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In the Matter of)
)
The Toledo Edison)
Company and) Docket No. 50-346
Cleveland Electric)
Illuminating Company)
)
Davis-Besse Nuclear)
Power Station)

DOCKETED USAEC FEB 4 1971 Office of the Secretary Public Proceedings Branch

Affidavit

I, Vicki Evans, being first duly sworn, offer the following affidavit:

I am Vicki Evans, Co-Chairman of L.I.F.E. (Living In a Finer Environment), Bowling Green State University, Bowling Green, Ohio representing L.I.F.E. as an intervenor in the matter of Toledo Edison Company and Cleveland Electric Illuminating Company, Davis-Besse Nuclear Power Station, Docket Number 50-346.

I have read pages 2645 and 5922 of American Men of Science, The Physical and Biological Sciences, 11th edition, 1967, R.R. Bowker Company, New York and London and have read the statements therein indicating that Board members

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Dr. Charles Winters and Dr. Walter Jordan are employed by organizations with a direct pecuniary interest in the outcome of proceedings such as these.

Dr. Charles Winters is associated with Union Carbide Corporation whose Nuclear Division, according to the pages I have read in the Union Carbide Corporation Annual Report, 1969, pages 9 and 27, has the responsibility for operation of government owned nuclear facilities at Oak Ridge, Tennessee and Paducah, Kentucky under contract with the United States Atomic Energy Commission. The Annual Report also states that Union Carbide Corporation is also engaged in research not only on the peacetime applications of nuclear energy, but also specifically applying nuclear technology to electric power generation.

Dr. Walter Jordan is associated with Oak Ridge National Laboratories which, it is my understanding from the Union Carbide Corporation Annual Report, 1969, are operated by Union Carbide Corporation under contract with the United States Atomic Energy Commission. It is my understanding that Union Carbide Corporation at Oak Ridge National Laboratories processes enriched uranium in their gaseous diffusion plant for use in commercial reactors in nuclear power plants.

From this information it is my belief that these facts demonstrate the vested financial interest in commercial nuclear power plants of both the groups with which Dr. Jordan and Dr. Winters are associated. The proliferation of nuclear power plants therefore is a matter of substantial concern financially to the employers of both board members.

I have also read a recently published article entitled "Nuclear Energy - Benefits V.S. Risks", Physics Today, p. 32, May 1970. This article (attached) stated it was: (page 38) based on the work sponsored by the Atomic Energy Commission under contract with the Union Carbide Corporation and clearly states that despite the hazards involved nuclear power plants should be built. From these facts it is my belief that Dr. Jordan has already indicated his bias in favor of granting a construction permit.

Under such circumstances this Intervenor cannot receive an unprejudiced hearing of its arguments in opposition to the granting of the permit.

page 4

x Vicki Evans

Sworn to before me and subscribed in my presence this 26th day of January, 1971.

Beatrice K. Fleischer
Notary Public

no. exp. date

NUCLEAR ENERGY: BENEFITS VERSUS RISKS

Critics who dwell on the risks to the public from nuclear-power plants should compare these risks with the present hazards that would be eliminated.

Walter H. Jordan

JUST A FEW YEARS AGO almost everyone looked forward to the coming age of nuclear energy as a boon to mankind. Of course the coal interests have always been less than enthusiastic, but that was to be expected. Recently, however, many persons have undertaken the role of professional critics, joined by some conservationists.

I feel particularly betrayed in this instance, for I have long considered myself a conservationist. Certainly one of my strongest motives in promoting nuclear energy has always been the conserving of our valuable and irreplaceable fossil fuels, coal, oil and gas. Because this can be accomplished and, at the same time, the pollution of our atmosphere reduced, I felt a sense of righteousness in promoting nuclear energy. But these critics say that all these fine benefits just are not worth the risk. I strongly disagree. I believe that more lives have already been saved by the advent of nuclear energy than will be lost as a consequence of it in the next hundred years.

A swarm of controversy over the growing nuclear technology appears to be developing. If it were just an occasional book or article, I would be inclined to hold my peace. Unfortunately, it is deeper than that. Part of the federal licensing procedure for a nuclear-power plant, though not for any other kind, stipulates that a public hearing be held at which individuals may intervene. In some cases these hearings have been so drawn out that the power company has withdrawn its application rather than face the continued publicity. A power plant planned for construction at Bodega Bay, Calif. has been abandoned. The opposition was concerned mainly with the natural beauty of the proposed site, but the issue of earthquake damage was the deciding factor. New York State Electric & Gas Co has decided to postpone indefinitely the project to build a nuclear-power plant at Ithaca. In this instance the intervenors protested the possible thermal pollution to Cayuga Lake.

Electrical power, polluted air

First, let me summarize some of the benefits. I do this quickly because there really is not much argument about this part. The real reason that power reactors are being installed in so many places in the US (some 80 nuclear-power plants have been ordered; 15 are in operation) is to save money. Although construction costs of a nuclear plant are higher than those for a fossil-fueled plant, the operating costs are much less. As a consequence the cost of electricity will be less than it would have been with fossil-fuel plants.

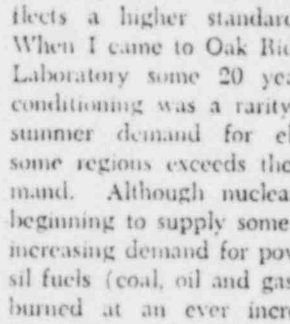
The demand for electricity has almost doubled within the past ten

Table 1. Risks in Daily Life*

Type of Risk	Death rate per 10^8 hrs of exposure
Riding in a private car (US)	0.95
Riding on railroads and busses	0.08
Flying on a scheduled airline	2.4
Riding a motorcycle	6.6
Death due to disease, old age	1.0
Smoking cigarettes	1.2
Rock climbing	40.0
Radiation at a rate of 5 rem/yr (extrapolated linearly from experiments at high-dose rate)	0.05

* Data from reference 3.

years, and another doubling is projected for the next decade. Part of this rise is caused by the population increase, but for the most part it reflects a higher standard of living. When I came to Oak Ridge National Laboratory some 20 years ago, air conditioning was a rarity. Now the summer demand for electricity in some regions exceeds the winter demand. Although nuclear energy is beginning to supply some of the ever increasing demand for power, the fossil fuels (coal, oil and gas) are being burned at an ever increasing rate. Moreover our reserves are very limited. Whether the commercial supply of them will be exhausted in 50 years or 200 years is not certain—but the time is short compared with the already brief span of man's existence on this planet, or with the hundreds of millions of years that it took to form those deposits of coal and oil. Our



With Oak Ridge National Laboratory since 1946, Walter H. Jordan was appointed assistant director in 1961. After receiving his PhD from Cal Tech, he taught at the University of South Dakota and worked at the radiation laboratory, MIT. He is now a part-time professor at the University of Tennessee.

limited reserves are fast going up in smoke.

And smoke there is! From a single large, coal-fired power plant, such as Bull Run near Oak Ridge, hundreds of tons of noxious sulfur oxides are emitted every day. In addition to the sulfur, thousands of tons of carbon dioxide are emitted by Bull Run per day. (It has been observed that the carbon-dioxide concentration in the atmosphere is increasing at about 2% per decade, a change that may have implications for long-term effects on climate.) No longer is the air clean and pure in the Tennessee Valley—or in New York, or in Los Angeles, or indeed in most of the US. Our eyes may burn, and pine trees drop their needles.

Unfavorable atmospheric conditions can be so bad that many people sicken and die as they did in Donora, Pa., in 1948 (43% of the population became ill, 20 deaths attributed to smog), or in London, England, in December 1952, when the excess fatalities were estimated at 3500.[1] (There was a time in English history, around 1300, when King Edward I decided to take steps toward reducing pollution. He made it a crime punishable by death to burn coal.)

It is imperative that we take steps to reduce this outpouring of noxious gases either by removing them from the smokestacks, thereby increasing the cost of electricity, or by installing nuclear-power plants. Coal-fired power plants are not the only contributors to the air pollution of the country: Automobiles and trucks also represent a major source, as does the heating of homes and buildings. To reduce this pollution caused by combustion, a general conversion to electricity will have to ensue. Homes must be heated electrically and automobiles and trains driven electrically, which will triple the demand for electricity, a challenge that can only be met economically with nuclear-power plants.

