Argonne's early history

as written by Lester C. Furney for Argonne's first Employee Handbook, published in October 1951. Mr. Furney at the time was Staff Assistant to Walter H. Zinn, Laboratory Director. He accompanied Dr. Zinn in 1956 when the latter resigned from Argonne to found the General Nuclear Engineering Corporation at Dunedin, Florida. Mr. Furney is now a resident of Clearwater, Florida.

This plaque was unveiled December 2, 1947, during the Fifth Anniversary reunion of those who participated in the event it commemorates. Officiating at West Stands were (l to r) R.F. Bacher, member of the new USAEC; Farrington Daniels, Director in 1945-46 of the Metallurgical Laboratory; Walter Zinn, Director of Argonne National Laboratory 1946- 56; Enrico Fermi, director of the experimental program which culminated in the event the plaque speaks of; and Robert M. Hutchins, then Chancellor of The University of Chicago.

Argonne National Laboratory was originally organized as the Metallurgical Laboratory of The University of Chicago in January, 1942 under a contract between the University and the Office of Scientific Research and Development of the United States Government (OSRD). Its operations were housed in various University buildings and certain temporary structures which were erected on University property. By the end of March, 1942 there was a total of about 150 individuals on the Laboratory's payroll. Of these, over ten percent are on the payroll of the Laboratory as of the end of March, 1951 and the majority of the others are still associated with the present Atomic Energy Commission activities at other laboratories or in various active consultative capacities. In its operations under the OSRD, the Laboratory carried out an experimental program which culminated on December 2, 1942, in a historic achievement — the establishment of the first self-sustaining nuclear chain reaction together with the equally significant demonstration that the accompanying release of nuclear energy could be controlled positively and simply. This first reactor was moved early in 1943 to the original Argonne Laboratory at the Palos Park site.

In this same period the Laboratory selected the site for the Clinton Laboratories (now Oak Ridge National Laboratory) and in cooperation with the E.I. du Pont de Nemours & Company designed its facilities. Included were the reactor to produce significant experimental quantities of plutonium, the new synthetic fissionable element, and the chemical separation plant designed to recover the plutonium produced in the pile and to serve as a pilot plant for the future Hanford production process. Simultaneously, again in cooperation with du Pont, the Laboratory developed the basic design for the Hanford production reactors. It also carried out essential chemical studies on the new elements, neptunium and plutonium, which existed only in submicroscopic quantities and developed a tentative chemical separation process for the Hanford production plant. The Laboratory was also primarily responsible for the development of supplies of metallic uranium and of graphite of the extreme purity required for use in nuclear reactors.

By May, 1942 it became clear that there was a real prospect for success, both in the production of plutonium and in its chemical separation. Such an achievement would inevitably involve the design and construction of major production facilities. Since the OSRD was not authorized to administer production activities, the Government assigned this responsibility to the Corps of Engineers, U. S. Army. The Corps of Engineers promptly established the Manhattan District in order to carry out this assignment. By May, 1943 the basic design work on plutonium production and processing had been essentially completed and the Laboratory's major task was the prosecution of the development program required in carrying out the detailed design of the Hanford facilities. The University of Chicago contract for the operation of the Laboratory was therefore transferred from OSRD to the Corps of Engineers on May 15, 1943.

While its activities in connection with the Hanford processes were given overriding priority, the Laboratory proceeded to formulate various alternative designs and processes in case major unforeseen difficulties should arise when the Hanford plant went into operation. In this connection, the first heavy water moderated nuclear reactor was

designed and built at the Laboratory and was placed in operation at the Palos Park site in the spring of 1944. The groundwork was laid for alternative separations processes and the various experimental programs were carried to the point of establishing relative feasibilities for actual production use. Likewise, alternative metallurgical processes were developed in connection with fuel element fabrication problems.

In July, 1944 the Hanford plant was nearing readiness for startup. The Laboratory, as it had done previously in the case of the Oak Ridge staffing problem, met the need for experienced technical personnel by transferring to Hanford a considerable group of its own staff.

Meanwhile, the Los Alamos Laboratory had been carrying forward its bomb development program. While the Laboratory here was never actively engaged in this work, one of its original assignments was the responsibility for organizing these activities. This responsibility was discharged by recruiting a separate staff for this work with the Laboratory serving primarily as a temporary operations center. With the essential completion of its Hanford task, the Laboratory was urgently requested by Los Alamos to make available all of the experienced staff possible in order to expedite their program. As a result, a considerable number of the remaining staff of the Laboratory was transferred to Los Alamos during the fall of 1944.

