, nuclear power will enjoy a resurgence. Many leaders of the nuclear industry subscribe to a view that, sometime after the next presidential election, a national reevaluation of the energy future will take place, and in that evaluation nuclear will discard the rags of Cinderella for the mantle of a princess.

If the United States has a national weakness, it is to seek simple solutions to complex problems. This zealous morality has led the nation into some aberrant actions that have often left scars but which have ultimately been overcome. The aberrations extend from slavery to prohibition to the Vietnam war, and I believe that the current attitude toward high technology in general and nuclear power in particular reflects that kind of aberration.

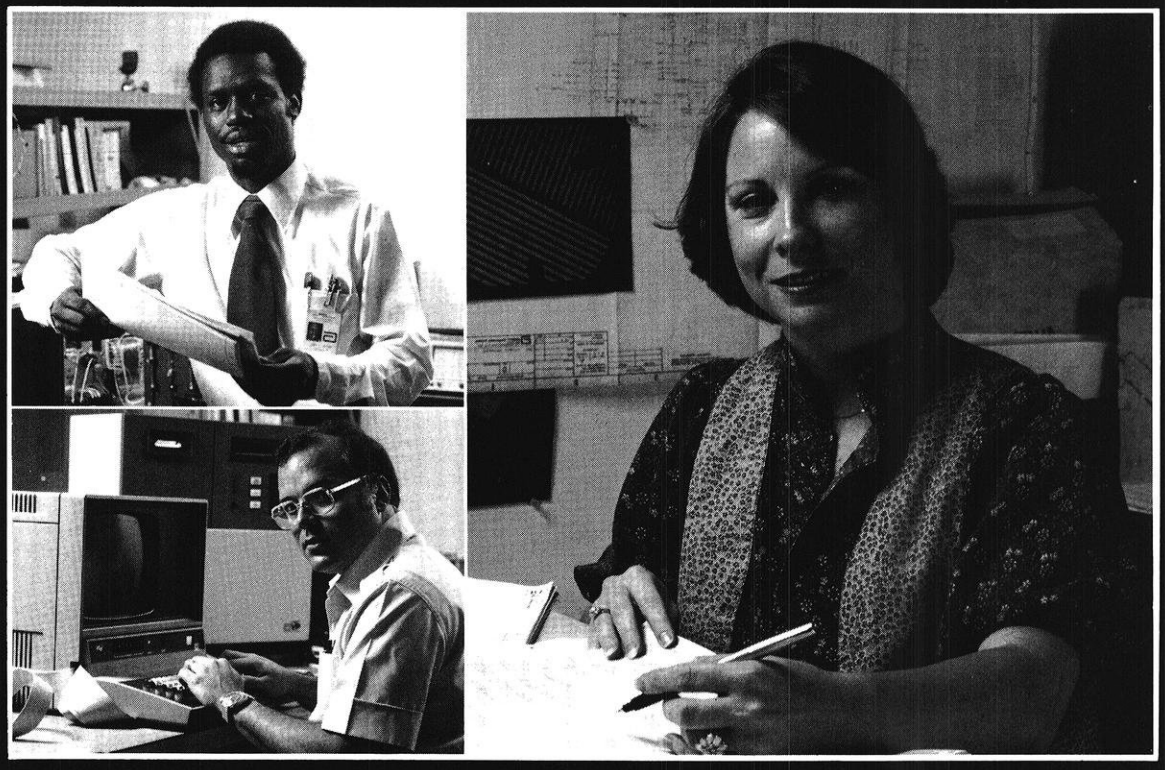
The great danger for nuclear power is that it has been institutionalized as a crusade of the American left against the technology. Opposing nuclear power has become, for some more radical members of the Democratic Party, an act of faith based on political creed rather than on technical judgment.

In today's political climate in the United States, if you're in favor of organized labor, redistribution of income, a more egalitarian society and other noble goals, then you are axiomatically, as part of that political creed, likely to be opposed to nuclear power. Likewise, if you subscribe to a conservative political philosophy, you are likely to believe in high technology, in continued ownership of the Panama Canal and in maintaining national defense at a high level – and in nuclear power as the cornerstone of the future energy development of the United States.

I deplore this polarization because it presents technology in political and ideological terms, where I believe it does not belong. I think hanging moral labels around technology, as has happened with nuclear power, is a piece of intellectual mischief for which the United States and possibly the world will pay. That the alternative technologies to nuclear are known as "appropriate technologies" and the Department of Energy has institutionalized this piece of semantic *legerdemain* by using that phrase, shows the extent to which the mischief has taken hold.

To explain why nuclear developments is in a hiatus is to explain the existential nature of the new class philosophies in opposing growth and protecting the environment at all odds. It is also to deny the empirical eveidence that America's well-being is symbiotic to its technological success. Energy and technology are the bulwarks of American civilization, and I hope that my adopted land will regain confidence in this destiny.□

"I don't feel like an employee... more like a member of a championship team!"



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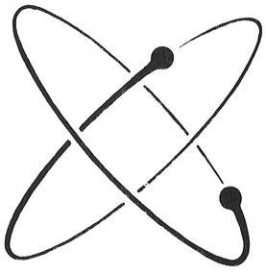
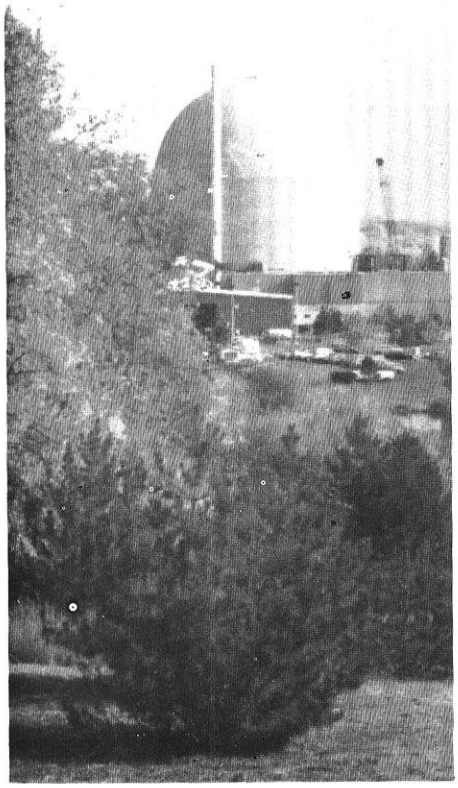
two views on Llewellyn King's class assault ide



by Pat Schwab

How about the proponents of nuclear power? We were sure that the nuclear engineers at UW-Madison wouldn't find much fault in King's words. Pat Schwab, chairman of the public relations committee of the student chapter of the American Nuclear Society here, echoed King's views.



As a veteran on the pro-nuclear side of the nuclear controversy, I enjoyed Mr. King's article immensely. Many people are just now coming to the conclusion that this controversy is only technological on the surface.

For example, the anti-nuclear people demand that existing power plants be shut down until nuclear waste disposal is available. Yet these same people vigorously protest the construction of such waste disposal facilities! Every respectable group of scientists to study radioactive waste disposal for the last 20 years has concluded that the waste can be solidified and safely deposited in a stable geological formation deep underground.

These scientists are continually surprised when their studies are totally ignored by all dedicated anti-nuclear people. That's because the issue is socio-political in nature, not technical. This may be disturbing to some engineers. There is no formula to plug numbers into, and pocket calculators are useless when applied to a socio-political problem.

We must address the problem on the proper grounds. As Mr. King points out, the controversy is not just about nuclear energy but about any form of centralized energy supply system. The so-called anti-nuclear people whom I often argue with are also opposed to coal-fired electrical generating stations, oil and gas wells, and even large centralized solar power stations. Instead they advocate what Amory Lovins has labeled "soft" energy technologies. This is the real issue: What are "soft" energy technologies and are they really incompatible with centralized energy sources?

A "soft" technology is any power-producing device that will fit in your garage or back yard. The total "soft" approach is based on two assumptions: 1) that total U.S. energy consumption will be reduced by about 50%, and 2) that the other 50% can be produced by windmills, woodburning stoves, small solar collectors, etc. (Most engineers think neither of these assumptions are valid, because the United States is an industrial nation.)

But what is it about big, centralized energy souces that is incompatible with these individually-owned devices? Nothing at all. The anti-nukes say the "soft" approach would offer everyone a free choice of energy sources and then hypocritically declare that no one should be free to choose a centralized energy source. Actually, the two are not mutually exclusive. I claim that we can use windmills, solar heaters, *and* nuclear power plants.

This is the socio-political question that will soon be decided. Will we continue to have the option of power cables and gas pipelines to our homes and factories or will we have only one option left, the so-called "soft" approach? The majority of the people do not like the idea of climbing up on the roof to shovel snow off a solar collector, yet centralized energy sources are being effectively blocked. Those of us who wish to advocate nuclear power intelligently must realize that "soft" technology is really an attack on big, centralized technology.□

and cons of *"Nuclear power in crisis"*

by Bart Ramsey

Realizing that Llewellyn King's statements were bound to touch some raw nerves in the anti-nuclear camp, WE invited the Daily Cardinal *to respond. Bart Ramsey of the* Cardinal *staff answers King's charges.*

In response to Mr. Llewellyn King's article, "Nuclear Power: The New Class Assault," I am compelled to argue that resistance to nuclear developments is nurtured by more than "idealistic yearnings," and with a more concrete goal than to "hobble the American economic machine," as King claimed.