Nuclear power offers a virtually inexhaustible supply of cheap electricity. Moreover, it offers a chance to clean up the atmosphere. But there is, in addition, a third major benefit—the myriad uses of radioisotopes. These isotopes, produced so copiously in every nuclear-power plant (and indeed representing the chief danger in their operation), have already proven to be a great boon to mankind. Although production reactors have been the chief source of the fission-product radioisotopes, such as Sr^{90} and Cs^{137}, power reactors will undoubtedly become the major producers in the future. Research reactors and cyclotrons supply most of the medical isotopes. Estimates of the benefits of these isotopes to industry are of the order of a $1000 million a year. Many major industries use radioisotopes to gauge the thickness of sheet steel in a rolling mill, the level of a liquid in a tank or the flow of oil through a pipeline is measured with radioisotopes. Isotopes are also used for well logging in the exploration for oil. A slow leak in a water main or a gas line can be found with an isotopic tracer. The gamma rays from Co^{60} are used for "x raying" welds and are used in a chemical plant to produce new plastics. The dramatic uses of radioisotopes in agriculture, biology and medicine have caught everyone's attention.

Daily hazards

I could easily lecture for many hours about the benefits of nuclear energy. However, there are also risks. Those radioactive isotopes that are so useful when properly prepared also represent a major hazard. The possibility, no matter how remote, of spreading millions of curies of radioactivity over the countryside is not a pleasant one to contemplate. The critics present a gloomy picture. How likely is such an accident? Before discussing that question, let us recall some risks that we all encounter in everyday life[2,3] (see Table 1).

To get a feeling for the numbers involved, consider the probability that an average member of the population will die during the next hour due to disease, such as heart failure and cancer. The figure is about one in a million, or probability $P = 10^{-6}$ hour^{-1}.

It appears that people are willing to accept a risk of about that same magnitude provided it is voluntary and the benefits are personal and real. For example, the risk of being killed while riding in a car is about 10^{-6} per hour of exposure, about one-tenth of what it was a generation ago. There have indeed been significant advances in automobile safety. The risk of riding in a commercial airplane is now about 10^{-6} per hour, which means that air travel is some ten times safer than auto travel on a mileage basis because planes travel so much farther in an hour. Air travel in private planes is a much more dangerous undertaking

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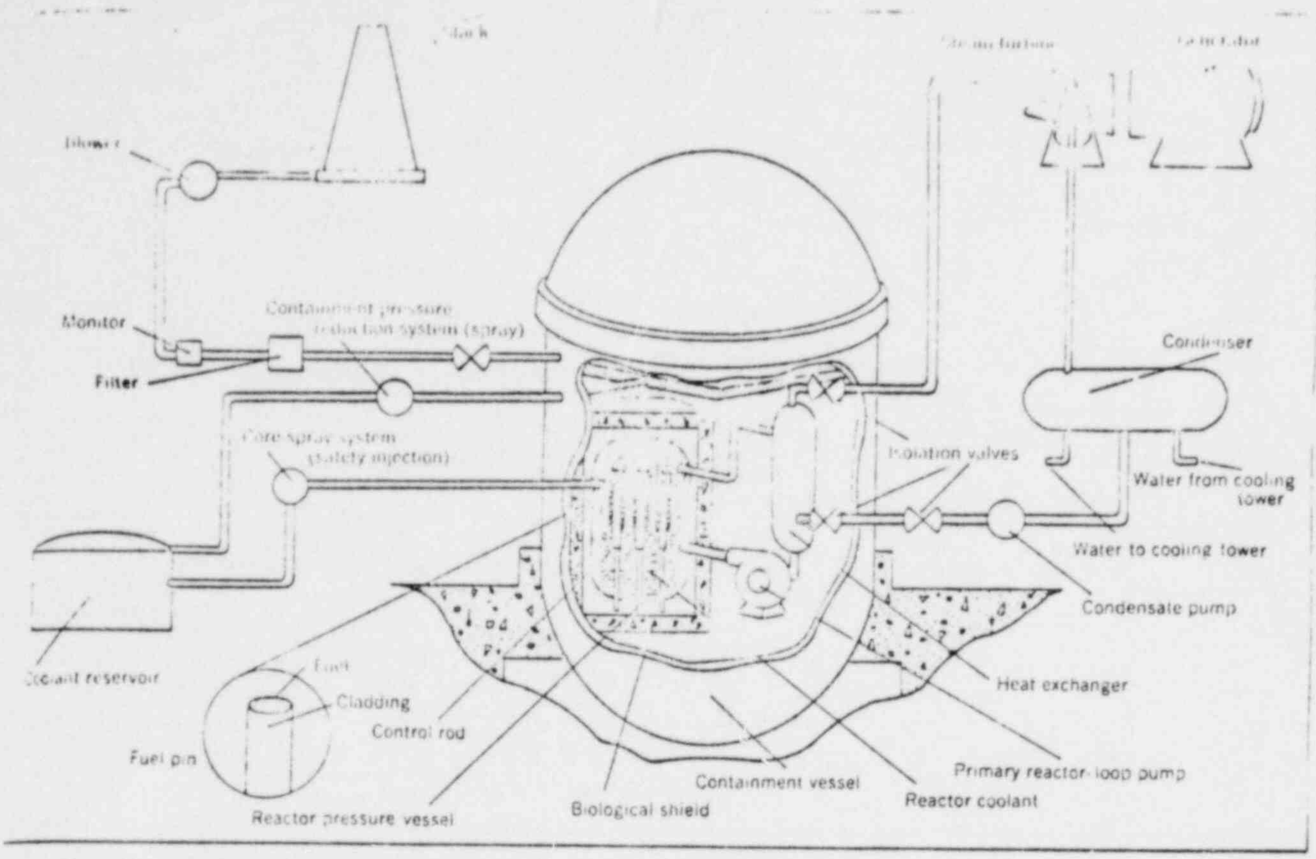


…EGUARDS IN A NUCLEAR-POWER REACTOR. The fuel cladding, the reactor vessel and the …ntainment vessel are the three major barriers that prevent the escape of fission products.

…lities in these flights are some 20 … 10^{-6} per hour of exposure, 20 …es more risky than commercial air …vel. And yet many people willing… take the risk of their own free will. …one imposes the risk upon them.

On the other hand, if the risk is im…ed upon a person (such as an air…e falling on a busy street, or the …osion of gas mains in a city,) he …insist that the probability of death …much less than the normal disease …h rate. He will live below a dam, …e is convinced that the chance of …dam collapsing is very remote (per… 10^{-8} per hour of exposure), and …there is good reason (benefit) for …s to live with the exposure to a …l but not zero, hazard. He may …test if a chemical plant or a nuclear-…er station is built near his home—…gesting that it be built in another …tion—but if he is convinced that …risk is small, he will not move. A …f risk is, as we have assumed, …ething less than 10^{-8} per hour of …osure or 10^{-4} per year. In other …ds, if he is convinced that a major …astrophe will happen only about once in every 10 000 years, he will feel that the risk is acceptably small. Will Los Angeles and San Francisco be spared a major earthquake for that long? Less than 50 years ago 150 000 people were killed in Japan as a result of an earthquake.

Nuclear risks …

Only by experience can we demonstrate that the risk of living near a nuclear plant is small. The situation is indeed remarkably similar to the budding electric-power industry in the latter part of the last century. There was a great deal of opposition to the introduction of electricity into the home. The critics pointed out that electricity was dangerous, that people would be electrocuted, that innocent children would stick their fingers into electric sockets and die a horrible death and that wires would become overheated and burn down the homes. Of course they were right. A thousand people in the US are accidentally electrocuted every year. Moreover, it has been estimated that 16% of the fires are electrical in origin and 1200 Americans lost their lives last year in these fires. However, there are 200 million people in the US, so the individual's chance of being killed is small, about 10^{-9} per hour of exposure. This is well below the "acceptable" risk of 10^{-8}, and the benefits of electricity are so apparent to everyone that no one wants to turn back the clock.

Let us now turn to the risks of operating nuclear-power plants. These can currently be classified as:

- Thermal pollution of the rivers and lakes, also known as thermal effects.
- Low-level release of radioactivity into the air and ground waters caused by the normal operation of nuclear-power and reprocessing plants.
- The accidental release of large amounts of radioactivity.

To my mind this last item is the risk causing the most concern, but the critics (Chauncey Starr calls them "nuclear hypochondriacs") have been equally vociferous about the first two items.

