Chapter 7.0 Atomic Energy Commission

A. Introduction

In 1952, along with the Savannah River Project, the Atomic Energy Commission was expanding its facilities at Richland, Washington, by building additional reactors, plutonium separation plants, and improved fuel canning facilities. At the same time Argonne, Oak Ridge, Los Alamos, and Brookhaven National Laboratories were building permanent facilities. However, the reactor development program had not been pushed in the sense that no long-term Power Reactor Development Program had been agreed upon. Most attention had been placed on production of weapon materials -- and rightly so, I think.

Suddenly, the Commissioners realized the above situation. So, they started yelling at Dr. Laurence Hafstad, Director of the Division of Reactor Development, and Mr. Richard Cook, Director of the Production Division. At the meeting early in January, 1952, the Commission pushed Dr. Hafstad for a program of reactor development. He had none, as the whole Staff had been too busy on other problems. Dr. George Weil had been heading up the Development Reactors Branch. So, Larry pushed him aside and called James Lane, of Oak Ridge National Laboratory, and me to move to Washington to develop a program.

It is my opinion that Dr. Weil was doing a better job than Dr. Hafstad recognized. But the

move got the Commission off Dr. Hafstad's back and on the Lane's and my backs. And the Commission Members soon got interested in other things and forgot about the Reactor Development Program -- at least the Commission took very little interest in the Program afterwards.

Unfortunately, as we had been living in a rented house, Winnie had been spending months looking for a house to buy. She had found one about Thanksgiving time. We got possession, and we moved at the end of January 1952. It was a beautiful house designed by Frank Lloyd Wright, one of his first. Actually, we moved from Downers Grove to Naperville, Illinois, on a Friday and spent all weekend getting settled. So, Monday morning, when I walked into the office, the phone was ringing. It was Dr. Laurence Hafstad, transferring me to Washington. Just normal McLain luck! Or perhaps Winnie's luck with me! Poor Winnie got moved around. She was a wonderful person. I have tears in my eyes just to write this.

I should point out that I had had many long distance telephone calls; so the regular Washington long distance Operator knew my schedule. Once on a Saturday morning, a call came in when I was visiting Argonne National laboratory after I left there. At exactly 0830 the phone at the check-in desk, in the Nuclear Engineering Building began ringing. When the girl at the desk was asked for me, she aid there was no one there. Actually, I had just opened the door and walked in; so I as standing in front of her desk. The Washington operator told the girl that I must be there as I stated that I would be there at 0830 on my "Travel Sheet," and that it was 0830 in Chicago. Finally, the girl said, "Are you McLain?" I asked the Operator how she knew where I was. She replied, "For several years I have located you all over the Country. I know you, Dr. Zinn, Dr. Hafstad, and Mr. Lane follow your schedules; so I always know where to locate you. I have just learned your habits." Of course, I had never seen her. We did know each other's voices.

After agreeing to move to Washington, I commuted form February through June in order that our boys could continue in school in Naperville. Commuting means that I took the Baltimore and Ohio Railroad train, the "Capitol Limited" to Washington Sunday night and back Friday night. Between Naperville and Chicago, I usually rode the Burlington local commuter trains. I always travelled with a brief case only and washed my underwear socks, and shirt every night on the Pullmans, and in Hotels. I always preferred trains to Hotels when I had a choice. They saved time. Airplanes are faster, but they save little time East of the Mississippi River for men going to Conferences as the men now have to go to Hotels.

We moved to Bethesda, Maryland, in June 1952. Neal spent one month in Montana, near Billings, digging trilobites and brachiopods out of the Upper Cambrian limestone formations during that summer.

James Lane and I undertook to develop a program for the Commission. Both Lane and I were on leave and both planned to return to our previous locations at Oak Ridge and Argonne National Laboratories.

Dr. Zinn objected to my transfer to Washington, as he then told me that he wanted me to take over responsibility for Argonne's facilities at the National Reactor Testing Station near Idaho Falls. I don't know that we wanted to move there. We never had to decide except in reference to the Materials Testing Reactor. I am quite sure that I would have resigned rather than to have moved except for the Materials Testing Reactor position. I would have clashed with the Area Manager-- or he would have clashed with me -- and I think that I would have won! Why Area Offices? They sure have been nuisances. They never fulfilled any useful function -- except possibly Accounting -- if that is a useful function? I have always thought that Accounting was over emphasized, as it is not a "productive profession" Like Law?

Perhaps Accountants and lawyers keep the rest of us on the straight and narrow track --

or at least most of us! The Area Offices simply waste money, time, and people -- and interfere with transfer of information and orders.

In addition to my assignment in the Reactor Development Division, I was appointed an Assistant Director in the Production Division with responsibility to raise the production of the Production Reactors at Hanford and Savannah River. Why, I never knew. Some of the people that I had contact with are mentioned later.

B. Development Division

In 1952, the Atomic Energy Commission was divided into several Divisions. The main ones of interest to me were the Production Division, under Mr. Richard Cook, and the Reactor Development Division, under Dr. Laurence Hafstad. The other divisions had to do with weapons, their test and storage; research; engineering; biology; medicine; and administration. It is interesting to note that during World War 11, I worked on non-nuclear weapons testing. I never had anything to do with nuclear weapons except the production of plutonium and tritium. The Production Division supervised the Uranium 235 Separation Plants and the Plutonium Production Plants at the Reactor Installations at Richland and Savannah River.

When I arrived in Washington, the Reactor Development Division was divided into the Production Reactors Branch, Reactors Evaluation Branch, Aircraft Reactors Branch, and naval Reactors Branch. James A. Lane of Oak Ridge National Laboratory and I were transferred to the Atomic Energy Commission in Washington in July 1952.

C. Production Reactors Branch

Lane and I were assigned to the Production Reactors Branch. We were responsible for programming, budgeting, and supervising the development of new reactors. This included those under construction and in operation. My main responsibility in cooperation with Lane was to plan a new program for reactor development. This program was to include new production reactors, if needed. So our first task was to determine the direction we should move. Lane did the work. In addition, I was responsible for a large part of the budgets of Brookhaven, Argonne, and Oak Ridge National laboratories. As indicated below, I had responsibility for a few other special projects. The Argonne and Oak Ridge responsibilities included nominal guidance of the development of the materials Testing Reactor and the Fuel Reprocessing Plant in Idaho.