Those who come out in favor of nuclear energy are rational individuals according to King, while those opposed are harboring a "blind hatred of the technology." The situation is obviously not as simplistic as he would like to paint it. Nuclear power is surrounded with controversy for good reason.

King observed that "four traumatic events . . . have produced a stratum of society with a different set of priorities and . . . expectations for the future," namely the civil rights movement, the Vietnam war, the environmentalist movement and the Watergate scandal. These events have created a society, he said, that is more suspicious and distrustful of established institutions.

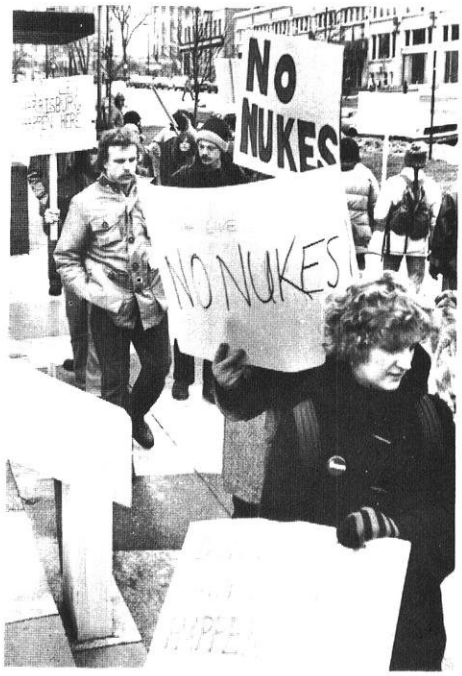
First of all, he assumes that these are isolated events unconnected to any overriding problems. Secondly, he assumes a critical look at traditional institutions is inherently negative. Both of these assumptions are weak and simplistic. The old, unwavering faith in science and scientific experts, and the belief that untrained people are not capable of making decisions or understanding the concepts behind technological developments are two ideas which are on the wane. There is a growing sense of responsibility and involvement among citizens as they discover they can and should understand technical data.

King complains that because Department of Energy officials are not entirely on the side of nuclear power, they are automatically untrustworthy and absolutely wrong. His fussing about the political power struggle evades the real question: whether nuclear energy is a feasible energy source.

Nuclear energy advocates argue that nuclear energy creates a minimum amount of waste, and is therefore extremely conservational. The simple volume of waste is only part of the problem, however, The waste is highly toxic and will remain so for hundreds of years.

Nuclear energy poses many other safety questions, as evidenced by the recent shut-downs of five power plants on the East Coast. Whether high radiation areas

Photos by Bob Conover, Daily Cardinal



Protestors in front of Wisconsin Power and Light offices in Madison the day after the Three Mile Island accident.

cause cancer or other diseases to occur at a greater frequency, for example, is still a subject of debate.

Many experts optimistically believe that this country's long-term energy future looks good. The biggest quandary, they say, will be surviving economically until alternative technologies can be developed. If nuclear power is used to fill the energy void, with its safety problems and wastefulness, research and development of energy alternatives and conservation measures will inevitably be forestalled.

The incentive for society at all levels to conserve energy will diminish greatly with the proliferation of nuclear power plants. The government will be less inclined to enforce conservation and meticulous management of energy at both industrial and consumer levels. Nuclear power, for all its other pitfalls, will only discourage energy – and environmental – conservation.

Coal-fired energy stations are not without environmental, conservation and health-safety hazards of their own. But at this point, they are more desirable than nuclear power stations by a wide margin. They will, in conjunction with other power generation sources, do better to provide energy safely until current energy technologies are made more efficient and other energy technologies are created.

King complains that people are anti-nuclear because they are anti-big business. Certainly, many question the motives of utility companies who have invested heavily in nuclear energy research and who then claim that nuclear energy is perfectly safe. They have a lot to lose. The possibility that such companies have refused to explore alternatives because they may not be able to reap such a large profit and would have to re-invest in new research is not far-fetched.

The utilities have a direct interest in maintaining the present level of energy consumption – especially nuclear energy, which must be distributed from a highly centralized, and therefore highly profitable source.

King's gross generalization, however, that opponents of nuclear power comprise a new class that "sees the enemy as all that is big and find the concept of big, centralized government abhorrent," is ludicrous. This modern-day version of "red-baiting" evades the real problem by pointing a paranoid finger at resisters – who say that nuclear energy is dangerous. One could just as easily argue that everyone involved in big business adamantly supports nuclear developement, blindly and without consideration for the environment. There will always be some who simply follow the status quo, but this a weak defense of nuclear energy.

We hope to see, as does Mr. King, "a national reevaluation of the energy future." But instead of hoping for a vitalization of nuclear developments as a simplistic escape hatch, we should, as informed, active consumers, make industry and government aware of the need to conserve energy and to search for alternatives for our future energy supply.□

Nuclear political economy

uncertainty in an uncertain age

by Charles Cicchetti

Poor economic health has caused cancellation or postponement of more nuclear power plants than have questions of safety. Charles J. Cicchetti is the chairman of the Wisconsin Public Service Commission. The following article explains the reasons behind the PSC's apparently anti-nuclear stance. It is the text of an address given by Mr. Cicchetti to the Atomic Industrial Forum at their January 15 meeting in Las Vegas.

The Wisconsin Record

The purpose of my remarks is to discuss (1) the reasons for the recently adopted policies of the Wisconsin Public Service Commission, which appear to be anti-nuclear, (2) my views on the reasons for the current malaise of nuclear power, and (3) the Carter administration's proposed legislative solution for nuclear power in this country and its rather obvious errors and omissions.

Let me begin with Wisconsin's nuclear history. About thirty percent of our electricity is generated by nuclear power. It has been clean, safe, reliable and incredibly cheap. More than half of our nuclear power came on line earlier in this decade at less than $200 per kW built under turnkey contracts. I do not know any serious energy observer in Wisconsin today who does not wish we had built more such units. We are currently collecting dollars for decommissioning our nuclear plants and for the permanent storage of spent waste. Many of our utilities are triple or double A-rated and Milwaukee, our largest city, has the lowest electricity prices of the top twenty cities in the nation. This has certainly been helped by the excellent economic performance of our existing nuclear plants. But, the fact that we have virtually no oil-fired electricity, and our state's treatment of construction work in progress, and funds used during construction have also been part of it.

To be sure, despite a rather envious record, Wisconsin has its utility-related intervenor and political problems. In fact we just elected a new Governor in part because he was at the same time anti-utility, anti-PSC, anti-environmentalist, pro-consumer and pro-nuclear. With that persuasiveness maybe the AIR should hire him away from Wisconsin to breathe some new life into a stagnant, somewhat defeated, organization.

The Wisconsin PSC, quite distinct from and prior to our recent gubernatorial election, voted to set nuclear power back rather dramatically. This rather obvious inconsistency is directly related to what I believe to be the specific ills of the nuclear industry in this country. The actions taken were: (1) to restrict Wisconsin's nuclear future by eliminating three of five proposed nuclear units, (2) to prohibit through a nuclear moratorium any expenditure of planning dollars on future nuclear power, (3) to consider, under less than neutral circumstances, the two remaining possible nuclear plants in separate need proceedings, and (4) to eliminate further Wisconsin utility contributions to the Clinch River Breeder Reactor Project.

It is interesting to note that after thousands of pages of hearing transcrips in a state that has been well served economically and environmentally by both coal and nuclear, I concluded, and was joined in the final vote by the other two commissioners, that nuclear power was, with respect to short-term environmental problems, superior to coal. That long-term environmental problems were present in both, with nuclear potentially more of a problem. But, on net, coal was environmentally inferior to nuclear.

It was the economics of nuclear power, particularly its political and economic uncertainty, that tilted the commission course of action. Let's begin with what we know. In less than a decade nuclear capacity costs, comparing actual Wisconsin plants under review and in operation, have increased more than sixfold (from $167 per kW to more than $1,000 per kW).

Nuclear and coal plants which both started their way through the regulatory morass in the mid-seventies also differ dramatically. First, the coal units will be on line in two years or so, while the nuclear regulatory process continues. This is not simply due to the environmentalists. Utility-related postponements of a year or two, with virtually no economic penalty for the utilities, given our treatment of construction work in progress, are commonplace and increase the economic burden for consumers. Second, those same coal units will be built and operating for five years or so sooner, at costs per kW in 1978 dollars for construction at about half that of the delayed nuclear units (about $500 versus $1,000). Further, now that utility growth rates in Wisconsin have been cut in half, the smaller sized coal units are more readily adjusted to our system which also add to their economic advantage.

The above economic factors can be measured, and tilt the choice towards coal, despite its obviously higher operating costs. In fact, the most persuasive "economic" arguments made for nuclear

in Wisconsin are (1) avoiding too great a dependence on one electric generating fuel, and (2) a fear that the Environmental Protection Agency will win its ridiculous internecine war with the Department of Energy for the employment of "best available control technology" even, ironically, for those situations in which it is found to be bad environmentally and economically.