Thermal pollution is not a new phe-

Disagreement in New York City

The controversy surrounding nuclear power erupted at a 4 March public hearing in New York City, where the city council is considering a law that would ban nuclear reactors and a resolution that would urge the Atomic Energy Commission to deny an operating permit for Columbia University's research reactor. The move to ban reactors, whose main sponsor is Theodore Weiss (D-3rd Council District), is being challenged by a more moderate bill introduced by Bertram Gelfand (D-8th Council District) that would require a city license for all reactors, after AEC approval.

Held before the council's Committee on Environmental Protection and General Welfare, the arguments pivoted on two issues: the validity of AEC safety standards, especially "permissible" radiation levels, and the city's jurisdiction over nuclear-power plants and reactors.

Gelfand favors city licensing because ". . . controls should be a little closer to the people affected than the AEC is in Washington. But banning all reactors is an extreme answer. It precludes not only the use of nuclear energy, but the examination of it for educational purposes. It could represent as great a danger to the well-being of the people as an over proliferation of these devices. Yet local control is important, and unless scientists and their organizations can accept this control, they will stimulate local opposition and will encourage a spectrum of people to exploit the issue and create unjustified hysteria that will prevent technological progress."

The emphasis on local control was strengthened by Elise Jerard, who represented the Independent Phi Beta Kappa Environmental Study Group, the Citizens' Rights Committee and the Committee on Environmental Contamination: "The US Congress in 1959 deliberately deleted a pre-emption statement that would have given the AEC sole control over radioactive hazards 'in violation of the rights of states to safeguard citizens and their environment.' This right must be also recognized on the local level. The AEC must cease to act as an authoritarian self-regulating principality before it leads us to irreversible disaster." Local control, she contended, is needed to cope with ". . . the blind momentum of industry abetted by the AEC and the Congressional Joint Committee on Atomic Energy, which will place 12 large reactors on Long Island Sound."

Joseph Di Nunno, AEC special assistant to the General Manager for Environmental Affairs, attempted to convince the committee of the AEC's conservative position on urban siting. In the testimony before the Congressional Joint Committee on Atomic Energy in 1967, he said, ". . . the AEC pointed out that urban siting required further important advances in reactor-plant design . . . and that until additional research and development results were obtained and more experienced gained . . . the AEC planned to maintain a conservative approach in evaluating plant safety and in establishing a balance between compensating engineering safety features and population density. Although this does not rule out the possibility that power reactors may one day be authorized for metropolitan centers, as a practical matter they have not been authorized either in New York City or in any other location having equivalent population densities."

Di Nunno then made the distinction between the AEC's policy on nuclear-power plants and research reactors. The research reactors, he says, ". . . have been constructed in many different locations including metropolitan areas because neither their normal effluents nor the potential ef-

fects of equipment failure are sufficient to justify isolation on safety grounds. Also, extensive, favorable experience has provided much confidence that they can be used safely. About 100 such reactors have accumulated some 750 reactor years operating time without causing any instance of radiation exposure beyond the established safety limits to members of the public."

The validity of these safety limits for radiation were severely questioned during the hearing. Di Nunno assured the committee that the AEC ". . . has obtained the advice of the best scientific talent available in the world in establishing maximal values for releases of routine radioactive effluents from reactors."

The strongest challenger of AEC's standards was John W. Gofman, of the Biomedical Division, Lawrence Radiation Laboratory, Livermore: "Exposure of the US population to federally allowable radiation dosage would lead to . . . 32 000 extra cases of cancer and leukemia annually . . . These numbers mean an extra cancer for every ten that occur naturally. The existing safety limits are a joke on the unsuspecting public . . . The most potent enemy of atomic energy is not truth, but it is a false optimism and an ostrich-like approach of refusal to examine the underlying risks in a reasonable fashion. Every bit of scientific evidence we have examined shows that no foundation at all exists for a 'safe' threshold."

Gofman's testimony was refuted by Victor Bond, associate director of Biomedical Sciences and Chemistry, Brookhaven National Laboratory, who said: "The public has no way of knowing that Gofman's numbers have virtually no relation to reality now or in the foreseeable future. To obtain these numbers, he assumes that everyone in the US is exposed to the maximum of the exposure limits. The actual exposure of the public from industrial sources, for now and the foreseeable future, is estimated to be an extremely small percentage of what he assumes. In addition, his numbers are purely hypothetical. We have had a great deal of experience with radiation since 1895 and literally hundreds of thousands of persons have been exposed; yet there is not a single case of serious injury or death documented to have resulted from doses and dose rate commensurate with the federal standards."

This sharp division within the scientific community, says Weiss, who sponsored the bill to ban reactors, ". . . indicates that there should be a broader consensus." He is also ". . . impressed and persuaded by the number of scientists who have worked for the AEC on radiation and are opposed to building nuclear reactors in urban centers." "The AEC," he says "should be leading the fight to ban nuclear reactors in urban centers, but if it does not then it is our obligation . . . The AEC would like us to believe that all scientific bodies are behind them, which is not true and makes me think that the AEC is not leveling with us."

W. W. Havens, Jr, head of the division of nuclear science and engineering at Columbia, defended his research reactor with his statement ". . . if I could afford it, I would rather heat my home with a TRIGA reactor than with the oil burner that I now have because the TRIGA is much safer." The hearing closed after about 12 hours of debate, and the council was to vote on the question at a closed meeting during April.

nomenon, nor is it confined to nuclear power plants. Many industrial plants generate a large amount of heat, and it is much less expensive to dump the waste heat into a river than to release it to the atmosphere. The rivers that flow through Pittsburgh, for example, are raised in temperature by 20 or 30 deg. This has had an adverse effect on the fish and has in general upset the ecology. Federal standards are needed and enforcement by the states is most desirable. Such legislation is now pending in Congress. These regulations should apply to any plant, be it nuclear, fossil-fueled or chemical. Nuclear plants should conform no more or no less than any other type. It is true that a nuclear electric plant dumps more heat into a stream than a fossil-fueled plant of corresponding electric-power output. But it does not make sense to raise a storm of protest over a nuclear plant of 500 MW electric capacity while a 1000-MW electric fossil-fueled plant escapes almost unnoticed. New York State has passed legislation requiring nuclear plants to make an environmental-evaluation report, which is not required for conventional plants.

It is not surprising that a nuclear power plant that generates millions of curies of radioactivity may discharge a very small amount of radioactivity into the atmosphere or waste stream. The whole argument has to do with defining a "small amount" of radioactivity. The nuclear critics insist that it should be zero for a nuclear plant, whereas they recognize that a coal plant does emit some radioactivity from the small amount of uranium and its daughter products in the coal.

Merril Eisenbud and Henry G. Petrow[4] have noted that although the amount of radioactivity from a large coal-burning power plant is less than 1 curie per year of Ra^{226} and Ra^{228}, this release is the equivalent of considerably greater amounts of I^{131} and Kr^{85}, which are the principal atmospheric effluents from a nuclear-power plant. In either case the radiation dose to the nearby population is very small compared to the natural background of radioactivity.

... from radiation effects

Actually we know much more about the effects of radiation on the human body than we do about the effects of various chemical pollutants that occur in ever increasing amounts in the air we breathe and the water we drink. Hundreds of millions of dollars have been spent by the Atomic Energy Commission in biological research aimed at establishing not only the effects of radiation on man but also on the environment, so we can be certain that the ecological effects will be minimal. This concern is almost without precedent. Certainly the automobile industry has not expended much money on the effects of smog on the population, or the tobacco industry on lung cancer or the chemical industry on the effects of DDT on the ecological cycle. One of the nuclear critics' favorite expressions is that there is enough radioactivity in a reactor to irradiate everyone in the US with a lethal dose. There is also enough insecticide manufactured to poison every US citizen; moreover, the insecticides are meant to be widely distributed, yet the radioactivity is carefully confined.

As a result of the tremendous research effort on the effects of radiation, the Federal Radiation Council has developed a set of radiation-protection guides. The levels that have been set, even for workers in the nuclear industry, are meant to be at least an order of magnitude below that where physical effects on the individual would be observed. (This is in contrast to the ozone level in Los Angeles, which is set just barely below the level where eye irritation will be noticed.)