All the above meant a large amount of travel, most of which I did by railroad. Some trips ran something like this:

Direct from work leave by cab to the Washington depot to take the Washington Capitol Limited on the Baltimore and Ohio Railroad for Chicago overnight;

By Argonne car and driver to Argonne; and all day at Argonne National Laboratory; then by car and driver back to the depot;

Leave Chicago on overnight and all the next day on the Chicago and Northwestern-Union Pacific train for Pocatello, Idaho; then by Government driver and car to Idaho Falls;

Overnight at hotel;

All day at the Materials Testing Reactor and other facilities by Government car;

Government car and driver to Pocatello;

Overnight train to Richland, Washington;

Government car all day at Richland;

Two nights and a day to Chicago by train for a day at Argonne by Government car and on the Washington, overnight; and directly to work by cab the next day.

Twice I went from Richland to San Francisco and Los Angeles, and home to Washington via Oak Ridge. Such a trip required two weeks. And yet I preferred overnight on the Pullmans to Hotels. Hotels saved no time on trips like the above. I used them only when necessary.

I had a couple of interesting things happen during travel. One time I rode with Senator Frank Church of Idaho all day across Wyoming. I never met, to the best of my knowledge, a less intelligent or a less informed man! And I have known many farmers and laborers who had had only grammar school educations, or even less. How he became a Senator will always be a mystery to me. If all Senators are as well educated and intelligent as Senator Church, woe be unto us! The few other Senators that I have met were different and all were very intelligent. Perhaps he thought that I was a spy.

On another trip just outside of Omaha, I went into the Club Car and started reading. A little later a couple came in and sat down opposite me. They were "sixty-ish". When the woman got settled and realized I was reading intently, she kicked my foot; and when I looked up she said, "What-cha reading?" I replied, "Ancher very briefly. She then said to her husband, "Come over and sit on the other side of this man." She and he turned out to be quite wealthy New Yorkers that had had a very interesting life. They insisted on my having dinner that night and lunch the next day with them. I enjoyed their company. They were a very informed couple. I did not tell them for whom I worked. I think they were surprised when a man in uniform and sidearms met me at Pocatello and took my bag as I got off the train. Airplanes have taken all the fun and glamour out of travel. They should never have been invented.

I was always amused at the Idaho Operations Office and the emphasis on "Spit and Polish". Why have a driver in a fancy uniform with sidearms to pick up people like me? Why have an Idaho Office of more than one man and a Secretary? Or an Office at all? Why have a Reactor Testing Station other than parts of Oak Ridge and Argonne National Laboratories? How we do waste time and money! A Nuclear Reactor Power Plant is less than one percent of the hazard of a Coal Fueled Power Plant of equal capacity. I suspect the hazard ratio is about 1 to 1,000, nuclear to coal fueled Power Plants. This includes mining, transportation, construction, operation, and plant and waste disposal. In fact, as noted, I believe a Nuclear Power Plants, once built, is about the hazard of a single motor vehicle accidents do.

7.1 Reactor Development Program

As stated, the main work of Lane's group on Reactor Evaluation and my group on Reactor Development, and later Peter Peterson's group, was to develop a program for reactor development. When the assignment was given to Lane and me through Dr. Laurence Hafstad, we were unclear what the objectives of the program were to be; and after all these years, I do not know. The Commission wanted a program; but the Commission could not write a set of objectives; or at least the members did not. Had we realized this, we would

have acted differently; and perhaps we would have refused to move to Washington. In retrospect Lane and I should have written such a set of objectives as our first project. But again, for some reason, hindsight seems to be a better guide than foresight. Of course, we all had a general idea of what should be done. That was to develop a Nuclear Power Industry.

Nevertheless, as is so necessary in Government, one proceeds. The real truth is that the program was already so complex; and there were so many opinions being expressed by knowledgeable people that it was difficult to sift out what should be done. After all, there are many different types of nuclear reactors; and even today after years of development and actual large-scale construction and operation, no one knows what is the most economical or even the safest type. Probably the ones being built are not the best. There are simply too many variables. This is easier to say today in 1982 and more obvious than it was in 1952. Today, I believe that for economy and safety reasons including the hazards of carbon dioxide buildup in the atmosphere that only liquid metal cooled Breeder Reactors should be built for all Electrical Power Plants, Worldwide. Fusion may become practical. Its use may be preferred. Coal, oil, and natural gas are organic chemical raw materials. All the World's supplies of these materials should be reserved for manufacture of chemicals. Then, too, combustion of organic fuels is resulting in the buildup of carbon dioxide in the air. This may alter the Earth's temperature scales, which we have today. Such temperature changes would have drastic effects on the World. Probably it would require hundreds or thousands or even hundreds of thousands of years for correction.*

The coal fueled power plants recently built in Montana and New York will result in a very serious degradation of the Canadian Shield's biological equilibrium due to the sulfur dioxide emissions. Further, widening desertification will occur across Canada from Alberta to New Brunswick. The Canadians are complaining about "acid rain" from the Ohio coal fueled plants -- they complained to President Reagan when he visited Canada after his election. New England's people are complaining about the sulfur dioxide from Canada (1981). There are no fish in Lake Champlain, Northern New Hampshire and Vermont and Southern Maine will become a vegetation desert! In fact, this northern area may be reduced to a Biological Desert due to the United States' Scientists and our Congress insisting on our burning coal rather than constructing and using Nuclear Reactors where the power is needed. I personally believe and I predict that desertification of the Canadian Shield will occur. I believe that use of coal is due to Communist Propaganda; and the effect of the Soviet Propaganda on our Scientists! How dumb can we be? The six Coal Fueled Power Plants ordered by the Public Power Commission of New York certainly should be cancelled and Nuclear Power Plants built instead.

Los Alamos, separate from the Reactor Development Program, was attempting to develop a high temperature homogeneous reactor, which required gold plating of all operating surfaces. It turned out to be a nearly impossible job and eventually the project was abandoned. I had no part in that project; nor did I ever want any part! I did recommend its cancellation; and perhaps my recommendation was of value.

A. Oak Ridge National Laboratory

Oak Ridge National laboratory was following two lines of development. First, and most important, was the Homogeneous Reactor. This development was well along. A small-scale experiment had been built and operated successfully in spite of the marriage of the heat production in the reactor to the fuel reprocessing plant. In this reactor the fuel is dissolved in the coolant and pumped through the reactor, which in reality is just a tank built in a coolant system. A neutron reflector is wrapped around this main tank. They were working on a two

liquid system separated by a zirconium sheet. Corrosion abetted by hot spots finally caused failure of the zirconium.