Two reactions to such a line of reasoning enter my thought process. First, Wisconsin continues to be a national leader in nuclear power. Indeed, our state's largest utility has at least forty percent nuclear generation. I really wonder, after the "diving for the foxhole" performance of the federal government in the aftermath of Proposition 13 in California, what will happen to us high nuclear states if nationally we continue to fail to adopt a politically acceptable solution to nuclear waste disposal. Second, our coal continues to be supplied from both eastern UMW and non-UMW sources, and as well as western non-UMW sources, both by barge and rail. It is too overly simplistic and therefore wrong to think of a ton of coal as a ton of coal from a security of supply standpoint. It is of course possible that narrow, simplistic and stupid environmental regulations will lead us in Wisconsin to prefer a single coal source and to select a single transport mode. But the case for coal stock-piling, and coal source and transport diversity, as well as continued opposition to a yet-to-be-finalized EPA policy, all seem far stronger arguments on the side of coal than the nuclear "avoid putting all your eggs in the coal basket" argument.

Still working against nuclear were three economic factors that led me to vote for our nuclear moratorium, joining at least four other states. What makes Wisconsin unique is that our action was a formal vote of a regulatory commission, as distinct from Iowa's informal, but very real, commission position, and the legislatively determined or voter initiatives passed elsewhere.

The three factors which, in my opinion, are crying for federal government solution and which present too great a financial and political risk for nuclear power are: (1) permanent waste disposal, (2) plant decommissioning and (3) guaranteeing fuel availability for the current plants in operation or under construction. Committing more than a billion dollars per unit, with the multiple uncertainties of what storage, decommissioning and future nuclear fuels will cost, and the potentially more serious prospect that nuclear plants may be forced to close down before the end of their expected operating lives, are risks too great to impose on a state regulatory commission or utility ratepayers. The federal government's virtual silence in these matters leaves decision makers few options than to be virtually negative.

Some Weak Solutions

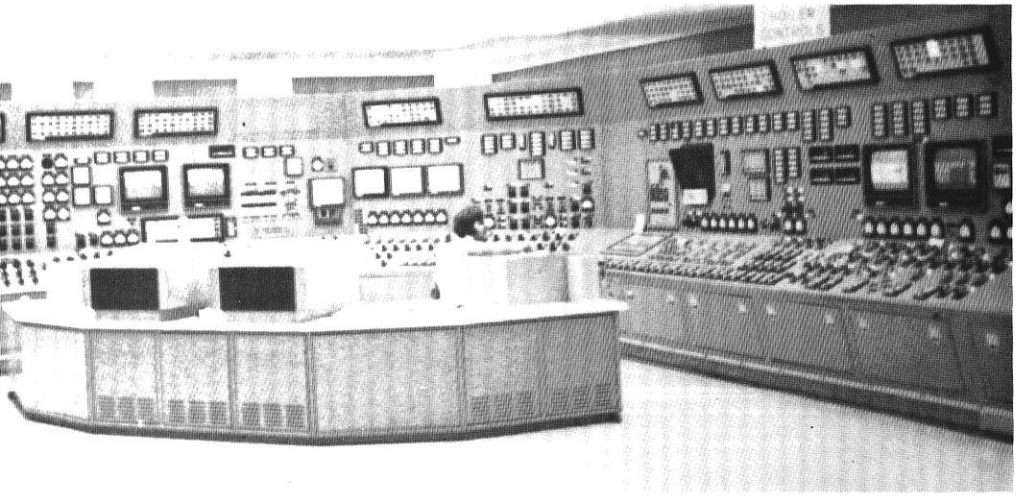
As nuclear construction costs continue to explode, as the financial regulators of Wall Street see the regulatory and cash flow problems mount, nuclear orders are cancelled, and *Business Week* carries an article so gloomy about nuclear power that I won't be surprised to see it reproduced in every environmental newsletter in the country, three basic solutions have been offered. These are: (1) the standardization of nuclear units (e.g. SNUPPS), (2) the Deutch task force and, (3) the Administration's Nuclear Siting Legislation.

While none of the above are sufficiently strong enough medicine to do the job, there is some logic, and quite a bit of good about each. But in my opinion we do not have a mildly sick patient. The nuclear industry which, given the oil embargo, plus the environmental and union-related problems of coal, should be a high flyer, is instead near dead in this country.

My purpose is not to join the chorus of gloom, but to raise serious questions about the deficiencies of the proposed cures, and in that way try to revive the patient. The cures will, however, never return nuclear power to its over-promising days and earlier "too cheap to meter" bravado. But, I think, if such cures can be developed, the nuclear option can be restored to a position where it can compete economically, environmentally and then perhaps even politically with coal. (If this last objective seems naive, study the recent Wisconsin election results.) Let me review each of the current rather deficient goals in turn.

SNUPPS (Standardized Nuclear Unit Power Plant System) was sold to utilities and regulatory commissions as a way to hold down joint costs and reduce regulatory delay by standardizing design. Those goals are certainly desirable. However, they are gained by accepting considerably greater pre-certification expenditures and commitments. Given the other economic uncertainties of nuclear, it is my judgment that, as desirable from both an economic and safety standpoint standardization is, something must still be done to reduce *pre-certification* nuclear expenditures and commitments. The economic risks of a nuclear unit are considerable, if tens of millions must be expended and hundreds of millions committed before it can be determined whether a nuclear plant is "needed." Standardization creates two other economic problems. As some participants

Photo by John Wardale



The control center of the Columbia II Nuclear Power Plant, Wisconsin

in standardized unit designs pull out, remaining members must bear greater costs. Even without standardized design an all too likely temptation for nuclear vendors today, as cancellations are received and/or not forthcoming, is to spread fixed vendor costs over a smaller number of units sold. Standardization in design has not solved this problem. In fact, I suspect it has made it more acute, thus increasing the capital costs of a new nuclear generator even further.

Professor Deutch's Committee has addressed the nuclear spent fuel problem. Every new presidential administration seems to believe that one of its first priorities is to address the nuclear waste disposal problem. The present Administration has gone further. It has also honestly laid out a timetable. But the promised date is long after any political accountability will exist. State Commissions who are asked to take the political heat for waste disposal need more than a new, albeit more well defined, promise. There have been nearly three decades of promises, making the Deutch report seem hollow, when it is in fact a rather serious and important effort. In my opinion nuclear power needs financial and/or legal guarantees, not political promises, to deal with the twin problems of waste disposal and plant decommissioning.

The Nuclear Power Plant Siting Act has also been offered by the Administration as a means to revive nuclear power. I drafted a resolution of support, which was passed by the National Association of Regulatory Utility Commissioners, for a not yet written *redrafted* version of that Act, but I still feel it is far too weak to do the job. My support is lukewarm for two reasons: first, the previous Administration version was, to be kind, ambiguous. When this was explained to them by those more or less supporting the bill, we were asked to help them pass something and the ambiguities would be corrected in legislative history. The nuclear issue is far too serious and politically intricate for any serious regulator to accept a request to help "win one for Jimmy," when those of us who must deal with these issues directly know it is simply not enough.

I will state for you what I consider the essence of the minimal siting bill preferred by this Administration. It must: (a) turn need determination over to states, if they want to accept it, (b) similarly, environmental impact of particular sites must remain a state matter unless rejected by an individual state, and (c) nuclear plant safety can continue as a federal matter. The Administration claims that these objectives are what it intended. At a minimum we must insist that they draft their new bill accordingly. Even with clarification, the bill only becomes acceptable. It does not become a good, and, therefore, nuch-needed nuclear siting bill. For nuclear power to be economically revived, the Administration must either establish federal responsibility for storage, decommissioning and fuel availability in its nuclear siting bill, or, in parallel legislative action, accomplish the same thing. The Deutch Report, plus the present siting bill, simply do not go far enough.

My Ten Proposals For Reviving Nuclear Power

I. The federal government in either its power plant siting bill, or elsewhere, should assume legal responsibility for the storage of dangerous nuclear wastes.

II. Methods for charging for this assumption of responsibility, and the financial and legal treatment of any future value in such spent fuels must be defined within 180 days.

III. The federal government similarly, in either its power plant siting bill or elsewhere, should assume legal responsibility for the eventual decommissioning of nuclear plants.

IV. Methods for charging utilities for this service must also be defined in 180 days.

V. The Internal Revenue code should be amended to permit utilities that are assessing current customers for either future waste disposal or decommissioning to deter treating such revenue as income until such offsetting expenditures are actually made.

VI. Nuclear fuel availability must become a federal responsibility. As the breeder is sidetracked and the prospects of imported nuclear fuel become likely, the continued flow of nuclear fuel to billion dollar plus reactors must be assured.

VII. The federal government, vendors, and the financial community must take bold steps to reduce pre-certification expenditures and commitments.

VIII. Similarly, the federal government, vendors, and the financial community must take steps to reinstate turnkey contracts.

IX. Public admissions that nuclear power benefits were grossly overstated must be forthcoming.

X. The health of our national economy must be protected and any attempts to promote nuclear by overly and/or poorly regulating coal must be avoided. Under proper economic and regulatory climates both coal and nuclear power have a role.

The Future of Nuclear Power in Wisconsin

The preceding section should give support to the pro-nuclear forces in Wisconsin and infuriate some of my state's anti-nuclear forces. The fact is, however, that as long as the federal government: (a) ducks the waste storage, decommissioning and fuel availability problems, (b) vendors insist on large pre-certification expenditures and reject turnkey contracts, (c) consumers keep their growth in consumption around four percent, and (d) the federal government practices a balanced well thought out coal/air pollution policy, I will support a full moratorium on the expenditure of any further dollars to even plan new nuclear plants in my state.