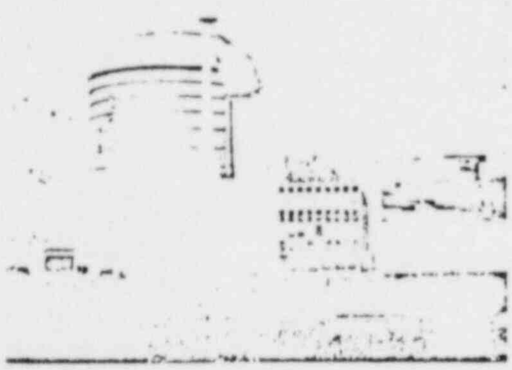
If workers in the nuclear industry were to get the maximal level of 5 rem per year, there probably would be a small increase in the observed number of deaths caused by leukemia after a number of years. But the additional risk of death by leukemia to each person so exposed would be less than 10^{-8} per hour of exposure, less than the normal occupational hazards.[5] Actually, it is rare for anyone to get 5 rem during a year, and most of us get much less. Although 5 rem is considered to be a conservative figure (much less, for example, than radiologists used to take) it is thought that an additional factor of 30 reduction should be made when considering the dosage levels to the population at large. Hence the protection guides limit the amount of activity to such a low level that the general population will receive no more than a fraction of a rem per year. Everyone receives something like a tenth of a rem per year of radiation because of cosmic rays and natural radioactivity in the earth and air—everyone, that is, but those who live in certain high-level radiation areas, like India, where they receive eight times as much.

When one adds to this the radiation from medical x rays (estimated to be another 0.1 rem to the average member of the population), it is apparent that the amount contributed by nuclear power is small in comparison. I do not hesitate to take several rem of x rays when it is needed for diagnosis or treatment of disease. Here is a very real example—the benefits far outweighing the risks. On the other hand, I am opposed to taking even medical x rays needlessly. Some of the older machines for dental x rays sprayed the whole body; the use of a filter and cone can produce better pictures with less radiation. X-ray machines in hospitals have also been greatly improved; good, clear, lung radiograms can be obtained with a dose of one-tenth to one-hundredth of a rem rather than with the several rems required with poor equipment and procedures.

Recent measurements by the Bureau of Radiological Health, Department of Health, Education and Welfare, have shown that the Dresden Nuclear Power Station, Ill., has contributed a negligible amount of radioactivity to its environs, something less than 1% of the natural radioactive background and orders of magnitude below permissible limits. But despite the conservatism in setting the federal radiation-protection guides, the Minnesota Pollution Control Agency, responsible for water purity, has recently protested the granting of a license to operate a reactor, unless the operator guarantees to maintain a level of activity release that is a factor of 100 below the values recommended by the Federal Radiation Council. If the utility is not granted a license to construct a nuclear-power station, power demands will have to be met by adding fossil-fuel stations with all the stack effluents. All in the name of "safety." I believe it is demonstrable that the hazard from the presently regulated amount of radioactivity released in normal operation of a nuclear-power station is much less than that from the pollutants emitted by the operation of a fossil-fueled station.

Safeguards

However, the risk of releasing a large amount of activity inadvertently is quite another matter. The hypothetical consequences of such an accident were the subject of a much publicized Brookhaven National Laboratory report some ten years ago. The authors assumed the worst possible combination of circumstances. They gave no credit for containment in estimating that half of the fission products would become airborne; they assumed that the accident would occur during an atmospheric inversion and low-wind velocity; and thus the fission products would be carried straight toward a population center with very little dilution or mixing. Under these catastrophic, but unlikely, circumstances up to 3000 people could be killed, assuming evacuation was not possible. The possibility that such a major catastrophe will occur is, I believe, exceedingly remote. However, the occurrence of several smaller events is



PEACH BOTTOM ATOMIC POWER Station, Unit 1, located in Pennsylvania.

certainly within the realm of possibility; there surely is some risk. Nevertheless, it is the stated mission of the nuclear industry and the regulating agency to make the possibility of such an accident exceedingly remote. How do we go about it?

First, the fission products are contained in fuel elements that would melt only if cooling were to fail. Second, the fuel elements are contained within a primary coolant circuit that undergoes the most thorough series of tests and inspections that any pressure vessel has ever been subjected to. Then the whole works is contained within a large steel or concrete containment vessel. Finally, there is an exclusion area surrounding the power plant and a low-population zone outside of that. This should result in considerable dilution of the radioactive fission products before they reach the population centers as well as introduce a delay so that evacuation can begin.

For the radioactive fission products to escape, the fuel elements must melt, the primary vessel must burst and the containment vessel must fail. Even if all these failures occurred, it appears that probably no more than 5% of the fission products would become airborne—rather than the 50% assumed in the Brookhaven report. Even so, the release of 5% of the radioactive products under unfavorable atmospheric conditions would be serious. And we can see ways that it might happen. However, bear in mind that, when a mechanism for an event can be postulated, the design can be modified to make that particular mode of occurrence most unlikely. It is true that fate has a way of figuring out another path to an incident that was not foreseen. But the designers and builders of nuclear-power plants have exercised sophisticated ingenuity and have spent large sums of money to make the plants as safe as they know how.

There have been accidents and releases from experimental reactors.[6] The releases have been small by comparison with the hypothetical Brookhaven incident, and no member of the public has been injured. The graphite moderator of a large reactor in Windscale, England, caught fire, causing some fuel elements to melt and burn. A considerable amount of radioiodine was spread over the countryside, thereby contaminating milk supplies and crops. That reactor was not in a containment vessel (all nuclear-electric stations in the US are contained), so perhaps 2% of the fission products did escape. No power reactor in the US has been similarly involved. There were some fuel elements melted in the Fermi reactor, but neither the primary nor the secondary containment was violated.

A small experimental army reactor (SL-1) released a considerable amount of radioactivity to the building where it was operated, but only a relatively small amount of activity, an estimated 80 curies of I^{131}, escaped from the building and precipitated on the desert. The prophets of doom have heavily dramatized these reactor incidents, pointing out that it can happen despite our best efforts. It all depends on your point of view. To me it demonstrates that a fairly major release of radioactivity from the core can occur, as at Windscale or SL-1, and yet no one outside the reactor building received a tolerance dose of radiation.

The important question still remains. Have we succeeded in reducing the risk to a tolerable level, that is, something less than one chance in ten thousand that a reactor will have a serious accident in any year? When we have one hundred nuclear-power stations in operation, which is not too far in the future, an accident once every hundred years might be expected. And if a hundred people were to be killed, such as now happens in a major airline disaster, it is a lower calculable risk than that taken by many facets of US industry today, and a small price to pay for the benefits.

Have we succeeded in reducing the hazards to such a low level? There is no way to prove it. We have accumulated, so far, some 100 reactor years of accident-free operation of commercial nuclear electric power stations in the US. That is a long way from 10 000, so it does not tell us much.

The only way we will know what the odds really are is by continuing to accumulate experience in operating reactors. There *is* some risk, but it is surely worth it. I am impatient with those who cry "wolf" when there is so much to be achieved. On the other hand, it is a mistake to use the head-in-the-sand approach and say it can never happen to us. Scientists and the public should be prepared to face the possibility of a nuclear incident just as we expect major earthquakes that will exact a large toll in property and lives. Only a few people advocate abandoning the West Coast. I hope only a few advocate abandoning nuclear power, which promises so much for mankind.

* * *

This work was sponsored by the Atomic Energy Commission under contract with the Union Carbide Corporation.

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PROD. & UTIL. FAC. 50-346

(Seattle), 55-57; assoc. prof, cot. med, Wayne State, 57-62; private practice, 62- Dipl, Am. Bd. Surg, 51. U.S.N, 42-46. Soc. Univ. Surg; Am. Med. Asn; Heart Asn; Col. Surg; Fedn. Clin. Res; Int. Soc. Surg. Cardiovascular surgery. Address: 772 Fisher Bldg, Detroit, Mich. 48202.

JORDAN, DR. RAYMOND ELLSWORTH, b. Pa, July 26, 08; m. 31; c. 2. MEDICINE. M.D, Pittsburgh, 34, B.S, 48. PROF. OTOL. & CHMN. DEPT, SCH. MED, PITTSBURGH, 58- Med.C, 41-46, Lt. Col. Otol. Soc; Laryngol, Rhinol. & Otol. Soc; Am. Med. Asn; Col. Surg; Acad. Ophthal. & Otolaryngol. Otology; conservation of hearing in children. Address: Dept. of Otolaryngology, University of Pittsburgh School of Medicine, Pittsburgh, Pa. 15213.