In spite of the uncertainties regarding the ultimate future of the Laboratory which were prevalent during 1945 due to lack of long-term objectives, its research and development programs moved ahead with vigor. For example, in both physics and chemistry basic research results of interest and importance were obtained. The groundwork for the Experimental Breeder Reactor was laid, and the engineering studies which led to the mastery of the techniques for the use of liquid metals for cooling media were started. Active steps were taken in the development of a new and more effective separation process. The intensive biological and medical program not only produced new and vastly better data on radiation tolerances, but also made a signal contribution by calling attention to the hazards of beryllium and by carrying out important experimental investigations on the biological effects of beryllium poisoning just at the time that this material was becoming available for reactor work.

In the meantime, the problem of developing satisfactory solutions to the basic problems of the Laboratory's future devolved upon its administration. Three major questions demanded answer. First, what were the principal needs for such a laboratory operated under government sponsorship on a long-term basis, and what should be its corresponding objectives? Second, could such a laboratory be organized and staffed in such a manner that these objectives could be achieved? Finally, what could be done about the long-term housing of the Laboratory in view of the fact that the major share of the Laboratory's facilities were situated either in university buildings or in temporary structures on university property which due to their character would have to be abandoned very shortly?

After considerable study, it became clear that there were research and development functions which should continue and that, in addition, steps should be taken to encourage active participation in the atomic energy program by the qualified universities and research institutions of the Middle West. This planning was carried out throughout 1945 with the active cooperation of the Corps of Engineers. These activities culminated in the appointment, by the Corps of Engineers, of an advisory committee comprising leading scientists of the Middle West. The first meeting of this group was held on December 2, 1945, the third anniversary of the date of the startup of the first reactor. The committee worked actively during the winter and spring of 1945-46 and developed a proposed Plan of Organization and Statement of Operating Policy for Argonne National Laboratory. They simultaneously recommended that The University of Chicago continue as operating contractor. This plan was accepted by The University of Chicago and the Corps of Engineers. It was then ratified by representatives of the major universities and research institutions of the region in May 1946. These organizations thus became the charter members of the Laboratory's Participating Institutions. The necessary contractual supplements were executed and Argonne National Laboratory began its official existence on July 1, 1946 with Dr. Walter H. Zinn as Director.

After an exhaustive study carried on in cooperation with the Corps of Engineers, a site was chosen in DuPage County to serve as a location for the new Argonne National Laboratory. The site was agreed upon both by the contractor and by the representatives of the Participating Institutions and was submitted to the Corps of Engineers for their approval and acquisition.

In the meantime, Congress passed the Atomic Energy Act of 1946 and soon thereafter the President appointed the first Atomic Energy Commission. The decision with respect to the acquisition of the DuPage site as a permanent location for Argonne National Laboratory was referred by the Corps of Engineers to the Atomic Energy Commission. In January, 1947 the Commission approved the new location and acquisition of the site was actively undertaken.

For the first year and one-half of its official existence under the new plan, the Laboratory was primarily concerned with work in the fields of basic research investigations and fundamental development studies. As a result of a Commission decision on January 1, 1948, the Laboratory was requested and agreed to assume the responsibility of serving as a principal reactor development center, in addition to the above research and development responsibilities. As one of the results of this decision, the Naval Reactor Division was established and a phase of its work is now nearing completion in cooperation with the Westinghouse Electric Corporation. Some phases of the Materials Testing Reactor Project, now being built at the Reactor Testing Station, were developed at Argonne in cooperation with Oak Ridge National Laboratory. More recently, the Laboratory is participating with the du Pont Company in the design and development of new production facilities. In the meantime, the development and design work for the Experimental Breeder Reactor has been finished and construction has been completed at the Reactor Testing Station in Idaho.

Even before the final decision had been made with respect to the exact location of the Laboratory's facilities, work had been started in the Laboratory on the design of necessary buildings. With the decision to acquire the DuPage site, the design activities were immediately stepped up and a group was organized in the Laboratory to assume the responsibilities in connection with the design of the new buildings. The planning for the facilities was still in an early stage when the decision was made to assign major reactor development responsibilities to the Laboratory. This decision introduced new requirements into the construction program, enlarging its scope beyond that previously contemplated. Ground for the first of the new buildings was broken in 1948 and construction has proceeded actively ever since. The East Area, consisting of a number of quonset-type buildings, was completed in 1949 and the Laboratory is now in the process of occupying the permanent buildings in the West Area.