The nuclear industry can revive itself, but it can only do so by understanding the problems of state regulators who, in increasing numbers, are refusing to take all the economic risks and political heat of nuclear power. Solving the nuclear related problems described above will make it possible for those among the state regulators, who believe as I do, that coal is environmentally more costly, to accept the political heat of nuclear power. Failure to reduce the economic risks of nuclear power will only fuse a union among the just plain anti-nukes, and those informed about the all too ubiquitous nuclear economic problems.□

How much is enough?

the effects of radiation on organisms

by Norma A. Vargas

At the root of the nuclear power debate is a deep-seated fear of radiation and its effects. Norma Vargas is a graduate student in journalism with a B.S. in biology. She was well qualified to speak with Kelly Clifton of the UW-Clinical Sciences Center and report on his answers to some of our questions about the dangers of radiation.

Is it safer to live next door to an operating nuclear power plant than it is to live in Denver?

That depends on who you talk to.

Proponents of nuclear energy say that because of safety devices installed in the plants, the amount of radiation escaping into the environment is less than what Denver (at a mile above sea level) receives because a thin atmosphere scatters and absorbs less of the natural radiation from the sun and outer space.

Nuclear energy opponents would disagree with that. The statement however, epitomizes a basic argument of the nuclear energy debate.

As public awareness focuses on radiation not only from nuclear power plants but from other man-made sources, such as X-rays, there is renewed concern about the potential hazards and detrimental effects for humans.

Radiation constantly bombards us in the form of energy waves and particles from the sun, outer space and earth.

About 65 percent of the 0.19 rads that an average person receives annually comes from natural sources, says Kelly H. Clifton, professor of human oncology (the study of tumors) at the Clinical Sciences Center. (A rad is a unit of absorbed radiation. One chest X-ray is about one-tenth rad. A series of diagnostic X-rays and fluoroscopy may add up to about 10 rads.) The other 35 percent comes from man-made sources, with the nuclear industry contributing less than 1 percent to that amount.

Most of the data on the effects of radiation on humans has come from survivors of the 1945 atomic bomb explosions in Japan. As a result, evidence of the detrimental effects are based on those studies and experiments with animals.

Tracing a single dose of radiation to specific effects is difficult because of all the variables involved. "An individual's sex, age, diet and lifestyle could account for certain responses," says Clifton.

For example, the consequences of an exposure to the hands would be less damaging than one to the sex organs. So far, the conclusions link high radiation doses with genetic mutations, cancer and birth defects, but questions remain about lower dose effects.

For years, radiation techniques have been used to bring about genetic changes called mutations in plants, to produce improved strains of grains and flowers. Statistics on induced mutations in mammals have come from "millions of breeding mice" at Oak Ridge National Laboratories in Tennessee, says Clifton.

How the mutations occur is unresolved, but some researchers believe that radiation striking a gene, the basic unit of hereditary in the cell, may effect a change in the gene's chemical constituent, DNA. The alteration may be carried on in later cells to produce a detectable effect.

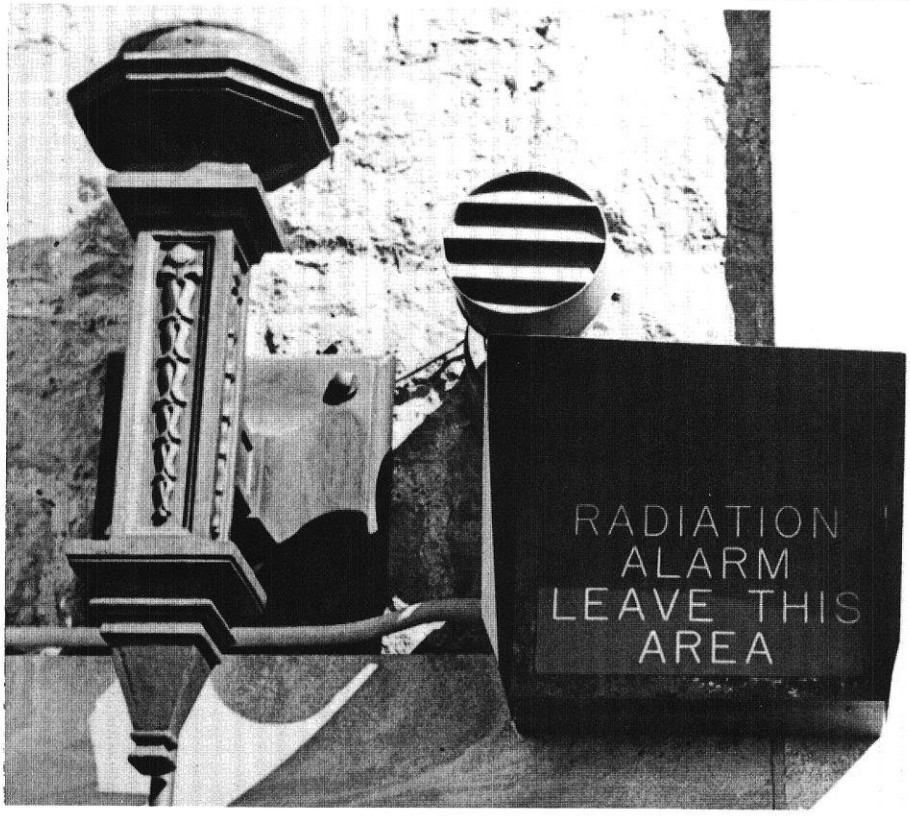
From the studies, a "linear hypothesis" has developed between the rate of mutations and the radiation dose. That means the rates at which the genes undergo changes are directly dependent on the radiation dose. Using the linear relationship, Clifton says that a single high dose given in a short time period could produce more than the same dose given at a low dose rate over a long period of time. Even though no "safe" dose has been found, "it is perhaps safest to assume that biological effects are directly proportional to the total dose received." Clifton adds, "a single 30 to 50 rad exposure to the germ plasm (DNA) could double the rate of spontaneous mutations."

There is concern over increased numbers of genetic changes which may result from the nuclear industry. The alterations might affect susceptibility to a range of outcomes, such as susceptibility to disease, but attributing one to the other would require "many observations of a relatively rare event," continues the scientist.

Besides the possibility of a single gene mutation from radiation, strings of genes called chromosomes may break and rejoin abnormally. The results may produce malformations in future generations. The resulting malformations seen in the so-called "human monsters" are primarily spinal and brain deformities. In children born to survivors of the Hiroshima and Nagasaki bombs, an unusually large number of cases of microcephaly, or deficient brain size, were noted, says Clifton.

But the scientist says that the passage of time is a crucial factor. Following radiation exposure to the sex organs, there is a time interval in which abnormal sex cells are shed. In addition, minimum doses of 250 rads (to the sex

Photo by Paul Nuber



organs) may produce temporary sterility. In mice, abnormalities have been seen only in the first two litters. Explains Clifton, "If enough time were allowed between radiation and conception, the likelihood of 'monsters' would be minimized.

Not only can radiation exposure affect a child before it is conceived, but also while it is developing in the womb. In experiments with rats, says Clifton "embryonic abnormalities have been induced in about 10 percent of a population receiving single doses of 50 to 150 rads." Because the developmental changes occurring during the first two weeks of the rat pregnancy roughly correspond to the first six weeks in humans, he adds a single dose of "one to 10 rads rarely leads to detectable damage, but it is important." Furthermore, an adult who was irradiated during prenatal development, might expect an increased susceptibility to other radiation linked effects.

A more recent concern of radiation exposure is how it may affect aging. Though there are no definite conclusions, some biological processes says Clifton are "disproportionately influenced by radiation exposure." Research suggests two preliminary results in a radiated population: certain diseases, such as hardening of the arteries "occur at an earlier age" and "radiation related diseases, such as cancer occur more frequently." The appearance of any consequences, though, are controlled by the individual's genetic background, as well as other factors, says the scientist. Various reports have estimated measures of life shortening connected to radiation levels emitted by operating nuclear power plants, but Clifton discounts them as "extrapolations from inadequate data."

Much of the public clamor about nuclear energy is over data citing increases in leukemia among residents near weapons testing sites and among workers in nuclear related jobs. Clifton believes that comparison of nuclear power plants with atomic bombs is "like confusing the fire in your furnace with a flame thrower. Both may burn you, but the probabilities are very different." A White House Task Force recently asked the government to issue more warnings about hazards associated with work in nuclear industries.

According to federal standards established in 1957, individuals in the general population should receive less than a "maximum permissible dose" of 0.5 rads a year, while nuclear related workers may receive no more than a total annual 5 rad dose. The worker-allowed exposure is greater because "the number of radiation workers is small as compared to the total population and a very small percentage of them receive the 'maximum permissable dose'," says Clifton, adding that he believes the standards are "adequate."

As for a connection between radiation and cancer, the scientist says a relationship similar to the linear hypothesis for mutations has not been proven for all cancer types. In part, this could be due to the fact that cancer is a family of diseases. Also, in certain cancers, a time lapse of one to 30 years may occur between the cancer causing event and the diseases' onset. "If one assumes linearity, the radiation risks aren't as well established for cancer induction as for mutations," says Clifton.