JORDAN, DR. RICHARD CHARLES, b. Minneapolis, Minn, Apr. 16, 09; m. 35; c. 3. MECHANICAL ENGINEERING. B.Aero.E, Minnesota, 31, Am. Soc. Heating & Vent. Engrs. fel, 32-33, M.S, 33, Ph.D.(mech. eng), 40. Head air conditioning div, Minneapolis Br, Am. Radiator & Standard Sanit. Corp, 33-36; instr. petrol. eng, Tulsa, 36-37; eng. exp. sta, MINNESOTA, 37-41, asst. prof. MECH. ENG, 41-43, assoc. prof, 43-46, PROF, 46-, HEAD DEPT, 50-, asst. dir. eng. exp. sta, 41-44, dir. indust. labs, 44-45. Consult, Corps Engrs, U.S. Army, 51-52; adv. panel eng. sci, Nat. Sci. Found, 54-57, chmn, 56-57; consult, Agency Int. Develop, 64-; various indust. orgns. Mem. div. eng. & indust. res, Nat. Acad. Sci-Nat. Res. Coun, 54-65, chmn. div, 61-66, mem-at-large, 56-63, mem. ad hoc cmt. eng. in developing countries, 59-61, ad hoc cmt. eng. & soc. sci, div. eng. & indust. res, 61-65; adv. cmt. int. orgns. & progs, off. int. rels, Nat. Acad. Sci, 65-; v.pres. exec. cmt, Int. Inst. Refrig, 59-63, tech. bd, 63-67, U.S. del, 57-64; mem, CENTO Surv. Mission, Iran, Pakistan & Turkey, 63; v.chmn. eng. & accreditation cmt, Region VII, Eng. Coun. Prfnl. Develop, 64-66. Del, Int. Cong. Refrig, Paris, 55, Copenhagen, 59, Munich, 63; U.S. nat. cmt, Int. Inst. Refrig, Moscow & Prague, 58; Am. Standards Asn. del, Int. Standards Orgn, London, 58; del, World Power Conf, Melbourne, 62. AAAS; Soc. Mech. Eng; Nat. Soc. Prfnl. Eng; Soc. Eng. Ed; Solar Energy Soc; fel. Soc. Heat, Refrig. & Air-Conditioning Eng. (Wolverine award, 49, treas, 50, v.pres, 51-52, pres, 63). Air filtration; dust analyses; conditions of comfort; heat transmission; refrigeration; quantitative and qualitative analysis of atmospheric dust; solar energy; engineering administration. Address: Dept. of Mechanical Engineering, University of Minnesota, Minneapolis, Minn. 55455.

JORDAN, DR. RICHARD HOLLISTER, b. Minneapolis, Minn, Sept. 21, 11; m. 39; c. 2. OPERATIONS RESEARCH. A.B, Cornell, 33, M.A, 39, fel, 40-41, Ph.D.(sci. ed), 46. Teacher, pub. schs, N.Y, 34-40; exam. sci, bd. exam, Mich. State Col, 46-47; assoc. prof. geol, Fla. State, 47-52; opers. analyst, continental air defense command, U.S. Air Force, 52-58; chief, opers. anal. div, bur. res. & develop, Fed. Aviation Agency, 58-60, res. div, 60-61; sr. res. analyst, inst. transportation & traffic eng, California, Berkeley, 61; SR. ANALYST, ANAL. SERV, INC, 62- U.S.A.F, 42-46, Lt. Col. AAAS; Geol. Soc; Opers. Res. Soc. Economic geology; education; air defense. Address: 6518 Lakeview Dr, Falls Church, Va. 22041.

JORDAN, DR. ROBERT, Pub. Health Admin, see 10th ed, Phys. & Biol. Vols.

JORDAN, DR. ROBERT JR, b. Macon, Ga, Sept. 11, 20; m. 42; c. 3. PEDIATRICS. B.A, Vanderbilt, 41, M.D, 43. Intern, PEDIAT, univ. hosp, Duke, 44; resident, Henrietta Egleston Mem. Hosp, 44-45; res. fel, TENNESSEE, 48-49, asst. prof, 49-54, ASSOC. PROF, 61-, MED. DIR, CHILD DEVELOP. CENTER, 57- Dipl, Am. Bd. Pediat, 50. Med.C, 45-47, Capt. Acad. Pediat. Neurologically handicapped children. Address: Dept. of Pediatrics, University of Tennessee, Memphis, Tenn. 38111.

JORDAN, DR. R(OBERT) H(ENRY), Org. Chem, Med, see 10th ed, Phys. & Biol. Vols.

JORDAN, DR. ROBERT HOUGH, b. Ft. Lawn, S.C, Aug. 18, 08; m. 34; c. 2. MEDICINE. M.D, Med. Col. of Va, 33. ASST. CLIN. PROF. MED, MED. SCH, YALE, 46- Dipl, Am. Bd. Internal Med. Med.C, 42-46, Maj. Fel. Col. Physicians; fel. Col. Chest Physicians. Address: 111 Park St, New Haven, Conn. 06511.

JORDAN, PROF. R(OBERT) M(ANSEAU), b. Minneapolis, Minn, Feb. 13, 20; m. 42; c. 3. ANIMAL HUSBANDRY. B.S, Minnesota, 42; M.S, S.Dak. State Col, 49; Ph.D.(animal nutrit), Kans. State Col, 53. Instr. animal husb, Minnesota, 42; sales rep, Lyon Chem, Minn, 45; instr. ANIMAL HUSB, S.Dak. State Col, 47-49, asst. prof, 49-51, assoc. prof, 51-54; asst. prof, MINNESOTA, 54-56, assoc. prof, 56-64, PROF, 64- U.S.N, 41-42. Soc. Animal Sci; Brit. Soc. Animal Prod. Use of hormones in animal production; nutrition of pregnant ewes; digestibility studies; antibiotics in relation to sheep nutrition; lamb fattening; lactation studies of sheep; suckling lamb nutrition; growing-fattening lambs and dry ewes; early weaning of lambs; protein requirement of lambs; nutrient levels for lactating ewes; energy requirements of six weeks old lambs and year around energy requirements of ewes; restricted time grazing studies with ewes. Address: Dept. of Animal Husbandry, University of Minnesota, St. Paul, Minn. 55101.

JORDAN, DR. ROBERT R, b. New York, N.Y, June 5, 37; m. 58; c. 2. GEOLOGY. A.B, Hunter Col, 58; M.A, Bryn Mawr Col, 62, Ph.D.(geol), 64. Geologist, DEL. GEOL. SURV, 58-64, instr. GEOL, UNIV. DELAWARE, 62-64. ASST. PROF, & ASST. STATE GEOLOGIST, 64- Univ. Delaware Res. Found. grant, 64- Geol. Soc; Soc. Econ. Paleont. & Mineral; Asn. Geol. Teachers. Sedimentary petrology; stratigraphy; geology of the Atlantic Coastal Plain; micropaleontology; ground water supplies. Address: Dept. of Geology, University of Delaware, Newark, Del. 19711.

JORDAN, DR. RUSSELL T(HOMAS), b. Geneseo, N.Y, 13; m. 46; c. 6. VIROLOGY, IMMUNOCHEMISTRY. B.S, Arkansas, 49, M.S, 51; Novy fel, Michigan, 52, Ph.D.(virol), 53. Asst. prof. bact, sch. med, Michigan, 53-54, Rackham res. fel, 53; clin. asst. prof. infectious diseases, sch. med, California, Los Angeles, 54-59; chief, dept. exp. immunol, Nat. Jewish Hosp, Denver, 60-63; ASST. PROF. MICROBIOL, SCH. MED, COLORADO, 61-; DIR. RES. & LABS, BIOMED. RES. LABS DIV, BIO-ORGANIC CHEM. INC, 63- Chmn. dept. microbiol, City of Hope Med. Center, Calif, 54-60; lectr, California, Los Angeles, 56-59; res. fel. immunochem, Calif. Inst. Tech, 58-59. U.S.A.A.F, 42-45. Am. Immunol; Soc. Exp. Biol; Am. Cancer Res; Soc. Cell Biol; Research Soc; N.Y. Acad. Microbiology; interference phenomenon; infection and resistance; virus induced neoplasms; immunochemistry of cancer; immunochemical properties of tumor specific antigens and antibodies. Address: Bio-Medical Research Labs, 4940 E. Asbury Ave, Denver, Colo. 80222.