This, then, is your Laboratory ... Its history and certain of its personnel date back to the beginning of the atomic energy project as a "business" and its record of achievement is one of which you may all be proud. It is your opportunity and your responsibility, as a member of the Laboratory, to make your contribution to the activities effective in maintaining this record.

Those early days as we remember them: part II

Arthur H. JaHey
Chemistry Division

In 1942, once the decision had been made to attempt to make plutonium-239 (Pu^{239}) for an atomic bomb, it was important to find "macroscopic" properties of plutonium, both as metal and as compounds. In a bold and imaginative program, it was proposed to make micrograms of Pu by cyclotron bombardment, and then to investigate its chemical and physical properties on a microscopic scale.

In the period of August 6 to August 22, 1942, I was engaged in extracting such Pu from 300 pounds of uranium nitrate hexahydrate (or UNH, as it was called).

I had been with the Metallurgical Laboratory only a few weeks, learning to precipitate and oxidize another isotope of plutonium (Pu238) when the first shipment of Pu^{239}-containing substance arrived from the cyclotron at Washington University in St. Louis. It had been formed by bombarding UNH with neutrons. The material — 300 pounds of it — came packaged in small plywood boxes of various sizes, made to fit the various niches available around the cyclotron target. Glenn Seaborg, the project leader, estimated that from this entire mass the yield of Pu^{239} would be about 200 micrograms.

Dr. Seaborg gave me the assignment of helping to organize the separation process. I was much impressed with two aspects: the need for speed and the preciousness of the material we were working with. During the last of the separation stages, the latter reached trepidation proportions, one might almost say fear. For the first time in my life I was handling something terribly precious, very important and not to be recovered if lost.

Practically the entire manpower of Seaborg's section became engaged in this separation process. We also were much impressed by the scale of the operation. Most of us had no acquaintance with handling large amounts of

chemicals, our experience having been limited to what might be called table-top chemistry.

The standard method for separating Pu from UNH, developed by Seaborg, took advantage of the fact that UNH dissolves in ether, which then obligingly separates into two phases: one of ether containing about 9/10th of the uranium nitrate, and the other of water containing the plutonium, many fission products, and 1/10th of the uranium.

One run-through thus would bring the 300 pounds of UNH down to about 30 pounds — still an enormous amount from the point of view of the concentration of Pu in it. So the procedure would be repeated; but since the UNH was now dissolved in water it had to be reduced to the solid hexahydrate (crystals) before it could be ether-extracted again. The second extraction would bring the mass down to about three pounds. For prudence' sake, this would then be divided into four batches, each to be separately treated by "tabletop" chemistry. This process involved evaporating the uranium nitrate solution down, extracting with ether again, then precipitating the plutonium out of the uranium.

This over-simplified account sounds a little like whipping up a batch of fudge. Although I won't go into all the details, it wasn't that easy ...

The large-scale extraction work was carried out in an old storeroom in the attic of the fourth floor of the University of Chicago's Jones Laboratory. The west end of the floor was occupied by laboratories, but the east end had never been finished and was used as a storeroom for discarded apparatus. By pushing things aside, we cleared an area in which we could work. From this large room one could open a door onto a roof-space and this we used as an outdoor laboratory those sunny days of August 1942. During the evaporation phase we needed ventilation, since both ether and acid fumes came off.

"We" were pretty young, ranging from 20 to probably 30 years old. The whole operation was carried out in the spirit of what one might say was boisterous fun. At any one time there might be as many as eight or 10 of us shaking up the ether solutions and extracting it. At other times, as during the evaporation, there were of course fewer people involved. There was a lot of kidding and joking. By this time we had come to know each other well, we were all single, we ate lunch together, many of us had dinner together. We might even take a few minutes for a beer together. We were like a close-knit, small family.

Despite the high spirits and joshing, everybody worked hard and enthusiastically and for very long hours. There was a sense of urgency about getting the Pu^{239} extracted. We all had worked with tracer experiments on Pu^{238}, we knew how elusive the stuff was, and we knew it would not be possible to determine the real properties of Pu until a sizable amount had been extracted. The effectiveness of our operation was registered by the fact that the entire procedure lasted sixteen days, and this in cluded all the stumbling efforts to gather equipment and to learn how to do things most effectively.