It appeared in 1951 that the Homogeneous Reactor had sufficient promise that we kept it on the development list. I now believe that we should have done so (1981). Anyway, the continued failures resulted in its being dropped from the Development Program. So, I have been criticized for keeping it on the Official List.

A breeder type reactor using uranium 233 was under development at Oak Ridge. My nephew, Howard McLain, worked on it for years. While the Commission has stopped the work, EBASCO Services talk of a full scale power reactor. Such a Reactor should be built. (I'm not up to date.)

Oak Ridge was also designing and constructing a gas cooled graphite moderated reactor using CO2, or carbon dioxide, coolant. This was well along. I had no part in it. After short term operations it was dropped. It should be noted that the British kept on developing gas cooled reactors. However, they have not pushed the High Temperature one beyond just operating it. So their Chief Engineer came to this country. As a result Gulf-Shell Atomics has pushed the development and I believe have sold several High Temperature Gas Cooled Reactors, using helium coolant and a solid fuel made of coated pellets in a graphite matrix. I have no data on operations or costs.

Since Oak Ridge was well into the development of gas cooled and homogeneous reactors, we made no change in their program.

Later, I was criticized for not shutting down both of the last two reactor development programs mentioned above. I believe that one does research and development work at early stages of an industry in several directions. No one can tell what is best. But I believed then and now that light water cooled reactors were the poorest. These are the Reactors being built in the United States. I believe the reason is that Utility Executives understand -- or think they do -- water boilers and the use of steam. At least they have heard about them; and they have confidence in their operations; Utilities have guaranteed profits; so their Executives don't worry about costs! As noted, we should have pushed only the Fast sodium cooled Breeder Reactor.

B. Argonne National Laboratory

Argonne National Laboratory had been designated by the Commission as the Power Reactor Development Center. Why, I never could even guess. It was never carried out. Why do we need the complex Atomic Energy Commission, its Area Offices, and all the red tape? I soon became disgusted with the whole foolish outfit. I still am. What a waste of money! As noted, the Area Offices never served any useful function -- except possibly Accounting. They also interfered with information flow.

The original Graphite Reactor, CP2, which was a larger rebuilt version of CP1, the first critical reactor, which had been built under the West Stands of the University of Chicago's Football Field, had been rebuilt at Palos Park in a Federal Forest Reserve some 20 miles Southwest of Chicago. CP3, a heavy water reactor, had been built at the new site.

The Forest Reserve did not want these reactors as a National Monument; and we had to tear them down and bury the parts we couldn't recover. I thought this was another of the most stupid decisions I ever heard of in Government; and I have heard about many stupid things! "Let not thy right hand knoweth what thy left hand doeth." The Reactors would have become of great Historical significance and interest. Perhaps the Forest Reserve people will dig them up

someday soon and exhibit them. They would be of great interest to many people. Maybe such actions are the reasons that many people don't like Democracy! We must select better people to govern ourselves -- bottom to top -- especially the top -- what characters we do come up with! What rank could they get in the Army or Navy? Corporal, perhaps?

Dr. Zinn was interested in two reactors. One was a larger test and development reactor, which was built as Argonne test facility and called CP5. It was a very important test facility. Dr. Zinn was also interested in the fast reactor. Soon after the close of World War II, Dr. Zinn and others at Argonne started development of the Fast Reactor called originally CP4, and later called the Experimental Breeder Reactor I, or simply EBR-I. Natural uranium consists of about 0.7 per cent of the fissionable isotope uranium 235 and about 99.3 per cent of the nonfissionable isotope uranium 238 and traces of uranium 234. In a Breeder Reactor, Uranium 238 is converted into fissionable plutonium 239; or thorium 232 maybe converted into fissionable uranium 233*. In a Breeder Reactor more new fissionable fuel is made than fissioned. You pick yourself up by your bootstraps and fly away!

The Experimental Breeder Reactor I, or EBR-I, was designed to give engineering data and, if possible, provide a demonstration of breeding. The power level was low, 1400 kilowatts (of heat). This, however, was sufficient to provide some basic engineering data. It was cooled by a sodium-potassium alloy, called NaK. Two cycles of NaK cooling were used, only one was necessary. One cycle probably if safer than two since coolant equipment failures are halved. So, two single heat transfer systems should be used rather than two heat transfer cycles. Increased safety would be provided by two parallel circuits, not by two sequential cycles. The primary coolant transferred the heat to a secondary NaK coolant; and, this in turn, boiled water at pressures, which produced steam to drive a small turbine. This was large enough to demonstrate production of power by lighting the town of Arco, Idaho; and in 1955 to demonstrate breeding by producing more plutonium than the uranium 235 or plutonium fissioned. Also, this reactor used electro-magnetic pumps for the circulation of the liquid metal coolant. Thus EBR-I was first in demonstrating breeding, use of liquid metal coolant, and the first liquid metal, or other coolant, cooled reactor to product electrical power. The Los Alamos Fast Reactor had become critical late in 1946. It was a Mercury-cooled Plutonium reactor of very low power level. It was useful in providing physics data only.

While Breeding was expected from the Physics measurements, the actual achievement was important. Of course, I actually had nothing directly to do with it. So in 1955 I was greatly honored by being asked by Dr. Zinn to make the Public announcement that Breeding of Nuclear Fuels had been accomplished. I was then in the Atomic Energy Commission on leave from Argonne National Laboratory. I refused to make the announcement and it became known to everyone that Dr. Zinn should have made the announcement. I regard Breeding of Nuclear Fuels as one of the greatest events in the History of Mankind, perhaps the greatest after the discoveries of fire, writing, medicine, metallurgy, agriculture, and printing -- or number seven in importance. Where do we place speech, ships, railroads, automobiles, or even harnesses, for horses, etc, etc? I had nothing to do with research and development work.

While we recognized that development of the breeder reactor involved a very extensive program, its long-term importance due to its negative fuel requirement, its high temperature operation, etc, required that its development be continued. Thus, the Experimental Breeder Reactor II was conceived.

I mentioned in discussion of the MTR that aluminum cladding and structural materials were used. Since aluminum is high in the electromotive series, it can when molten, react with water. Serious explosions of hot aluminum and water have occurred. So, Mr. Samuel Untermeyer, may his name be blessed, began an investigation of what would happen when aluminum clad fuel assemblies melted in water. Sam found that they simply melted.