Although the processes that cause cancer are not fully known, studies have shown that the incidence of thyroid cancer in children, breast cancer in women and leukemia seem to be closely linked to radiation exposure. Of the long-term disease rates found in survivors of the atomic bombs, Clifton says, "An increase in leukemias peaked six to seven years and then 13 years after exposure."

Regarding potential radiation dangers from operating nuclear power plants, the scientist states, "I'm much more concerned that radiation exposure from necessary diagnostic X-ray procedures be minimized than with the nuclear industry."

Because there's never been a major accident at a nuclear power plant, the estimates of cancer deaths, mutations, birth defects and other radiation damage possibly resulting from such an event come from computer projections. The outcome from a core meltdown would depend on "the population within a given

radius . . . how the radiation is distributed (from a meltdown)" and other factors.

Investigations on the probabilities and extent of radiation damage have been based on human dose responses cited in a report, the Biological Effects of Ionizing Radiation (BEIR).

At the level when observable changes are detected in some people, a single 50 rad exposure, "symptoms of acute radiation sickness including one or two days of nausea, diarrhea and fatigue are noted," says Clifton. These symptoms might reoccur three or four weeks later, along with increased susceptibility to infection and fewer blood cells. "At about 450 rads 50 percent of the exposed population might die" probably within a few weeks. At 600 rads, "all of those exposed probably would die."

But to determine the long-term effects of a specific event, the scientist says, would entail a study under controlled conditions with a "large population matched by sex, age, lifestyle and other variables."

At the present time, nuclear groups are using the data to support their pro- or anti- stands. Since 1957, research commissioned by groups, and the government have sought to validate their claims about nuclear safety. Most of them differ on probabilities and results of a reactor accident, such as a meltdown of the containment "core" which houses the radioactive fuel elements. The groups have offered figures on fatalities and other possible consequences.

Most frequently, nuclear energy opponents criticize the 1974 Rasmussen Report, an investigation supported by the Nuclear Regulatory Commission. A 1975 issue of the Editorial Research Reports contrasted the report with a study by an anti-nuclear group, the Union of Concerned Scientists. The numbers suggest that perhaps politics bias biology.

According to the Rasmussen conclusions, following a hypothetical accident about 62 "prompt fatalities" would occur as opposed to 620-990 predicted by the UCS study. About 300 "lethal cancers" might eventually result as opposed to 10,000 to 20,000 cited by UCS. Also, Rasmussen estimates predict that 300 "genetic defects" might be observed, while the UCS group figures are 3,000 to 20,000.

Clifton calls the studies "guesstimates," relying on assumptions for their validity.

Despite the scientific investigations, many of the questions surrounding radiation hazards remain. □

Most of the information being released on the Three Mile Island accident refers to the amount of radiation in terms of rems (radiation equivalent man). Rads (radiation absorbed dose), as used in this article, are multiplied by a RBE (relative biological effectiveness) factor to get rems. The RBE factor relates the biological effects of gamma rays to the rays under study. Rems is more commonly used when regulations on permissible doses of radiation are written.

Photo by Paul Nuber

Statistics on induced mutations in mammals have come from millions of breeding mice.

What choice is there?

if not nuclear, what are the "alternatives?"

by Eric Binder

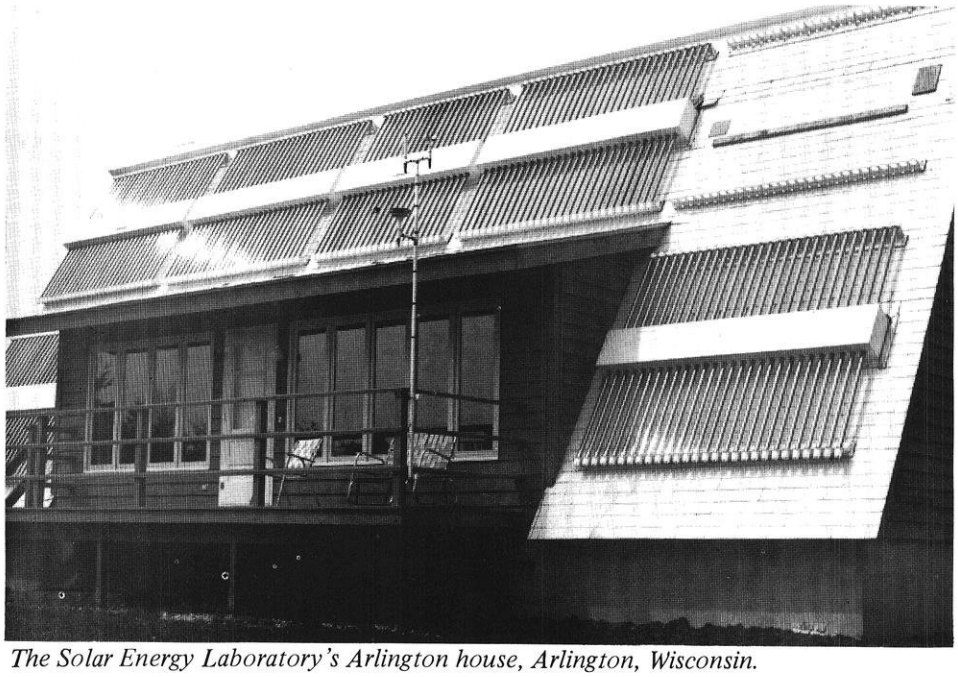
Many groups have formed across the country in the past ten years advocating the development of "alternative" energy sources. WE *asked Eric Binder, a science writer with the University-Industry Research Center, to provide us with a view of the energy picture from the "alternative" side of the controversy.* Wisconsin Engineer *recognizes that some of the information presented in the article is of questionable validity from an engineering standpoint, but the tone of the alternative technologists is certainly captured here.*

The American lifestyle is due for a shakeup; the cheap, low labor-intensive fossil fuels are running out. The energy utilities, to meet our power needs, have endorsed building more nuclear and coal power plants. However, alternatives to coal and nuclear fission can provide a comfortable lifestyle without radically changing our lives.

The alternative energy sources—solar, water, wind, biomass and conservation—are five ways to meet our current and predicted energy needs. "Wind and water power have supplied America with electricity for many years. Since the 1930's, over 150,000 windmills across the country could have generated 14 percent of our electrical needs," said Paul Prevenas, spokesman for the Alternative Power Alliance.

"In Wisconsin alone, there are 400 megavolts ready to be tapped in pre-existing dams. Also, solar energy is expected to contribute about 25 percent of our electricity by the year 2000."

For the rural communities, organic



The Solar Energy Laboratory's Arlington house, Arlington, Wisconsin.

ALTERNATIVE FESTIVAL MAY 5

On May 5, the Center for Community Technology, in cooperation with the Wisconsin Union Directorate, will host the Third Annual Alternative Festival, with this year's theme, "Extending Our Self-Reliant Heritage." The free outdoor educational event will be held on the renovated State Capitol Concourse in Madison. The Festival has been moved from the State Street Mall to accommodate more exhibits and events, and to attract a larger regional audience.

The theme will lend a historical perspective, demonstrating how individuals, and groups can work together with local resources in the future. The festival will feature exhibits, workshops and demonstration projects, films and slide shows, speakers, folk dance and music, mime and theater, and special activities for children.

The Alternative Festival provides diversified people, groups, and businesses an opportunity to share ideas and methods involving alternative energy, transportation, housing, farming, food, health and communication. This year's festival will add craft sellers and concessions, and allow exhibitors to sell their products.

CCT, a Madison based non-profit organization which sponsors several alternative technology projects, needs volunteers to work on publicity, crafts, sponsors, events, exhibits, set-up and concessions. If you are interested, contact the festival coordinator, Charles Moore at (608) 251-2207. The group cordially invites the public to participate and help create the most successful and educational Alternative Festival yet.

The ECE department wind energy conversion station harnesses wind power and supplements the local AC electrical system.

material and methane gas can be burned or converted into some other useful material that can be burned. Corn, for example, can be converted into gasohol, a gasoline substitute.

Conserving energy is our greatest energy source, according to Randy Korda, a spokesman for the Center for Community Technology.

"Conservation doesn't mean doing without electricity; it means designing power systems to save energy," Prevenas explains. "Conservation goes beyond readjusting your thermostat or turning your lights off when you leave a room. It has to do with making appliances more efficient, with connecting applicances together to save energy and with designing newer ways to more effectively generate energy.

"A refrigerator, for example, can use electricity more effectively by a slight alteration. By adjusting the motor to start every four to five hours, this would save energy and keep food between 31° to 41°—temperatures at which food is still good; currently, a refrigerator motor starts every half-an-hour to preserve food at a constant temperature. The constant stopping and starting wastes electricity."

Appliances could be linked together to save power.

"When the refrigerator stops, then the freezer could start; when both are off, then the hot water heater goes on. This design prevents any major energy drain by balancing the rate of energy consumption," Prevenas suggests.

Another aspect of conservation is the principle of cogeneration—getting something for nothing. Sweden, France and Germany use steam—a by-product from power generation—to generate more electricity. The steam turns turbines which crank out the juice. In nuclear power, approximately two-thirds of all the energy is wasted as uncollected steam inside the cooling tower, according to Prevenas.

Solar, hydro and other alternative sources are preferred choices because these energy forms encourage self-sufficiency, independence, do not harm the environment, are clean, provide jobs and are adapted for a specific area.