JORDAN, RUTH, b. Danville, Ind, July 4, 91. FOODS. B.S, Purdue, 20, M.S, 29; summers, Chicago, 22, 35. Teacher, pub. sch, Ind, 11-14, 15-18; in charge all home econ. courses, Cent. Nor. Col, 20-21; asst. home econ, agr. exp. sta, Purdue, 21-30, asst. prof, 30-52, foods & nutrit, sch. home econ, 52-62, assoc. home econ, agr. exp. sta, 39-62; RETIRED. AAAS; Chem. Soc; Home Econ. Asn; Inst. Food Tech. Effect of cooking procedures on calcium content of vegetables; effect of various processing methods on functional properties of eggs; effect of frozen storage on meat palatability; effect of hydrogenation of lard on culinary properties; problems associated with use of homogenized milk in cookery; calcium metabolism in adults. Address: 230 Harrison St, West Lafayette, Ind. 47906.

JORDAN, DR. S(TEVEN) E(RNEST), Pharmacol, see 10th ed, Phys. & Biol. Vols.

JORDAN, DR. T(HOMAS) EARL, b. Tyner, N.C. July 4, 08; m. 43; c. 2. CHEMISTRY. B.S, Atlantic, 31; M.S, Richmond, 34, Ph.D.(org. chem), Duke, 36. Instr. physics & math, Elon Col, 31-32; chem, Richmond, 32-34; asst, Duke, 34-36; prof, Furman, 36-37; group leader, Barrett Div, Allied Chem. & Dye Corp, Pa, 37-45; res. assoc, Inst. Textile Tech, 45-46; group leader, Publicker Industs, 46-48, dir. chem. res, 48-50, res. & develop, 50-55, mgr, Louisville Butadiene Plant, 55-58; HEAD CHEM. DEVELOP. LAB, DOE RUN PLANT, OLIN MATHEISON CHEM. CORP, 58- Prof. eve. sch, Drexel Inst, 37-42. Am. Chem. Soc; Inst. Chem. Eng; Brit. Chem. Soc. Coal tar chemicals; oxygenated aliphatic chemicals; creatinine derivatives; sterioisomerism of aldoximes; vapor pressures; latex polymers; alkyd and phenolic resins; petrochemicals; physical chemistry; distillations; vapor pressures of organic compounds. Address: 2205 Emerson Ave, Louisville, Ky. 40205.

JORDAN, DR. THOMAS F(REDRICK), b. Duluth, Minn, June 4, 36; m. 59. THEORETICAL PHYSICS. B.A, Minnesota, Duluth, 58; Nat. Sci. Found. fel, Rochester, 60-61, Ph.D.(physics), 62. Res. assoc. PHYSICS, Rochester, 61-62, instr, 62-63; Nat. Sci. Found. fel, Berne, 63-64. ASST. PROF, PITTSBURGH, 64- Sloan Found. fel, 65-67. Mathematical physics; quantum mechanics; field theory; relativistic particle dynamics; scattering theory; elementary particle interactions; quantum theory of optical coherence. Address: Dept. of Physics, University of Pittsburgh, Pittsburgh, Pa. 15213.

JORDAN, DR. THOMAS F(RIEDRICH), b. Kobe, Japan, Feb. 24, 31; U.S. citizen; m. 55; c. 3. MECHANICAL ENGINEERING. B.S, Hanover Tech, 52, M.Sc, 54, Ph.D.(appl. mech), 57; Fulbright scholar, California, 54-55, M.Sc, 55. Res. engr. mech. eng, California, 55; lectr. & asst. inst. mach. tools & metal working, Hanover Tech, 55-58; res. engr, E.I. DU PONT DE NEMOURS & CO, 58-64, TECH. REP. PLASTICS DEPT, 64- AAAS; Soc. Mech. Eng; Research Soc; Asn. Corrosion Eng. Solid state mechanics; plasticity; processing of metals and polymers; applications and marketing of plastics. Address: Plastics Dept, E.I. du Pont de Nemours & Co, 1007 Market St, Wilmington, Del. 19898.

JORDAN, DR. THOMAS L(EE), JR, b. Nashville, Tenn, Sept. 28, 20; m. 44; c. 4. MATHEMATICS. B.A, Vanderbilt, 42, M.A, 49, Ph.D.(math), 53. Instr. math, Vanderbilt, 46-51; assoc. prof, Wofford Col, 51-53; MEM. STAFF, LOS ALAMOS SCI. LAB, 53- Sig.C, U.S.A, 42-46. Math. Soc; Math. Asn. Lattices of subgroups. Address: 390 Manhattan, Los Alamos, N.Mex. 87544.

JORDAN, DR. WADE H(AMPTON), JR, b. Edenton, N.C, June 1, 32; m. 54; c. 5. ELECTROCHEMISTRY, PHYSICAL CHEMISTRY. A.B, E.Carolina Col, 54; Virginia, 53; John M. Morehead scholar, North Carolina, 54-56; Nat. Sci. Found. fel, Texas, 58-59, Robert A. Welsch Found. grant, 62-63, Ph.D.(chem), 64. Chemist, Liggett & Myers Tobacco Co, 54-55; Ethyl Corp, 56; Tracor, Inc, 58-60, sr. chemist, 60-62; RES. CHEMIST, E.I. DU PONT DE NEMOURS & CO, 63- William A. Felsing award, Texas, 57; mem, Franklin Inst, Pa. Chem. Soc; Electrochem. Soc; Faraday Soc. Electrodeposition; electrode kinetics; organic electrochemistry; corrosion; surface chemistry; reaction kinetics. Address: E.I. du Pont de Nemours & Co, Inc, P.O. Box 525, Wilmington, Del. 19899.

JORDAN, PROF. W(ALTER) E(DWARD), b. Winston-Salem, N.C, Jan. 27, 95. CHEMISTRY. B.S, Wake Forest Col, 17, A.M, 18; M.S, N.C. State Col, 25. Chemist, Viscose Co, 18; E.I. du Pont de Nemours & Co, 18; instr. CHEM, N.C. STATE, 19-21, asst. prof, 21-25, from assoc. prof. to EMER. ASSOC. PROF, 25- U.S.A, 18-19. Chemical kinetics; ultraviolet light; fluorescence. Address: Dept. of Chemistry, North Carolina State University, Raleigh, N.C. 27607.

JORDAN, DR. WALTER E(DWIN), b. Ashtabula, Ohio, Apr. 17, 09; m. 37; c. 2. PHYSICS. B.A, Col. of Wooster, 32; Ph.D.(physics), Ohio State, 37. Res. physicist, E.I. DU PONT DE NEMOURS & CO, N.J, 37-40, tech. supt. explosives dept, Del, 40-43, res. physicist, Manhattan proj, Ill. & Wash, 43-45, chief supvr, Hanford eng. works, 45-46, res. supvr, rayon dept, N.Y, 46-50, RES. MGR. TEXTILE FIBERS, 50- Chem. Soc; Phys. Soc. Smokeless powder combustion; atomic pile behavior; textile fiber engineering; polymer engineering processes; low voltage nuclear disintegrations. Address: Textile Fibers Dept, E.I. du Pont de Nemours & Co, Wilmington, Del. 19898.

JORDAN, DR. W(ALTER) H(ARRISON), b. Whitehall, Mont, Apr. 22, 08; m. 34; c. 1. PHYSICS. A.B, Oklahoma, 30, M.S, 31; Ph.D.(physics), Calif. Inst. Tech, 34. Asst. physics, Calif. Inst. Tech, 31-34; assoc. prof, South Dakota, 34-41; res. assoc, Mass. Inst. Tech, 41-46; physicist, OAK RIDGE NAT. LAB, 46-59, ASST. DIR, 59- Fel. Phys. Soc; fel. Nuclear Soc. Nuclear instrumentation and energy. Address: Oak Ridge National Lab, P.O. Box X, Oak Ridge, Tenn. 37831.

JORDAN, WESLEY A(LBRIGHT), b. Chippewa Falls, Wis, Apr. 10, 08; m. 31; c. 1. CHEMISTRY. B.A, N.Cent. Col, 30; Ohio State, 31-32. Chemist

Ohio State, 30-34, indust. res, 34-36; from res. assoc. to asst. head chem. dept, res. labs, Gen. Motors Corp, 37-67; RETIRED. Anachem award, 62. Chem. Soc; Inst. Chem. Analytical chemistry; alloys; petroleum products; organic halogens; internal combustion engines; gas analysis; spectrophotometry; polarography; electroanalysis. **Address**: 10764 Lincoln, Huntington Woods, Mich. 48070.