Sam then proceeded to consider what would happen if we allowed boiling to occur in the core of a reactor. Previously, some Physicists had claimed that the least boiling would upset the neutron control, very likely cause failure; or the temporarily uncooled fuel would melt. So, Sam tried it. Nothing happened. He then proposed that we build a "Boiling Water Reactor". Dr. Zinn concurred. Thus, Sam "invented" the Boiling Water Reactor.

Wally proposed that Argonne should build a small reactor with minimum facilities and use it in boiling water experiments. He suggested that it be built so that large excess reactivity could be added in a very short period; or so that he and Sam could find out just what would happen when failure did occur. Wally sent us a proposal for a small experiment to be built in Idaho near the EBR-I to tests the Boiling Water Reactor Idea. By that time I had used up most of my budget; so the Aircraft Reactor Branch helped, and we got the $500,000 together and approved Dr. Zinn's and Mr. Untermeyer's proposal.

The experiment was run in the next few months. Everything ran fine. The last experiment was to make the device supercritical by adding a large amount of excess reactivity very quickly, faster than would occur in any reasonable accident -- this does not include being struck by a large meteorite, or a nuclear weapon explosion. When the experiment was conducted, the core melted, large volumes of steam were formed, and the top of the core was blown out the top of the reactor. There was no explosion. The experiment demonstrated that boiling water reactors are safe. I never understood how an explosion could occur. A fast chemical reaction -- yes, but no explosion. To people not familiar with explosions, the chemical reaction may have appeared like an explosion. It could not have been an explosion.

So we added the Experimental Boiling Water Reactor II to our proposed program. Thus, the Boiling Water Reactors were invented by Mr. Untermeyer, and their feasibility demonstrated by him and Dr. Zinn. Many power plants based on these experiments are in operation; and many more are being built. Sam should be given a Nobel Prize, as should Dr. Zinn. Sam always insisted that I should be given a Nobel Prize for my work. I disagreed. I did many things; but I never discovered a new particle that may exist microseconds in stars. Their developments were certainly more important and original than most of the things for which Nobel Prizes have been granted. Discovery of an artificial particle is of very little value to Mankind while Breeder Reactors are its future energy source. They should be our present main source. I have always regarded Dr. Zinn as the greatest man that I ever knew, as I keep repeating.

C. Atomics International

Atomics International had been developing sodium technology. So it was natural that they should continue with the sodium cooled reactor. They suggested that a sodium cooled graphite moderated reactor be built. It had sufficient promise that we added this to the list. It was my idea that this reactor would help in the Fast Reactor Technology as I believe it has. However, since it has been discontinued, I have been criticized for including it in the test program

7.2 Light Water Cooled Reactors

The use of pressurized light water as a coolant results in poor neutron economy. However, there are several advantages such as known technology, and a rather compact core due to the very high efficiency of light water as a moderator, very high heat transfer rates, and no carbon deposits on decomposition. Since several Utilities were talking of building light **water** cooled reactors, we decided to assist these instead of the

Government building smaller experimental plants. Dr. Peter Peterson had been brought in by Dr. Hafstad; and John Landis was transferred to work with him.

We got into trouble. One of the most influential Commissioners thought that only Admiral Hyman Rickover could handle Reactor Projects. It was true that the Submarine Reactor was being developed using light water technology; and Westinghouse was pushing the light water cooled reactor. The Commissioner stated once that only Admiral Rickover and Westinghouse could build a Project of this size! I don't think he had ever heard of Savannah River or Hanford, both many times larger and more complex. Why was he a Commissioner? Why have the complex Commission at all? Of all the foolish wastes of money, this is it -- especially the Area Offices. We do need a small Washington Coordinating and Budget Staff -- of two people -- as I keep repeating.

Meanwhile, Peterson and Commonwealth Edison were discussing a small-scale production reactor. This was to have been the Pressurized Light Water Reactor which was built by the combined Government-Westinghouse-Pittsburgh group known as the Shippingport Reactor. When the Commission decided to go the Rickover way, Commonwealth Edison and General Electric proceeded with design and construction of the Dresden I Boiling Water Reactor independent of the Federal Government. Several other Utilities contributed funds. The Government did very little toward this Project. I think that the Commission acted very stupidly. I also admire Admiral Rickover for what he has accomplished.

The Shippingport Reactor was very expensive, and too small for any experimental or practical use. There was no reason to build it in my opinion. It was a total waste of money. I believe the decision of the particular member of the Atomic Energy Commission was questionable on several grounds. First, he made a technical decision for which he was not qualified; second, he made a decision based on personal prejudice rather than technical and financial reasons; so, the decision was both technically and financially wrong; and third, it was not his responsibility. It was Dr. Hafstad's. After 30 years in operation, the Dresden I Reactor is shut down for an "overhaul" at present (1981). It is a Boiling Light Water Reactor.

Because of the Shippingport Reactor and other reasons, I left the AEC and returned to Argonne. I admit to great disgust as I believed that the Shippingport Reactor was too small to be useful and that its construction was a total waste of Government money -- and I still think so (1981). Anyway, it helped to get me to resign from the Atomic Energy Commission. But, in retrospect, for the good of the whole program, I should have remained in Washington -- as should Lane -- at least for another one of two years.

A. Resume

The Power Reactor Development Program then became the following:

1. Homogeneous Reactor II
2. Experimental Boiling Water Reactor II
3. Experimental Breeder Reactor II
4. Sodium Graphite Experiment
5. Pressurized Light Water, or Shippingport Reactor.

This was supported by the private Utility Program for the Dresden I Reactor which actually was time-wise behind the others so that operating data on the EBWR II were available before Dresden I was placed in operation. Five men from the Dresden staff actually attended a lecture course that I gave after my return to Argonne National Laboratory.

In summary, I probably added little to the program. It certainly was not Lane and McLain's program. But I have been criticized for it! I now know (1981) that only Breeder Reactors should be built for all new Power Plants of 200,000 kwe and larger the World over. Thus, no coal oil, or natural gas fueled Plants should be built in the future -- anywhere in the World. Large ships should be propelled by Fast Reactors and all railroads and road transportation should be based on electricity derived from Nuclear Power Plants. I believe continued use of coal, natural gas, and petroleum will lead to a new "coal age," and the melting of all the ice in the World and a 270 foot rise in the Oceans in a century or two -- unless other actions than burning carbon based fuels are taken. I believe this will happen in about 300 years unless action is taken in 100 years or so. Perhaps the "hole" in atmosphere the South Pole area is already a beginning.