"We need to adapt the tools to fit a situation or an area, not the other way around," says Korda.

There are several reasons why alternative energy groups dislike and distrust large, capital-intensive power generators.

"Aside from the possible accidents, nuclear power is dangerous," Prevenas claims. "Low level radiation is a by-product that accumulates; its effects may not be detected for 20 years. Also, the waste products are detrimental to the environment."

"Beside the fact that nuclear power is unsafe, there is an over-supply of energy. The utilities have a 30 percent reserved margin that can be tapped." Prevenas said that during the last five years, the observed power demand fell way below the expected, so there is a surplus.

"During the last five years, the energy demand growth has dropped from five percent to one and four-tenths percent of the expected growth rate. Consequently, we are overpowered."

Nuclear power is expensive, according to Prevenas. Uranium 235 which cost $8 per pound in 1973, cost $48 per pound in 1978, and the supplies are running out.

Alternative energy groups prefer alternative energy because these sources are inexpensive and labor intensive; in contrast, nuclear power and coal are high capital intensive and produce few jobs. According to Prevenas, one job is worth $150,000.

Because the alternatives are small, community-oriented and renewable, they are gradually gaining support.

Randy Korda summed it up by saying, "What I am trying to do is to bring to the public some consideration of the natural environment and its limits, but also to keep human and social values or needs in mind, so that these factors will be considered when a group decides on their technological choice."□

The fusion future

an almost unlimited source of energy on our planet

by Eric Bauer

While the debate rages over fission reactors, fusion energy is as yet free of such controversy. Most of the press on fusion has been favorable, if not starry-eyed. Eric Bauer, a graduating senior in Mechanical engineering who is looking at job possibilities in the fusion research area, helps put the basic fusion principle in perspective for us.

The term "thermonuclear fusion" is much used these days and rarely understood. It is seen by many as the remedy for all our energy ills, and the public is deluged with the same optimistic reports about its potential as a source of atomic power that heralded the arrival of uranium fission reactors. But, just what is thermonuclear fusion? Why has it attracted so much attention recently? Isn't it similar to fission? Is it free of radioactive wastes? These are questions that many people have been asking.

To understand thermonuclear fusion, one must have an understanding of plasma. Plasma, often considered a fourth state of matter because it has properties unlike those of gases, liquids, or solids, is an ion-electron mixture that is formed by the ionization of elements. Some common examples of plasma are the flash of a lightning bolt, the conducting gas in a neon sign, and the sun.

If a plasma made from specific light elements (i.e. hydrogen) could be confined to a certain density for a minimum length of time, the nuclei of the light atoms would fuse and produce energy. Research has shown that the easiest such fusion reaction to produce is one between deuterium (D) and tritium (T), isotopes of hydrogen. The reaction is written as:

$$D + T = n + He$$

where n is a neutron and He is a He nuclei.

To obtain such controlled reactions is no easy task. Temperatures in excess of 100 million degrees Celsius and confinement pressures of monstrous magnitude are required to produce the needed conditions.

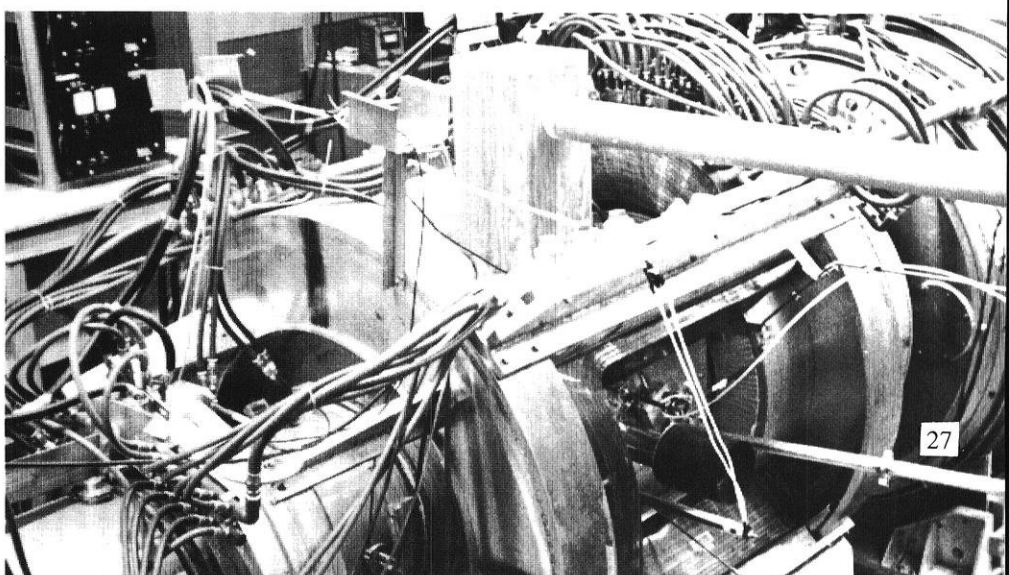
So why bother? The answer is that controlled fusion reactions would allow us to tap an almost unlimited source of energy on our planet – the hydrogen in sea water. Each gallon of seawater contains deuterium, the basic fuel for fusion reactions, with an energy value equal to 300 gallons of gasoline. The other hydrogen isotope, tritium, is produced from lithium, an abundant element. But fueling is not limited by the earth's lithium supply, as second or third generation fusion reactors should be capable of producing fusion reactions which require only deuterium (D-D) reactions.

How about radioactivity? The radioactivity associated with the D-T fusion reaction is from the neutron (n) product. However, the level of radioactive wastes that will probably occur during the D-T process are orders of magnitude less than the wastes produced by the current nuclear fission reactors. With careful engineering, these wastes should be minimized and easily maintained. In addition, if the second or third generation of fusion reactors are indeed capable of maintaining D-D reactions, no neutrons will be produced except by relatively insignificant secondary reactions. There are other exotic reactions under study which will possibly all but eliminate any neutron formation.

So, how close are we to commercial fusion reactor capability? To appreciate this question one should be familiar with the basic problems involved with achieving fusion in a small volume while keeping it from contacting ordinary matter, including air. This necessitates a vacuum chamber. Simultaneously, we must prevent the plasma's fusible nuclei from touching the chamber walls before they have had sufficient time to collide and fuse.

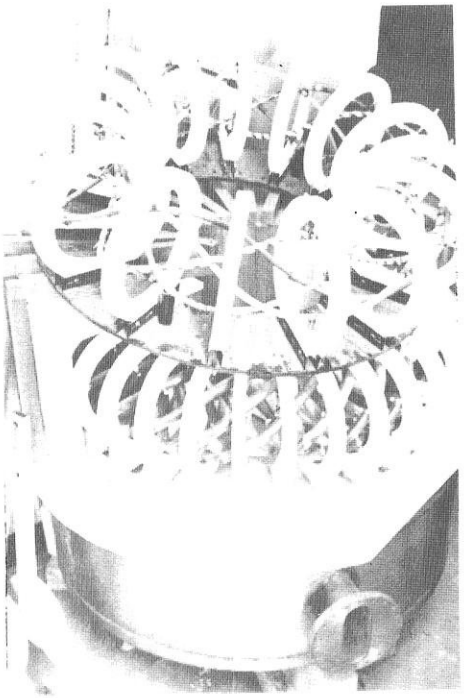
In addressing this problem, two basic methods have been developed – inertial confinement and magnetic confinement.

Photos by John Wardale



The tandem mirror machine, fusion test apparatus in ERB.

In inertial confinement, the fusion fuel is so rapidly heated that the nuclei react before they can escape to the walls. The three drivers presently being used to apply the heat are laser, relativistic electrons, and light and heavy ions. Of these, laser drivers are receiving the most attention.



A model of a toroidal system of confinement for fusion reactions.

The magnetic confinement method uses intense, and specially shaped magnetic fields to contain the charged plasma; thus, keeping it from touching the chamber walls. Two general types of "bottling" arrangements have been created: open-ended (mirror) systems and closed (toroidal) systems. In the open systems, intense magnetic-field regions, known as mirrors, repel helically moving plasma particles. These magnetic mirrors are located at both ends of the confinement region. This system traps the charged particles between the ends, reflecting them from one mirror to the other for the necessary amount of time to allow the fusion reactions to occur.

Closed systems bend the open tube into a circular shape, forming a torus. The particles then move freely along the magnetic field lines within the torus. To escape, the particles must cross the field lines, a relatively slow process.

Both magnetic approaches have suffered from a major problem known as plasma instability. Unstable gross motions and fine-scale turbulences cause either rapid expulsion of particles from the magnetic field or a somewhat slower but still unacceptable diffusion out of the field.

Within the last two years, significant developments have been made, stimulating a great deal of optimism in the fusion research community. There are presently large scale projects being conducted in the USSR, the USA, the European Community, and Japan. In these project areas, a toroidal system of confinement known as the Tokamak is receiving the most publicity and interest.

Despite the renewed optimism and extensive research in the area of controlled thermonuclear fusion, even the most promising estimates do not foresee a commercial fusion reactor in operation before the year 2000. It is obvious that, though nuclear fusion has the capability of providing a limitless source of commercial energy, it is not the answer to our immediate energy needs.