WINTER, PROF. R(OLF) G(ERARD), b. Dusseldorf, Germany, June 30, 28; nat; m. 51; c. 3. NUCLEAR PHYSICS. B.S, Carnegie Inst. Tech, 48, M.S, 51, D.Sc, 52. Asst. PHYSICS, Carnegie Inst. Tech, 46-51; instr, Western Reserve, 51-52, asst. prof, 52-54; Pa. State, 54-60, assoc. prof, 60-64; PROF, COL. WILLIAM & MARY, 64-, CHMN. DEPT, 66- Vis. physicist & lectr, Carnegie Inst. Tech, 55-56; Oxford, 61-62; Wisconsin, summer, 63. Indust. consult. Fel. Phys. Soc. Beta decay; particle accelerators; nuclear reactions. **Address**: Dept. of Physics, College of William & Mary, Williamsburg, Va. 23185.

WINTER, DR. RUDOLPH E(RNST) K(ARL), b. Vienna, Austria, Nov. 27, 35; U.S. citizen; m. 64; c. 2. ORGANIC CHEMISTRY. A.B, Columbia, 57; M.A, Hopkins, 59, Ph.D.(org. chem), 64. Nat. Insts. Health fel. chem, Karlsruhe Tech, 62-63; Harvard, 63-64; ASST. PROF. ORG. CHEM, POLYTECH. INST. BROOKLYN, 64- Am. Chem. Soc; Brit. Chem. Soc. Chemistry of naturally occurring substances, especially terpenes and sesquiterpenes; photochemical and thermal reactions; small ring compounds; four membered rings. **Address**: Dept. of Chemistry, Polytechnic Institute of Brooklyn, 333 Jay St, Brooklyn, N.Y. 11201.

WINTER, PROF. STEPHEN S(AMUEL), b. Vienna, Austria, Feb. 27, 28; U.S. citizen; m. 51; c. 3. SCIENCE EDUCATION. B.S, Albright Col, 48; Ph.D. (phys. chem), Columbia, 53. Res. chemist, Atlas Powder Co, 52-53; asst. prof. chem, Northeastern, 53-58; chem. & ed, Minnesota, 58-61; assoc. prof. ED, STATE UNIV. N.Y. BUFFALO, 61-66, PROF, 63- Nat. Sci. Found. sci. faculty fel, Harvard, 57-58, consult. Proj. Physics, 64-; consult. & hon. assoc. prof, Paraguay, 65. U.S.A, 46-47. AAAS; Chem. Soc; Sci. Teachers Asn; Asn. Res. Sci. Teaching. Measurement of outcomes of science instruction; effectiveness of multi-modal teaching. **Address**: 5 Wickham Dr, Williamsville, N.Y. 14221.

WINTER, DR. THOMAS G(REELEY), b. Los Angeles, Calif, Apr. 21, 27; m. 61; c. 3. PHYSICS. B.S, Stanford, 49; M.S, Catholic Univ, 61, Ph.D. (physics), 63. Appl. engr, Westinghouse Elec. Corp, 49-52; self employed, 52-56; proj. engr, U.S. Dept. Defense, 56-59; ASST. PROF. PHYSICS, OKLA. STATE, 63- Grant, U.S. Army Res. Off-Durham, 64-67. U.S.N.R, 45-46. AAAS; Acoustical Soc; Asn. Physics Teachers; Inst. Elec. & Electronics Eng. Ultrasonic absorption and dispersion in gases. **Address**: Dept. of Physics, Oklahoma State University, Stillwater, Okla. 74074.

WINTER, DR. W(ILLIAM) J, b. Pittsburgh, Pa, Dec. 20, 17; m. 42; c. 2. PATHOLOGY. B.S, Pittsburgh, 38, M.D, 42. Fel. neuropath, Toronto, 48-49; asst. pathologist, Armed Forces Inst. Path, 50-53; asst. prof. PATH, SCH. MED. MIAMI (FLA), 53-56, ASSOC. PROF, 56- Private practice. Asst. pathologist, Vet. Admin. Hosp, Coral Gables, Fla, 53-56, consult. 56-; assoc. pathologist, Hialeah Hosp. & Doctors Hosp, Coral Gables, 58-; dir. labs, N. Miami Gen. Hosp; consult. neuropath. & Dade County Med. Exam. Med.C, U.S.A, 44-46. Fel. Asn. Clin. Path; fel. Col. Am. Path; fel. N.Y. Acad. Sci; Int. Acad. Path. Traumatic neuropathology; hematology. **Address**: 5801 S.W. 77 Terr, S. Miami, Fla. 33143.

WINTER, DR. WILLIAM K(ENNETH), b. Manitowoc, Wis, Apr. 26, 26; m. 43; c. 1. PHYSICS. B.A, Wisconsin, 50; M.S, Kans. State Col, 52, Ph.D. (physics), 56. RES. PHYSICIST, PHILLIPS PETROL. CO, 56- U.S.A, 44-46. AAAS. Molecular spectroscopy; fluid flow through porous media. **Address**: Research Center, Phillips Petroleum Co, Bartlesville, Okla. 74003.

WINTERBERG, DR. FRIEDWARDT, b. Berlin, Germany, June 12, 29. THEORETICAL PHYSICS. M.S, Frankfurt, 53; Ph.D.(nuclear physics), Göttingen, 55. Group leader theoret. physics, Res. Reactor, Hamburg, Germany, 55-59; asst. prof. plasma physics & relativity, Case, 59-63; ASSOC. PROF. PHYSICS, NEVADA, 63- Cmn. mem, Int. Union Geod. & Geophys, 64. Summers, vis. prof, Stuttgart Tech, 64-66. Phys. Soc; hon. mem. German Rocket Soc. Neutron physics; nuclear rocket reactors; plasma physics; magnetohydrodynamics; general relativity; satellites; macroparticle-acceleration; biophysics. **Address**: Dept. of Physics, University of Nevada, Reno, Nev. 89507.

WINTERBOTTOM, DR. R(OBERT), b. New York, N.Y, Feb. 10, 15; m. 43; c. 2. ORGANIC CHEMISTRY. B.S, N.Y. Univ, 37, Ph.D.(chem), 40. Group leader pharmaceut. chem, Sterling Winthrop Res. Inst, 40-43; HEAD DEPT. ANTIBIOTIC & STEROID PROCESS DEVELOP, LEDERLE LABS, AM. CYANAMID CO, 43- Chem. Soc. Process development of antibiotic and steroid manufacture; methods of isolating natural products. **Address**: Lederle Labs, Pearl River, N.Y. 10965.

WINTERBOTTOM, DR. W. L, b. Pittsburgh, Pa, Sept. 27, 30; m. 51; c. 4. METALLURGY. B.Sc, Drexel Inst, 58; Ph.D.(metall), Carnegie Inst. Tech, 62. RES. SCIENTIST, SCI. LAB, FORD MOTOR CO, 62- U.S.M.C, 50-54, S/Sgt. Inst. Min, Metall. & Petrol. Eng. Surface physics; evaporation of solids; vapor-solid interactions; condensation and nucleation. **Address**: 26360 Powers Rd, Farmington, Mich. 48024.

WINTERFELD, THOMAS, b. Berlin, Germany, Sept. 21, 23; m. 53; c. 1. OCEANOGRAPHY. B.S, City Col. New York, 49; Northwestern, 49-51. Geologist, U.S. Geol. Surv, 51-54; OCEANOGR, U.S. NAVY OCEANOG. OFF, 54-61, NAT. OCEANOG. DATA CENTER, 61- Development of data management and data application systems in oceanography, intelligence studies in descriptive oceanography. **Address**: National Oceanographic Data Center, Washington, D.C. 20390.