B. Plutonium Fabrication Facility

One problem that had been recognized for some time was that of the manufacture of fuel assemblies that contained Plutonium, or the recycling of Plutonium in Power Reactors. Argonne had placed a line item in their budget request. I had had no contact with the planning at Argonne. This was for, I think, $900,000. My viewpoint was that this was far too little. So, immediately on my arrival in Washington, I called Dr. Zinn and suggested that this be revised upwards. Wally had not studied the item. When he did so, he called back and asked that it be deleted. The next year the item was again placed in the budget for $5,000,000. How far off can you be? 450% ? When I returned to Argonne, I became the Project Manager. This is the type of thing that Congressmen call "collusion." I think that I plead not guilty as I simply followed orders. What is morally right?

C. Fast Reactor Technology

California Research and Development had put together an excellent staff for the Materials Testing Accelerator described below. When that project was cancelled, I suggested that the staff should be used to develop sodium technology. Pumps, heat exchangers, boilers, piping, and maintenance needed further development work. This is Petroleum Technology. This we tried to do; but the budget figures came out very high, and the Bureau of the Budget cancelled the project. I believe that it should have gone forward. Argonne has not done its job as well as it should have.

I never figured out how the Bureau of the Budget knew more about Nuclear Reactor Technology than Dr. Zinn and I did. But they carried a heavier sick. Or club! I always thought they were jealous of others. I think Budgets should be cooperative efforts and not based on uniformed opinions -- or guesses by uninformed people. What does the Bureau of the Budget know about Army Ordnance or Fast Breeder Reactors? How could their financial people know enough to evaluate a Program? If so, they should be the Program Coordinators! Thus, the Bureau of the Budget should do coordinating of programs only. They would make very valuable contributions if they did. I don't think that the Bureau saves a penny above its own expenses. And as indicated, it may do harm--in fact I believe that it does.

The trouble with the budget for the California Research and Development Company was that we were too honest. We included the things which should have been included in the first

budget rather than overrun our budget and cry for help later, which is frequently done; or should I say, usually done? I'm still disgusted, 1981. Anyway, this argument helped to get me to leave Washington and Government Service.

D. Materials Test Accelerator

Dr. Ernest O. Lawrence was a terrific idea person. Among other things, he invented the accelerator. Once, at his desk, I held the casing of the "first accelerator" in my hand. I was thrilled! It was about five inches across and one inch high -- like a small aluminum dish. Because he invented the accelerator, he was listened to. At the same time many of his ideas were impractical -- practical or not, he pushed them. He who talks the loudest, gets listened to the mostest!

Because he invented the accelerator, he was listened to. One of his ideas was that an accelerator could be used to produce Plutonium. It could be. At that time there was a general idea among many Scientists that natural uranium in mineable concentrations was very rare. Why I never could find out. They had no basis for the statement. Why they talked and acted instead of asking Geologists' opinions is still a mystery, at least to me. The land areas of the world are sizable. So, they argued, to get fissionable materials, we either had to use breeder reactors or manufacture Plutonium in some other way. Dr. Lawrence's idea was that we could accelerate deuterons to a sufficiently high energy that when these deuterons plunged into a uranium metal block, the deuterons would cause spallation of uranium nuclei producing, among other things, neutrons. A deuteron at 350 mev will release on the average about sixteen neutrons on impact with a uranium target. Part of these neutrons would then form Plutonium by reaction with uranium 238 followed by decay to Plutonium. Thus, an accelerator could complete with the Breeder Reactor. Both could use thorium as the target material; so all the World's total thorium and uranium could be fissioned for fuel -- as they can be in Breeder Reactors. The fission reactions are listed in Appendix 1.

Anyway, Dr. Lawrence suggested that a Pilot Plant be built to check his proposal. And he sold the idea to the Commission! He was a very convincing salesman. So, some $18,000,000 of 1965 dollars were appropriated ($450,000,000 today, 1982). The California Research and Development Company, a subsidiary of Standard Oil Company of California, was brought into the picture; and the Company was given a contract to design and build a test facility. A design was prepared, an area near Livermore, California, was purchased, and the device constructed. This was called the "Materials Testing Accelerator," or MTA. It was not a Materials Testing Accelerator. It was designed to produce Plutonium.

The whole Project was top secret. It was also handled by the Production Division of the AEC. Why, I never found out although I tried to do so. I have always thought it was to bypass Dr. Hafstad, Dr. Zinn, and Dr. Weinberg. Of course, they would have objected on practical grounds. What was the Commission Members' thinking, or were they thinking? Apparently, the Commission later had had some second thoughts. They should have had some third thoughts! Maybe some fourth thoughts? Or even fifth?

The first I heard of the Project was about a month after I got to Washington. Even then, I heard only that the Project existed. I saw no drawings or reports. About one month later Dr. Hafstad, in a hurry as usual, opened my door, stuck his head in, and said, "Stew, the Commission just decided to transfer the MTA from the Production Division to the Reactor Development Division. I'm assigning the responsibility for the Project to you." He slammed the door as he left. I scratched my head a bit. From "know-nothing to Bossman" in 10 seconds!

So, the next day, after I received a formal Program Assignment, I went down to the Production Division. I found a four-drawer filing cabinet filled with Top Secret reports. I got these transferred to my office and began to study them. The Pilot Plant was described and plans for a full scale production facility with an estimated cost of $150,000,000 were included. The whole thing amazed me. I proceeded to estimate the cost, based on my Hanford and Savannah River experience, as $450,000,000 (1948 dollars); this was years ago before so much inflation had taken place. Today, 1981, it would be thirty times that, possibly 15 billions dollars, or quite a little money -- even in President Reagan's Budgets!

After due consideration, I proposed to Dr. Laurence Hafstad that he and at least one of the Commissioners, actually Dr. Keith Glennan, and I take a trip to California to see the Pilot Widget; to have the California Research and Development people tell us what it was all about; and to talk to Dr. Lawrence, Dr. Alviriz, and others at the University at Berkeley. This was a political move. I admit that my mind was made up before I saw the widget. One must always play the Political Game -- and I might have been wrong -- I have been on some other things. As noted elsewhere, I had had a Course in Nuclear Physics in the University; and I had been involved in enough projects to visualize what a full-scale device might look like.

Dr. Kenneth Davis led the discussions at Livermore. He made such a good impression that Larry hired him to take my place when I left Washington. Dr. Alviriz also made an excellent presentation. And we visited the Pilot Plant. For some reason, Dr. Lawrence did not show up. Why I was not told. It was a poor Political move on his part. He wouldn't have changed my opinion; but he might have changed of Commissioner Glennan. And the Commissioner carried a bigger stick. I've wondered at times if Dr. Lawrence had had second thoughts about the Project. He should have had such thoughts. You have an idea and others get carried away with it.