The Fusion Energy Foundation

messianic or nuts?

by Philip Stielstra

Photos by John Wardale

On any given Wednesday, it's hard to make your way through Union South without being accosted by a group of pro-nukes who call themselves the Fusion Energy Foundation. It takes most observers about fifteen seconds with them to realize that they are pushing something more than nuclear energy. Philip Stielstra, a survivor of the sixties and a man with considerable political experience, agreed to find out what they are all about for us.

Nuclear energy, once thought to be the panacea for our future energy needs, has met with stiff resistance. Opposition from political liberals and environmentalists alike has been strong, outspoken, and not without success. Originally promising to provide electricity "too cheap to meter," nuclear power is increasingly viewed as being too risky and too expensive to be worth the investment. Liberals, who tend to favor decentralized and no-growth policies, fear that nuclear power will promote unbridled, inflation-fueling growth while at the same time serve to increase the concentration of political and economic power. Environmentalists, of course, feel that the possibility of a nuclear accident on site or in transport, together with the inadequacy of nuclear waste disposal represent a direct threat to human life as well as the environment.

In spite of its detractors, nuclear power receives vigorous support from a variety of sources, creating in the process some very strange bedfellows. Quite naturally, nuclear engineers and scientists are among its most ardent proponents. Their opinions are often the most credible because of their familiarity with the subject mat-

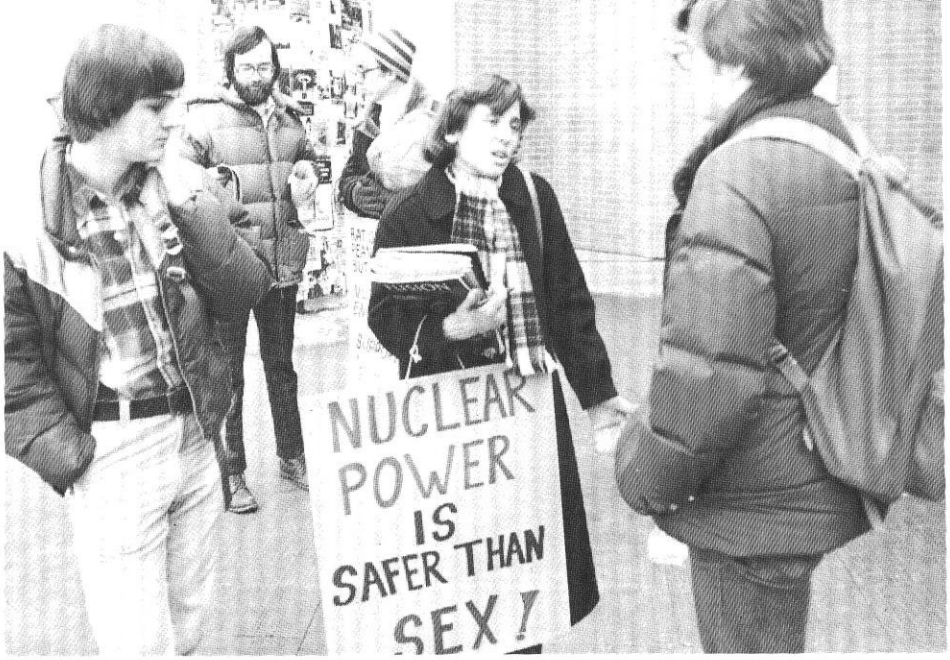
A familiar scene at Union South: the FEF pushes nuclear fusion power and politics.

ter, yet also a bit suspect because of their vested interest. In national and state political arenas, much of the vocal support for nuclear power is provided by political conservatives who believe it still holds its original promise. The problem, as they see it, is the environmentalists themselves who are causing the costs of nuclear energy to increase by unnecessary court battles and delayed construction.

Interestingly enough, a group representing the opposite end of the political spectrum, the Fusion Energy Foundation (FEF), has joined the fight for nuclear power. However, widely varying political philosophies, methods, and motivations prevent the engineers, scientists, and political conservatives from feeling comfortable in a pro-nuclear alliance with the FEF.

The FEF is comprised mostly of volunteers and organizers from the U.S. Labor Party. They talk to people about their ideas wherever they have an audience: airports, shopping centers, and even traffic islands. Despite the snow and cold winter weather, they can be seen almost weekly campaigning in front of Union South on the U.W. campus. Whether one agrees with their ideas or not, one has to admire their perserverance.

According to Paul Greenberg, chairman of the Wisconsin Labor Party, their campaign for nuclear power stems from a moral and political commitment to industrial growth through the advancement of technology. Basically humanist in outlook, Greenberg believes that "high technology reflects the development of the human mind." Marx and Lenin are *not* their heroes as one might expect; instead their favorite philosopher is Plato, who was a physicist, mathematician, and mystic all wrapped up in one. For Plato, the universal laws of nature were pre-existent and unchanging, and discovering them through the exercise of the scientific mind was a serious business. Similarly, Greenberg claims that the development of nuclear fusion is attainable and that problems associated with nuclear fission can be resolved by rigorously applying the creative powers of the human intellect.



But why nuclear power? Why not solar power or wind power, for example? According to Greenberg, nuclear power offers the best possible solution to the problem of energy scarcity because it is a high density source of energy, whereas energy from the sun or wind is diffuse and takes more time, space, and human labor to collect. Although requiring a higher initial capital investment, he considers energy-dense sources to be advantageous from the point of view that they increase the efficiency and productivity of labor. Fossil fuels and magnetohydrodynamics fall into the category of energy-dense resources, according to his definition, whereas coal liquefication/gasification and ocean thermal energy conversion do not.

Student attitudes toward the FEF on campus have varied from that of curious interest to hostility. Most students pass them by and are too busy to be bothered, but some stop and listen to the FEF sales pitch. However these conversations usually end abruptly when the student is asked to shell out $2.00 to buy the latest issue of *Fusion* magazine, FEF's monthly publication. Hostile responses, which occur infrequently, are best countered with a sense of humor, according to one FEF organizer I talked to. "One insult I can pass off by cracking a joke," she explained, "but if they keep being hostile, I just dish it right back and then they usually go away." One group that is particularly uneasy about FEF's presence on campus is the nuclear engineers. They feel that nuclear issues are being misrepresented by a group with dubious credentials and ulterior political motives, thereby detracting from the legitimate fight for the popular acceptance and adoption of nuclear energy. "Lunatic fringe!" and "Wishful thinkers pushing something which isn't even a proven technology!" were the most complimentary statements I could get out of one senior nuclear engineering student. Other nuclear engineering students I talked to used slightly different words, but the sentiment was the same.

It is doubtful that the FEF will recruit many to their cause at this campus, given the present political mood. Yet, their presence is noteworthy, if for no other reason than that they serve as some sort of social or political barometer. The future of nuclear power has become a very divisive issue, not only in the U.S., but in Western Europe and Japan. That the FEF believes that their pro-nuclear banners can provide them some political mileage is an indication of the political significance of the energy question. The pro-nuclear and anti-nuclear camps are not easily identified on the political spectrum. Revolutionary communists, power companies, and "Platoists" are advocating further development of nuclear power for some very different reasons. Who knows, some enterprising individual might do well selling score cards (to identify the players) at the next Public Service Commission hearing on a proposed nuclear power plant? □

Today's research-tomorrow's energy

by Bob Polasek

Energy research is being carried out on several fronts at UW-Madison, one of the nation's leading research institutions. The Energy Research Center assists in the development of energy research projects that range from conservation measures to nuclear fusion. A sophomore in the Engineering College, Bob Polasek, filed this report on the workings of the ERC.

Think back, when did the term "energy crisis" slip into our speech? Wasn't it about 1973? That was the year when gasoline stations rationed the amount of fuel sold, due to the Arab oil embargo. While many people still believe that the only reason for the oil shortage was a desire for prosperity by the OPEC nations, the fact still remains that oil and natural gas supplies are in finite quantity.

Although petroleum and natural gas supplies are not in danger of terminating in the imminent future, alternate energy sources must be developed for future security. Development of these alternate energy sources and efficient utilization of present ones are the aims of a number of research projects within the U.W.-Madison College of Engineering. The Energy Research Center (ERC) was established in 1976 in order to assist the faculty in the development of energy research projects, and to facilitate the transfer of research knowledge into applicable uses for industry, government, and the public.

Electrical and Computer Engineering Professor James J. Skiles, Director of the ERC, devotes much of his time to the development of the technical aspects of energy research, and often represents the ERC in public forums relating to energy. He is assisted by Tom Murray, Assistant Director, who handles publication and information activities. Associate Director, Willie Nunnery, is currently on leave with the administration of Gov. Dreyfus as Deputy Secretary of the Department of Administration for the State of Wisconsin. He devotes special attention to public policy and legislation concerning energy. The ERC receives support from the Wisconsin Electric Utilities Research Foundation, industry, private foundations, the Federal Government and the University.

The ERC engages in a wide variety of activities. Informing the public about the current energy situation is a major concern. A recent survey indicated that the public was skeptical of the entire energy research situation due to a lack of information. Steve Lovejoy, of the Wisconsin State Journal, and Tom Murray have assembled a series of newspaper articles entitled "Energy - Your Decision." These articles, published monthly in the Wisconsin State Journal since 1976, cover current energy developments from consumer oriented subjects, such as energy efficiency in the home, to more complex subjects such as research in nuclear fusion. The articles are written to familiarize the public with all facets of the energy situation.

