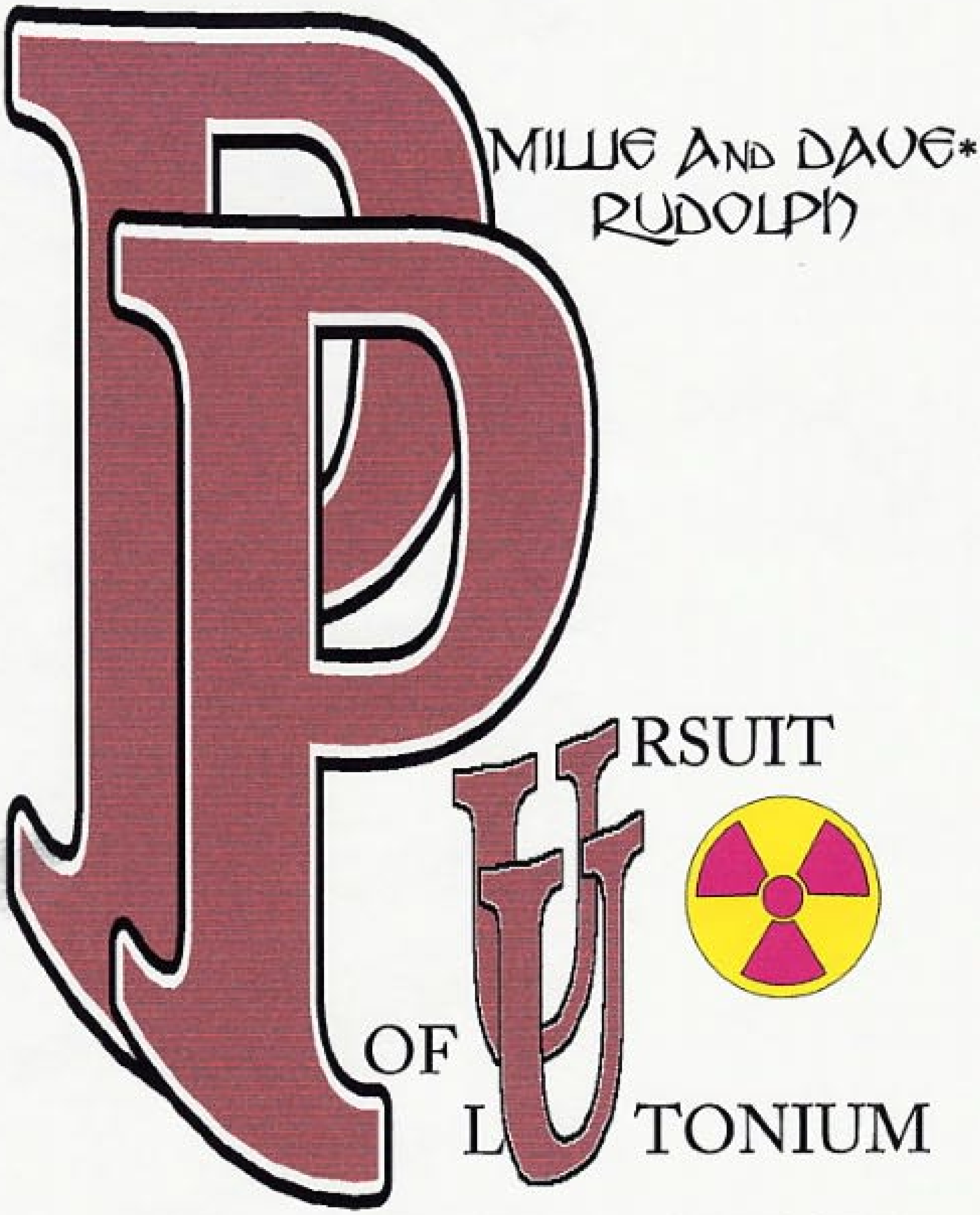


# THE BEANCOUNTERS' ODYSSEY IN THE MANHATTAN PROJECT

** Only survivor of both teams which mounted and witnessed the December 2, 1942, Stagg Field(first nuclear chain reaction) and the July 15, 1945, Trinity (first nuclear explosion) demonstrations.

## INTO WORLD WAR II

December 5, 1941, opens the narrative history of the recollections and reminiscences I am about to set down. That was the day we (Millie and I) made our first ever visit to Chicago's City Hall, to obtain our marriage license. This was in the aura of a good omen; a popular radio program of the time interviewed marriage-bound couples, posing inane questions such as, "What is your pet name for your intended?" However a reward was provided in the form of reimbursement of the license fee ($3.00) and a can of the sponsor's coffee. As an outgrowth of this experience, Millie and I have always had joint bank accounts, and I have been granted exclusive rights to prepare coffee for the household.

Pearl Harbor came two days later and twenty days before our wedding. World War II, however set a course for our future. My employer, a manufacturer of spring products for the furniture and bedding industries, was cut off from supplies of steel, and in short order many layoffs resulted, including mine.

As part of a co-op education program in that employment, my last assignment involved the preparation of inventory and sales reports using the then state-of-the-art Remington Rand ("Powers") data processing equipment.