Standard Oil Company of California had been brought in as the Design - Constructor of the Pilot Plant. This consisted of a huge shed type building in which the Pilot Accelerator was built. The Accelerator consisted of an ionization chamber for deuterons, a preliminary booster, and the Accelerator proper which consisted of 10 or 12 drift tubes -- actually magnetic devices to add energy to ionized atoms -- they were operated at several million volts, and a target. The whole widget was placed in a vacuum tank some 18 feet diameter by 80 feet long. But, strange as it may seem, it worked. Neutrons were produced in the uranium target.

One experiment should be on interest. A "target" of uranium metal perhaps a half-inch thick was set up outdoors, and the Accelerator "aimed" at this target. No one seemed to have worried about radioactivity due to production of neutrons in the target and activation of everything in the neighborhood. One would expect everything to become at least mildly radioactive very, very quickly, in a few microseconds. The target had been placed outdoors in an isolated area. When the accelerator was turned on, the instrumentation at the target showed no action. On examination of the target, it was found that its center had simply disappeared before anyone had had time to look at the instruments. Possibly not enough time was allowed for the instruments to show movement. While I was watching what was going on, none of us were looking directly at the instruments. The whole center of the target, about ten inches in diameter, had simply been vaporized. Apparently, no one had worried or even thought about heat transfer rates or target cooling. I shook my head. I didn't know enough to ask questions. No one had worried about radioactivity due to neutrons or other subatomic particles or radioactive fission products that might be produced.

There were two immediate problems. These were that the RCA high voltage AC-DC converter tubes still needed development; and there was uncertainty as to the number of neutrons produced per impact as a function of the voltage. So after some cogitation, I recommended continuing the tube development since these tubes have commercial uses; and

it did seem reasonable to finish the program as well over fifty percent complete; and the Government would have had to apply at least eighty per cent. Where do you draw the line? 50%? 80%? 90%? And I had to make the decision, almost offhand.

A different situation existed in respect to the neutrons versus energy data. The highest voltage accelerator at that time was the large cyclotron at Berkeley. I believe this was the 184-inch accelerator. Of course, this is peanuts compared to the five-mile diameter Monstrosity now at the National Accelerator Laboratory west of Chicago and the large one in California at Stanford University. What good are they? But the 184-inch was the largest then in existence, I believe. It had been calculated that the power level of the 184-inch unit could be doubled by stronger magnets. These could be installed at a nominal cost. So I recommended that these be installed and the data obtained. Both programs were completed.

I reviewed the information on the larger, or production accelerator. The following table presents my rough comparison between the pilot and proposed production models:

Purpose	Pilot	Production
Name	Mark I	Mark II
Tank, vacuum, ft	10 X 100	60 X 350
Voltage, mev	25	350
Milliamperes	50	??
Cost, 10(6) $	15	65*
Power, kw	??	150

*Estimated by Dr. Lawrence. My estimate was $45,000,000, about $3 per U.S. citizen, the California R & D people estimated $150,000,000. I was probably low. Maybe I was wrong, as construction of this widget might have prevented the construction of the National Accelerator, or Monstrosity, west of Chicago. If so, the device would have been worth while several times over!

After about the third trip to Livermore, I reported to the Commission on my findings and recommendations. Henry Smyth, one of the Commissioners spent two hours in the Commission Meeting after my presentation questioning me. He was a Physicist, and I was not. But after a few minutes I realized he was asking questions that he thought I could answer and not ones that might embarrass me. He was very, very careful in his questions. I recommended cancellation of the entire project. Later, the evaluation people under Manson Benedict concurred. But the Commission acted at the meeting, right after my presentation, and killed the project. Thank God!

Several years later Dr. Bennett Lewis at Chalk River, Canada, reinvented the idea as a neutron source. He couldn't quite believe what we had done until Dr. Kenneth Davis sent him some of our declassified reports. Actually, the only publicity, when we declassified the project, was a short note in "Popular Mechanics". I don't have the reference.

My comments on the White Elephant, or "Monstrosity", as I call it, at the National Accelerator Laboratory in Illinois are not printable. To me, in brief, it is nearly a total waste of Government money. So, maybe some Physicist will get a Nobel Prize for a new "artificial" particle that may exist in the sun and stars, for a few, microseconds? Will that put any beans or rice in the food pots of the starving people in the World? Still, I am a believer in Research. But the National Accelerator looks like a "Dead End" to me. As noted, I voted against the accelerator built at Argonne National laboratory.

E. Production Division

I was also a member of the Production Division. My duties were to attempt to develop new ideas for increased power levels at Savannah River and Richland. Actually, I did practically nothing toward increased power levels at Savannah River. I had had my sticky fingers in that Project earlier. I did assist in raising the power levels at Hanford.

F. Savannah River Reactors

All the Savannah River Reactors are natural uranium metal reactors. These are heavy water cooled and moderated. Since the heavy water is cooled by passage through stainless steel tubed heat exchangers, and the heat is transferred to clarified Savannah River water, the heat exchangers place a real limit on the possible power levels of these reactors.

We had designed into the reactors sufficient heat production capacity to reach the limit of the heat exchangers. Savannah River developed a very competent Staff that has moved continuously ahead. In actual fact, we calculated before construction started that each reactor probably could be raised "X" percent above its design power level. The heat exchangers and fuel were designed for a reasonable factor or safety.

G. Hanford Reactors

The situation with the Hanford Reactors, however, was just the opposite. The original reactors had been designed during World War II on a very conservative basis; and this design had been followed in subsequent reactors. There were five natural uranium metal fueled Reactors at Hanford. They were graphite moderated and cooled by clarified Columbia River water.

Soon after we went to Washington, D.C., there was a meeting with several of the Richland staff at Hanford. I sat in the back and said very little until just at the end. Then I asked why they were not trying the use of zirconium tubes in place of aluminum tubes. No one answered. All of the Hanford people looked surprised and wondered who the devil I was.

For several weeks on return to Washington D.C., I studied what reports I had time to read. How much Plutonium could have been made while I studied the Reports? What effects could that Plutonium have on our future? I learned how the reactors were built and operated. Of course, I had visited the reactors several times.