Another function of the ERC is the development of techniques which efficiently utilize energy resources, methods which will conserve energy. Professors James Skiles and John Mitchell have worked on committees advising the State Department of Industry, Labor and Human Relations in the development of modern building codes which will enhance the energy efficiency of newly created structures. Professor Wesley Foell works with the Public Service Commission and the Office of State Planning and Energy. He has surveyed energy use in the state, and developed Wisconsin's comprehensive energy plan. Other energy conservation projects include studies of heating and air conditioning systems, thermal insulation performance analysis, energy conservation in food processing plants, recycling waste materials, and computer controlled electricity demand. Professor Skiles also works with the Wisconsin Energy Extension Service promoting energy conservation and applications of alternate energy sources.

Photo by Paul Nuber

Professor Skiles, Director of Energy Research Center.

When energy policy is discussed, it must be recognized that the legislative bodies of State and Federal Government play an important role in determining which research projects warrant government aid. The ERC monitors proposed energy legislation at the state and national level, informs University faculty members of significant pending energy legislation and encourages the presentation of expert testimony at legislative hearings. ERC Associate Director, Willie Nunnery,

informs legislative bodies of energy research potential at the University of Wisconsin. His efforts have resulted in a greater understanding of engineering capability, along with a substantial increase in allocated financial support for research projects.

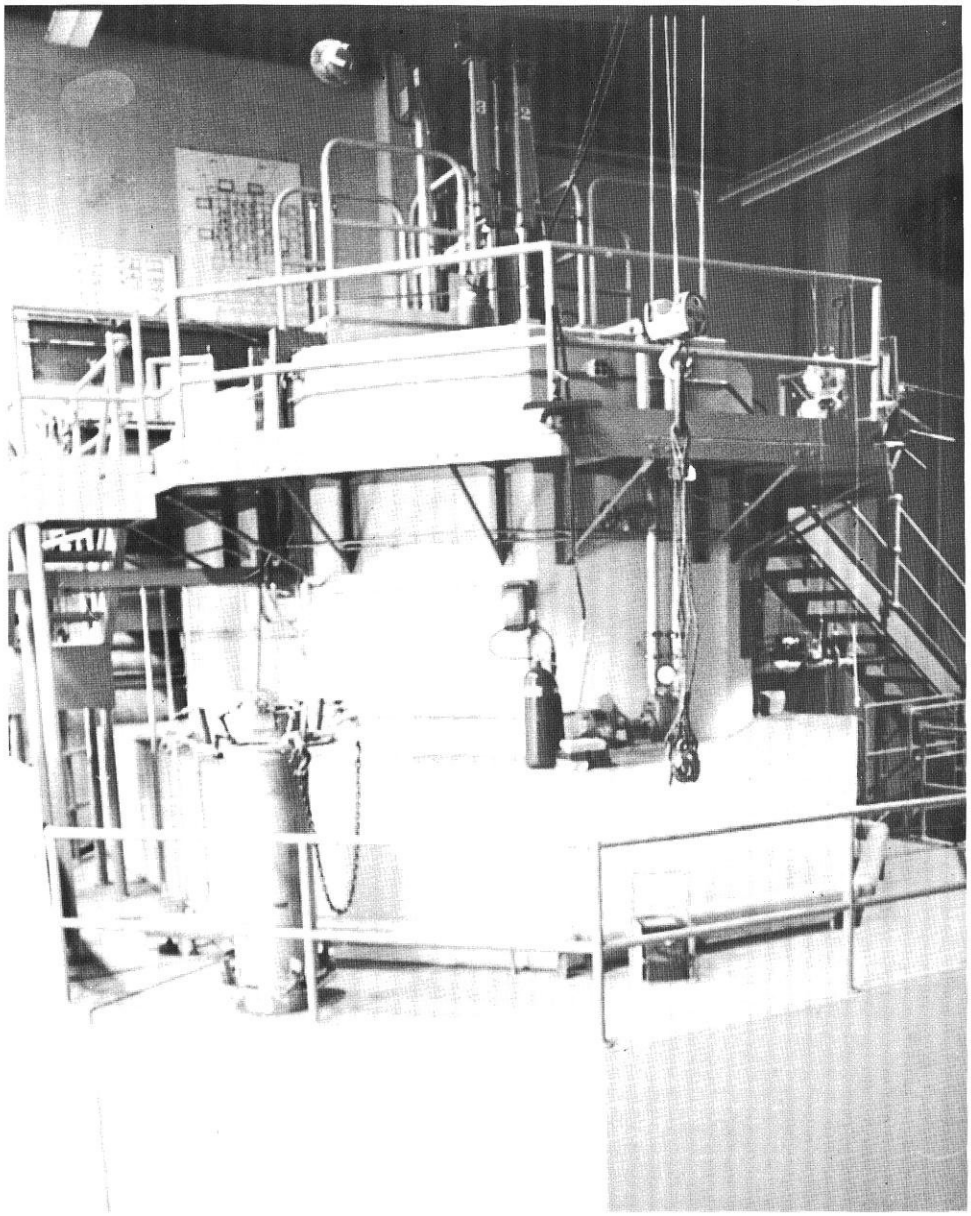
The final function of the ERC is the development of research projects for future energy sources such as coal liquefaction, geothermal energy, wind energy, and energy conservation.

Extensive research has already been done in the College of Engineering in many energy fields, including solar and nuclear energy which appear to be two of the most promising energy sources for the future. The staff of the Solar Energy Laboratory has developed methods of predicting how solar energy systems will work and how to design these systems. Components, such as the collectors, storage units, controls, buildings, and pumps, are tested, and relationships are constructed to find out how the components interact in the solar system. A computer simulation program, TRNSYS, developed for modeling the performance of solar heating and cooling systems, is the product of previous experimentation. This program has widespread applications in industry, solar energy firms, government, and universities. A recently developed method of designing solar heating systems (F-CHART), has correlated the results of many experiments. This method allows for quick estimates of thermal performance in solar heating systems, along with indicating the economics and optimum design. It has been implemented in the new solar heating industry as a design tool. The Solar Energy Lab has also been responsible for the recently completed Arlington solar home. It is an experimental project which will enable engineers to study a new type of solar heating system.

Generation of electricity by nuclear power is another area of energy study being conducted at U.W.-Madison. Nuclear fission research has been going on for years. Now attention is turning to another means of nuclear power generation. The potential of controlled nuclear fusion as a source of almost unlimited energy is the subject of major research efforts in the Nuclear Engineering Department, one of the recognized international leaders in this research. Although research is still in its early stages, reasonable evidence indicates that nuclear fusion could develop into our primary energy source sometime toward the middle of the next century.

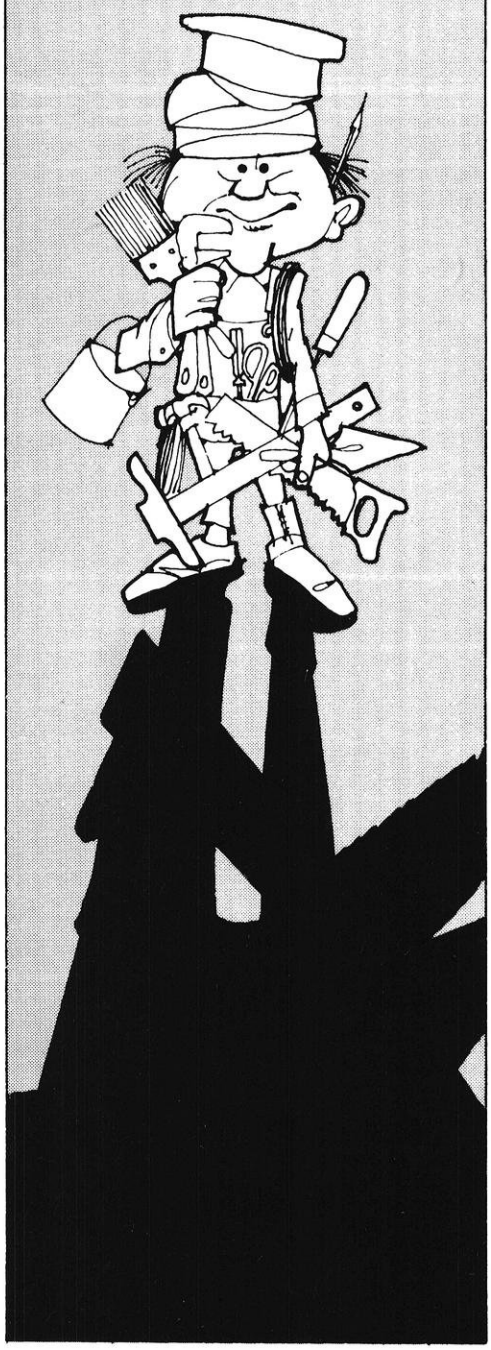
It is evident that substantial progress has been made in energy research by UW-Madison College of Engineering. However, it is essential that the public and the legislature understand what the current energy situation is, and what progress has been made in the development of future energy sources. Many people are skeptical of technological advances because they are unfamiliar with the the actual advantages and disadvantages of various energy sources. If energy research projects are to progress as they have in the past, it is mandatory that the public and the legislature support current research projects, both morally and financially. The ERC has recognized this and has initiated many programs in an attempt to solve this problem. □

Photo by John Wardale



The Nuclear Engineering department's research reactor in the ME building.

JACK OF ALL TRADES?



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