Our equipment ... The techniques we were using were those of table-top chemistry, just blown up in size. We needed a very large separatory funnel — a size hard to come by. Fortunately, somebody at the university had been involved, for some reason, in handling large volumes of chemicals and had left a number of 1- and 2-liter size funnels in the stockroom. Other than that we mainly had only some large evaporating dishes and some hot plates. For later bombardments, we worked out an extraction method with some remote control features, in which the ether was surrounded by a lead brick shield. But for this bombardment we suffered the exposure from the gamma-rays from fission products.

During the period from August 24 to mid-September I worked at extracting Pu from one of the earlier-mentioned four batches, separating it from the residual uranium and from fission products. The separation method then available involved successive cycles in which plutonium was oxidized, then reduced and precipitated with lanthanum fluoride carrier. This involved procedure led to a feeling of strong frustration. For one thing, I didn't understand the mechanism of carrying (I'm not sure anybody did then), and I was concerned that in the long process something might be going wrong that I didn't understand. I was constantly concerned that I might heat too fast or let the solution get too close to dryness, either of which could lead to a loss of material by spattering. I of course hoped in great suspense that, working with Batch 3, I would come up with at least my share (one fourth) of the quantity of Pu (200 micrograms) Seaborg had estimated the 300 pounds of UNH would yield.

Several times in this procedure, materials appeared for which there seemed to be no reason, although they may have derived from impurities in the ether extraction process or from dirt picked up in the largevolume separatory phase. Each appearance had to be tracked down to be sure that the solids did not contain the precious plutonium.

Before any separation was started, I had made an assay of the quantity of recoverable plutonium in a small volume of the original solution. Now, after the final precipitation process, I was very pleased to find that I had made a very good recovery; my assay of the amount of plutonium recovery from Batch 3 was very close to that early assay. The activity recovered was 6.7×10^6 disintegrations per minute, meaning that I had ended up with 67 micrograms of Pu^{239} (based on the then accepted value of the Pu^{239} half-life). I turned the plutonium over to the microchemists and Michael Cefola assayed the solution. He checked my result within three per cent, very good precision for those days.

So! That ended my part in the separation from this first shipment of bombarded uranium. The plutonium delivered from Batch 3, and that from two of the other three batches, served as the primary material for the microchemists' use until the next bombardment was worked up, quite a number of months later. It was this Pu which was made into the first observed and weighed Pu compounds, later described by Burris Cunningham and G. T. Seaborg.

Leonard Bogorad
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I wonder how many of us remember St. Valentine's Day 1949? A freezing rain developed toward closing time, turning Site D (Argonne's present Illinois site), then in early stages of construction, and all roads leading to it into one endless, glistening ice field. For the Argonne buses leaving the site, it was impossible to negotiate the hill on Bluff Road near Route 83.

I was in one of the last of them, so saw the whole tableau. Walter Zinn, Laboratory Director, was sliding up and down the road in his Chevrolet offering to drive back to the Lab anyone who wanted to return. About 15 of us accepted.

While we thawed out in the temporary lunchroom in Building 10, Dr. Zinn searched the cabinets and refrigerator for something we could eat. At that time the prepared food was brought to Building 10 from the cafeteria at Site A. Dr. Zinn was disappointed-what he found was pretty "slim pickin's."

About seven o'clock, with the buses still literally spinning their wheels, Dr. Zinn took us in relays to the Guest House and there, through his or someone else's magic, sandwiches appeared from the Site A cafeteria. We spent a comfortable night at the Guest House, and learned later that the buses didn't get out until about 11 o'clock. Dr. Zinn stayed at the Guest House too, and in the morning drove us in several trips to Site A for breakfast.

Of all the weather-prompted crises that have been my lot, this one stands out sharpest. I still wonder how and when those who chose to stay with the buses got home that night.

While Argonne was moving from Chicago to its new DuPage Site, and for some time afterward until employees could relocate or arrange their own commutation, the Laboratory operated a fleet of buses to get people to the site and home again. These are the buses that, in Mr. Bogorad's story of Valentine's Day 1949, couldn't negotiate the hill on Bluff Road near Route 83. This picture was taken on a summer day with the buses parked, as usual, at the Meter House (now Building 90), through which badgeflashing employees had to pass before entering the east technical area

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