1. Visit to Hanford. Then, at my suggestion, Dr. Frank Pittman, Deputy Director of the Production Division, and I went to Richland, Washington, to visit the Hanford Reactors. While there, I think we spent two days talking to the Development Engineers, one day on inspection, and a short time with the AEC, including talks with the Area Manager, David Shaw.

As I remember it, Dave took a very dim view of why we were there; but he never said so. He did not spend the two days on inspections with us. I thought he should have done so. While it would have had no effect on me, it is always good diplomacy to accompany visitors form Headquarters. That, at least, keeps your employees from telling visitors how dumb you are!

When we asked Dave why there was not a greater push to higher power levels, he stated that General Electric Company, the operating contractor, would not move to higher power

levels. Then, when we discussed the problem with the General Electric Officials, they stated that their contract with the Atomic Energy Commission stated that General Electric was responsible for any damage to the reactors that might occur in operation at higher power levels.

We did not push this point at the beginning; but after spending the two days talking to the Engineers and attempting to evaluate the Reactors' potential for higher power levels, we did push it

2. Technical Program. In looking at the technical program we simply went through the laboratories and talked to the Engineers and asked what they were doing. We then tried to put all their ideas together into a program along with one additional idea that had been used elsewhere.

I believe we first asked for a presentation of the various power levels, the flux levels, etc. I remember that in this session I started asking questions of the Engineers, why they were not moving to higher power levels, and what they thought the limits were. They were enthusiastic, and everyone thought the idea that he was working on could be used to produce higher power levels -- and thus more Plutonium.

3. Fuel Rods and Water Velocities

We asked about higher water velocities. This had led to erosion and other troubles. We then asked why higher temperatures drops were not being used. This led to the fact that the exit water of the hottest tubes in the center of the reactors was near the flash point of the exit water; so again, nothing could be done. So we asked why not increase the exit pressure to stop vapor formation in the tubes, and let the hottest tube exit water mix with the cooler water form the outside tubes. This would require higher pumping power. But this was small, we stated. Actually, in a few weeks this was being done, and much higher power levels were being obtained at a relatively low cost. Later, higher capacity and higher-pressure pumps were installed.

4. Zicalloy Tubes

I mentioned above the question of use of zircalloy tubes in place of the aluminum tubes. Since no one at Hanford seems interested, I actually ordered six tubes and had them made to the size of the Hanford aluminum tubes and shipped to Hanford, These zirconium tubes were made by rolling the thin sheet into tubes and welding the seams. When I asked why these tubes weren't being tried, I got the answer that they were welded tubes; and the General Electric people considered that it was not safe to use welded tubes in a reactor. I stated that this was foolish as it could be easily shown that the zirconium tubes had at least twice the strength of the aluminum tubes; and that no tube would be used prior to a pressure test. We got nowhere.

This discussion had an interesting sequel. Max Carbon, one of the engineers, was interested. Max was working on heat transfer. So sometime later Max tested the tubes, became enthusiastic, and finally all Richland became interested. At any rate a combined power and production reactor was built at Richland using zircalloy tubes. This operated for several years. Later, a replacement pure power reactor was designed. John Huffman acted as a consultant.

A year or so later Max left Richland to go the University of Wisconsin where I believe he became Head of the Nuclear Engineering Department.

5. Enrichment

I asked about partial enrichment, particularly of the ends of the outer tubes and the tubes near the edges of the reactor. This was frowned upon at the time. Later, it was used.

6. Other Changes

Several of the Engineers had ideas and these were all useful. However, I have forgotten many details.

H. Final Discussions

Before leaving Richland we had another discussion with David Shaw, the Area Manager. In this discussion we briefly outlined what we had found. I told Dave that the General outlined what we had found. I told Dave that the General Electric Company believed they could not take the risk of pushing to higher power levels as they would have to pay for any possible damages to the reactors. I further stated that I agreed with General Electric as their contract with the AEC was very specific. I then stated that I wanted the contract changed at once. Dave was quite surprised, I think, at being told by a person that he had probably never heard of to rewrite his biggest contract. I then indicated that I was responsible to the Commission; and that I had agreed that power levels could be increased. We left on a rather sour note that either the contract would be changed and the Engineers' and our ideas for higher power levels instituted in the near future, or we would have a new Area Manager. Frank Pittman said little; but he did back me up. I should have relieved Shaw of his job as of the moment and dictated a Report sitting at his desk.

Several years later, I again met Shaw. He had left the AEC and was President of United Nuclear. United Nuclear had offered to purchase Nuclear Engineering. I was a stockholder and member of the Board of Nuclear Engineering. When we met again, Hyman Federman was introducing the Nuclear Engineering Board members to him. Shaw simply said, "We've met before." We both smiled. Neither of us took the chance to refer to our previous meeting -- or wanted to do so.

I. Reports and Changes

On the train back to ward Chicago, Frank and I discussed what we had accomplished. Frank also started a report to the Commission based on the idea that higher power levels at Hanford could best be obtained by a large number of small changes. On return to Washington we prepared a rather complete report with the recommendation that the AEC change the contract with General Electric to relieve General Electric of responsibility for damages that might occur as the power levels were increased. Since, when any change is made, the power level of the reactor is raised very slowly, we considered that any damage that might occur would be very small and that it would be detected before serious trouble occurred. We also stated that we believed that the power levels could be raised without any significant danger to the reactors; and further this increase in power levels would provide sufficient Plutonium that no additional reactors would be required. I think that Most American Industrial Plants are over designed, as I keep repeating.

Actually, the power levels were raised substantially over the next few years. Almost immediately after we left, pressure valves were installed on the ends of the exit tubes to raise the exit pressures, and thus permit higher exit temperatures with higher power levels. Calculations were immediately started on our others suggestions. New pumps were ordered. Not only were higher power levels attained with comparatively small capital costs; but also the morale of the people improved.

As a result, the only additional reactor built at Hanford was the combined Plutonium Production-Power Reactor. Actually, higher power levels cost very little compared to the dollars for more reactors. Operating costs would have increased had additional reactors been built -- and time would have been lost. What effects these changes may have had on the International situation are unknown to me. In any case "War is Hell" -- whether or not directly involved. Now, 1982, the Russians have many more Nuclear Weapons than we have, according to Newspaper reports. I should have spent several months on work on the Hanford Reactors.

J. Odds and Ends

A few times the Commissioners had luncheons with Dr. Laurence Hafstad, Admiral Hyman Rickover, James Lane, and me to discuss our problems. These were interesting as usually it was Admiral Rickover that was quizzed. I always thought that the Commissioners knew too little about Lane's and my work to quiz us.