WINTERKORN, PROF. HANS FRIEDRICH, b. Mannheim, Germany, Nov. 24, 05; nat; m. 40; c. 2. PHYSICAL CHEMISTRY. Dr. phil. nat.(phys. chem), Heidelberg, 31. Head div. chem, Sch. Adult Ed, Mannheim, Germany, 29-31; res. chemist & engr, State Hwy. Dept, Mo, 31-32; vis. asst. prof. chem, Missouri, 32-33, res. assoc. soils, 33-40, res. assoc. prof. soil mech, 40-42, assoc. prof. CIVIL ENG, 42-43; PRINCETON, 43-55, PROF, 55-, DIR. SOIL PHYSICS LAB, 43- Mem, Hwy. Res. Bd, Nat. Acad. Sci-Nat. Res. Coun, 33-, chmn, physico-chem. phenomena in soils cmt, 36-67. Officer's Cross, Order of Merit, Germany, 57. Consult. with U.S.A; U.S.N; U.S.A.F; Civil Aeronaut. Admin; NASA. Soc. Civil Eng; Soil Sci. Soc; Road Builders Asn; Geophys. Union; German Road Res. Soc; Int. Soc. Soil Sci. Properties of water in colloidal systems, especially by electro-osmosis and thermo-osmosis; electric effect in thermo-osmosis; macromeritic systems; soil stabilization. **Address**: Dept. of Civil Engineering, E-432 Engineering Quadrangle, Princeton University, Princeton, N.J. 08540.

WINTERMOYER, DR. JOHN PAUL, b. Hedgesville, W.Va, Nov. 16, 13; m. 45; c. 4. APPLIED CHEMISTRY. B.S, Maryland, 38, M.S, 40, Ph.D.(soil chem), 42. Res. asst. soil chem, Maryland, 38-42; assoc. anal. chemist, east. exp. sta, U.S. Bur. Mines, 42-46; res. chemist, naval ord. lab, U.S. DEPT. NAVY, 46-52, ord. engr, res. & develop. div, ammunition & explosive br, 52-60, supvy. tech. engr, missile ord. div, 60-66, SUPVY. RES. ENGR, ARMAMENT DIV, NAVAL AIR SYSTS. COMMAND, 66- Chem. Soc; Ord. Asn. Pyrotechnic and chemiluminescent chemistry; chemical-biological warfare; cartridge actuated devices. **Address**: 5616 Ruatan St, Berwyn Heights, College Park, Md. 20740.

WINTERNITZ, DR. THOMAS W, b. Baltimore, Md, Nov. 14, 16; m. 41; c. 3. COMMUNICATIONS ENGINEERING, ELECTROMAGNETICS. B.S, Chicago, 38; M.S, Harvard, 40, Ph.D.(electromagnetics theory), 48. Test engr, West. Elec. Co, Ill, 40-42; engr, Bell Tel. Labs, N.J, 42-45; fel. electronics, Harvard, 45-48; mem. staff, supvr. & dept. head, BELL TEL. LABS, 48-67, DIR, KWAJALEIN RADAR FIELD STA, 67- Inst. Aeronaut. & Astronaut; Inst. Elec. & Electronics Eng. Military systems and electronics; radar and digital computers. **Address**: Bell Telephone Labs, Whippany Rd, Whippany, N.J. 07981.

WINTERNITZ, DR. WILLIAM WELCH, b. New Haven, Conn, June 21, 20; m. 49; c. 3. MEDICINE. A.B, Dartmouth Col, 42; M.D, Hopkins, 45. From instr. to asst. prof. med. & physiol, Yale, 52-59; assoc. prof. MED, COL. MED, KENTUCKY, 59-66, PROF. & DIR. CLIN. RES. CENTER, 66- U.S.A, 46-48, Capt. AAAS; Endocrine Soc; Am. Med. Asn; Fedn. Clin. Res. Diabetes Asn. Endocrine regulation of metabolism. **Address**: 1235 Eldemere, Lexington, Ky. 40502.

WINTERRINGER, DR. GLEN S(PELMAN), b. Arcola, Ill, Oct. 6, 06. PLANT TAXONOMY. A.B, Ill. Col, 29; A.M, Illinois, 30, Ph.D.(bot), 49. Teacher, pub. sch, Ill, 30-41; asst. curator BOT, ILL. STATE MUS, 49-56, CURATOR, 56- U.S.A, 42-45. Soc. Plant Taxon. Taxonomy of vascular plants, particularly of Illinois and adjoining states. **Address**: Illinois State Museum, Springfield, Ill. 62706.

WINTERS, DR. C(HARLES) E(RNEST), b. Pratt, Kans, July 15, 16; m. 41; c. 4. CHEMICAL ENGINEERING. B.S, Kans. State Col, 37; S.M, Mass. Inst. Tech, 39, Sc.D.(chem. eng), 42. Chem. engr, Mallinckrodt Chem. Works, Mo, 40-43; prin. engr, Manhattan Dist, U.S. Atomic Energy Cmn, 43-47; sect. chief tech. div, Oak Ridge Nat. Lab, Carbide & Carbon Chem. Co, 47-49, dept. head, eng. res. & develop. tech. div, 49-51, dir. exp. eng. div, 51-53, asst. res. dir, 53-55, asst. lab. dir, Union Carbide Nuclear Co, 55-61; res. dir. PARMA RES. LAB, UNION CARBIDE CORP, 62-66, MGR. FUEL CELL DEPT, ELECTRONICS DIV, 66- Mem. atomic safety & licensing bd, U.S. Atomic Energy Cmn. Chem. Soc; fel. Nuclear Soc; Inst. Chem. Eng. Electrochemical and nuclear engineering. **Address**: Union Carbide Corp, Parma Technical Center, P.O. Box 6116, Cleveland, Ohio 44101.

WINTERS, DONALD C(HARLES), b. Nassau, N.Y, June 2, 20; m. 46; c. 5. ELECTRICAL ENGINEERING. B.S, Rensselaer Polytech, 42; M.S, Northeastern, 58. Design engr, Electrons, Inc, 45-47; Raytheon Mfg. Co, 47-52; electronics scientist, U.S. AIR FORCE CAMBRIDGE RES. LABS, 52-57, CHIEF SPEC. PROJS. SECT, COMPUT. & MATH. SCI. LAB, 57- Sig.C. & U.S.A.A.F, 42-45. Simulation, instrumentation and techniques for extracting information from corrupted data; electronic and logical techniques in data processors, learning machines and pattern recognizers; bionics. **Address**: Electronics Research Directorate, U.S. Air Force Cambridge Research Center, Laurence G. Hanscom Field, Bedford, Mass. 01730.

WINTERS, DR. EARL D, b. Rio Grande, Ohio, Aug. 28, 37; m. 60; c. 1. PHYSICAL CHEMISTRY. B.A, Ohio Wesleyan, 59; Nat. Insts. Health fel, Mass. Inst. Tech, 62-64, Ph.D.(phys. chem), 65. MEM. TECH. STAFF, BELL TEL. LABS, INC, 65- Chem. Soc; Electrochem. Soc; Electroplaters Soc. Electronic absorption and luminescence spectra of organic molecules; electrodeposition of metals. **Address**: Box 96, R.D. 1, Macungie, Pa. 18062.

WINTERS, DR. EDWARD P(HILLIP), b. Chicago, Ill, Sept. 17, 26; m. 56; c. 2. PHARMACY. B.S, Illinois, 51, M.S, 55; Am. Found. Pharmaceut. Ed. fel. & Ph.D.(pharm), Florida, 59. Asst. pharm, Illinois, 51-55, instr, 55-56; Florida, 56-59; asst. prof, Ferris Inst, 59-60; mem. res. staff, pharmaceut. develop, ABBOTT LABS, 60-63, MGR. INT. NEW PROD. DEVELOP, 63- U.S.A.A.F, 44-46, Sgt. Chem. Soc; Pharmaceut. Asn. Pharmaceutical chemistry; international pharmaceutical research and development. **Address**: Abbott Labs, North Chicago, Ill. 60064.

WINTERS, DR. ERIC, b. Chicago, Ill, May 29, 04; m. 43; c. 3. AGRONOMY. B.S, Illinois, 27, M.S, 30, Ph.D.(soils), 38. Asst. agron, Illinois, 27-34, assoc, 35-38; instr. soils, Wisconsin, 38; assoc. prof. agron, TENNESSEE, 38-39, prof, 39-55, ASSOC. DIR. EXP. STA, 55-, head dept. agron, univ, 46-55. Chief soils & fertilizer res. br, div. of agr. relations, Tenn. Valley Authority, 51-53; collab, U.S. Dept. Agr. Soil Sci. Soc.(pres, 53). Soil survey and soil classification; crop response to fertilization; testing soils for nutrient availability. **Address**: Agricultural Experiment Station, University of Tennessee, Knoxville, Tenn. 37916.

WINTERS, DR. HAROLD F, b. Renton, Wash, May 19, 32; m. 56; c. 5. PHYSICS. B.S, Whitworth Col.(Wash), 56; Ph.D.(physics), Washington State, 63.