We also had frequent contacts with the Joints Committee on Atomic Energy of Congress. Mr. Walter Hamilton was the liaison person. He acted as Secretary to the Joint Committee's staff. After we had developed the so-called "Five reactor Program," the Commission adopted it; but the Bureau of the Budget, as I remember it, did not believe the test reactors needed to be built.* This was also the opinion of one of the most influential of the Commissioners. He wanted Admiral Rickover to boss all the work. So I called Mr. Walter Hamilton one day and suggested that it might be on interest if we just happened to meet in the first floor Hall of the Atomic Energy Commission Building at say 1100 the next day. He, of course, knew of the suggested program and its temporary demise. Office walls have ears.

Anyway, we happened to meet by "pure chance" just around the turn in the Hall at the front of the old Atomic Energy Building on Constitution Avenue. I told him that I thought the cancellation of the experimental reactor program was a great tragedy. I suggested that Congressional Hearings might be of interest. He nodded, and we parted.

A few weeks later, Congressional Hearings were held; and strange as it may seem, the small old program slightly updated became the Law of the Land.

One other item about Congress is of interest. Senator Anderson of Arizona was a member of the Joint Committee for Atomic Energy. One night he and Keith Glennan asked me to have a sandwich with them. Senator Anderson was full of questions; but his mind was made up. He wanted no answers to his questions that deviated the least bit from his opinions -- a typical Congressman? I never thought so. A fool? Definitely! How did he ever get to be a Senator? Politics are wonderful!

During the summer of 1963, Dr. Hafstad and one other man and I had attended a meeting at Chalk River, Canada. Dr. Hafstad and I agreed that the Materials Testing Reactor was essentially all declassified. However, we were not quite certain that the details of the fuel assemblies were completely declassified. So I took the cross section drawing of the core, and

cut out just the fuel section. At Chalk River, Dr. Hafstad reviewed the program evolved at Washington; and I presented the discussion of the design of the MTR. On return to Washington I was accused of presenting classified information. When I showed the cut up drawing and testified that I had divulged no classified data in Canada, the subject was dropped.

Also, in that summer there was an International Conference at Jenner, Norway. I was asked to go and planned to do so. Since I was going, Dr. Walter Zinn suggested that I present the paper on the CP-3 Heavy Water Reactor for Argonne; and it was reasonable that I should present the paper on the Materials Testing Reactor, including a discussion of the the fuel assemblies, heat production, neutron flux levels, etc. So, I prepared both papers. However, when we decided to leave Washington and return to Argonne, I asked Dr. John West of Argonne to present the CP-3 paper and Dr. Alvin Weinberg of Oak Ridge to present the MTR paper. This was done. The MTR paper created a sensation as it disclosed the tremendous heat production rate -- for which I had not been the designer, see the "Atomic Shield", 1947-1952, page 700.

Background data on some of the people mentioned above are presented in the Chapter, entitled "People".

1. Materials Testing Reactor

The Materials Testing Reactor design grew out of a study at Oak Ridge National Laboratory in 1947 of a Reactor for use for various tests, particularly for the properties of neutrons and for the production of radioisotopes. Basically, the Reactor utilized a fully enriched, ninety five percent or so, uranium 235* core with aluminum plate-type fuel elements. Thus, it had higher neutron fluxes ** than the original graphite moderated reactors then in use. Originally, it was designed at Oak Ridge National Laboratory as the High Flux Reactor. *** Later, it was renamed the Materials Testing Reactor. I have used that name of the initial MTR.

The original purpose of the reactor to produce a beam of neutrons for the investigation of their properties was lost sight of and the reactor was built to test materials such as steel at high integrated neutron fluxes, or total exposure of materials to neutrons, to determine their changes in strength, brittleness, etc. The original purpose of the neutron tests was dropped.

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* Uranium 233 and 235 are fissionable. U238 is not. About 99.3% of natural uranium is U238 and 0.72% is U235. There is a very small amount of U234 present in natural uranium.

** Neutrons passing a square centimeter per second.

*** The Commission transferred the project to Argonne National Laboratory in order to place Reactor Development at one Center. This was never completely carried out.

Dr. Hilberry should never have been appointed Director of the laboratory. Too, as pointed out, neither the Accelerator at Argonne nor the Monstrosity built west of Chicago at the National Accelerator Laboratory should have been built -- at least not in Illinois; possibly at Berkeley, California, or in Siberia, or in Antarctica on the ice. I think preferably in Northern Siberia. I believe that the Monstrosity has never served any useful function nor that it ever will. How we do waste people and money. Perhaps some Reactor in the Sun?

2. Ann Arbor Conference

Sometime in 1952, I think, I suggested to Professor George Grainger Brown of the University of Michigan, at Ann Arbor, that the University should sponsor an International Conference on Atomic Energy. He agreed and a committee was set up with me as Chairman and a meeting held. I believe that I gave three papers -- my memory may not be correct.

We planned a broad program and invited the United States Atomic Energy Commissioners, and the Commissioners from other Countries. The U.S. Commission took no notice of the meeting, at least no U.S. Commissioner attended. Several Foreign Commissioners did attend. I thought our AEC action was atrocious -- to put it mildly. As usual, my actual words are not printable. The program on the whole was excellent.

Due to the large attendance and particularly the International interest -- especially that of the Europeans -- I believe that our Commission suggested to President Eisenhower that a broad International Meeting should be held; and that the United States should declassify as much material as possible for that Conference. This was done, and the 1955, or "First Geneva Conference" was well attended. Two of the highlights were Dr. Walter Zinn's motion picture of the blowing up of the Boiling Water Test Reactor; and his results of the Experimental Breeder Reactor. I did not go because there was very little engineering discussion -- rather only physics and descriptions of Reactors. I should have prepared an "Engineering" paper and attended the Conference. I was too busy.

While I presented no paper at the Ann Arbor, there was a national meeting held in Cleveland the following year. I was at the International School. I was asked and presented talks on "Reloading of Reactors," and on other subjects. I have forgotten the titles. The paper on Reloading of Reactors was presented again to a group in New York, to the Society of Mechanical Engineers, I think. This was amusing as I had two short films that showed actual operations. However, facilities to show movies weren't the best. The talk was given in the Grand Ballroom of one of the more famous New York Hotels. It was summer, the windows were open, and we could not close two of them. Consequently, the wind blew the curtains so much that we could hardly see the pictures. It was on the south side of the Hotel on a bright sunny afternoon -- just normal McLain luck.