The Powers sales engineer who served our installation was able to place me with another client, a manufacturer of automotive equipment, who had a much more elaborate array of such equipment. I had just about mastered a role in that organization, when I was afforded an opportunity to complete my training in the University of Chicago's Graduate School of Business.

This segment, concentrating on production management, was intended to provide a pool of management specialists for plants beginning to tool up for war production. We did not have to pay any fees, and we did get financial support through a mysterious application of unemployment compensation rules, since we were training for future employment.

As students with specialized experience were identified, they disappeared in mid-term, and my turn came in August of 1942.

I was interviewed alternatively by Joyce Stearns and Norman Hilberry,* both physics professors on loan to the University of Chicago's Metallurgical Laboratory. (This penchant for rotating administrative tasks, which manifests itself even today in the science departments of universities, was also justified as way of maintaining-

*Norman Hilberry was later to become the second director of the post-war Argonne National Laboratory. He was also the author of the official history of the CP-1 experiment (University of Chicago Reports, vol. 13, no. 2, December 2, 1962).

secrecy. Thus, when important procurements required technical contacts with outside suppliers, different staff members would take turns in acting as liaison).

I was told that inventory experience was the issue, and I was asked to start work on Friday, August 6, 1942, (Hiroshima Day minus three years).

The following Friday, August 13, 1942, was the date the Manhattan District of The United States Army Corps of Engineers was formally established, and forevermore, until the end of 1946 I became enmeshed with its operations, and subsequently those of its successor, The United States Atomic Energy Commission, which took over the work on January 1, 1947.

My first supervisor was Dr. A. M. McMahon, to be followed by Lawrence Kimpton, who was to become president of the University of Chicago in the post-war years.

The University's Metallurgical Laboratory, and the overall Metallurgical Project reflected a cover name for the atomic bomb project, to conceal its true nature as a research project involving the top nuclear physicists in the world. A monumental irony (no pun intended) plagued the Project and the Laboratory. As fate would have it, it turned out that the major problems to face the project were in fact metallurgical, especially those relating to the behavior of uranium and a limited group of permissible cladding materials in various coolant environments.

My introduction to inventory control as practiced in the Metallurgical Laboratory was a cultural shock. I was sent to the quarters in Stagg Field to be received by William Jesse, another physics professor on loan to the project. Instead of neat computer printouts, he handed me a bound laboratory notebook filled with handwritten entries representing different forms of uranium (sh!!) compounds and pointed on the shelves to their location. Much of the material had odd names, such as "Gadolinium High."

I found that when this material had been in use at Columbia University, from whence most of the team had been uprooted, as an additional layer of security cover, the uranium materials were dubbed "molybdenum," mainly because that name was difficult to spell and pronounce.

I later learned from Walter Zinn that a large batch of uranium oxide purchased from a Canadian source, had been misrepresented by falsified analysis reports as free from critical impurities, and the Columbia group confronted misleading data in their experiments with the material.

Most of the material was stored on shelves installed in and around what was formerly the box office of Stagg Field, the University's athletic stadium. Because of security controls the entire athletic field was our private domain and I can well remember regular lunchtime volley ball games organized by Marvin (Murph) Goldberger, later to become president of Cal Tech and director of the Institute for Advanced Studies.

-- On that week-end Prof. Jesse left on reassignment to Metal Hydrides, a metal producing plant in Beverly, Mass. and I don't recall ever seeing him again, although we did get some interesting products from the facility he joined.

From then on I was responsible for maintaining inventory control of those materials and the enormous quantities that followed them in the pipelines from various suppliers. One aspect of maintaining security was the safe transport of large quantities of uranium oxide being received by rail shipment from Canada. The material was consigned to me, by personal name, and unloaded at Chicago's Polk Street Station freight yards, to which I would journey in a maroon van carrying the U. of Chicago Bookstore marking. The van would be escorted back to Stagg Field, by a station wagon carrying two or three armed guards; both vehicles were radio equipped for communication with the home office and with each other. In a much more elaborate form, this procedure is still the current practice for secure transport of nuclear materials.

I also had control of a hoard of bismuth metal biscuits procured by Leo Szilard, but never used, and blocks of beryllium metal in a large foot locker. A large office safe was used to store ingots (nominally 1"x1"x6"), probably tended for electroplating electrodes, including tantalum, tungsten, platinum, etc.

Of special interest was the receipt of sintered uranium metal compacts from Metal Hydrides. This material was extremely pyrophoric and was packaged accordingly. Each compact (1"x1"x1/2") was separated from its neighbor by 1/2" of asbestos, and packed in a metal-lined boxes, with the air replaced by argon (not related to Argonne) gas. And yet, when we opened the boxes, many of the compacts went up in smoke. Needless to say, these items were quickly shipped away for conversion to other forms.

More valuable were one inch metal cubes received from Westinghouse's Lamp Division at Bloomfield, New Jersey. As I later learned, the manufacturing process relied on solar energy; in that trays of an intermediate stage were exposed to sunlight on the roof of the large factory building. (Science, Vol. 212, 19 June 1981) These cubes were beginning to arrive in goodly number as the Fermi team was in process of assembling the "pile" which was to become Chicago Pile Number One (CP1) to achieve the world's first self-sustaining nuclear chain reaction. The details of how CP-1 was assembled are covered in Norm Hilberry's Report, cited above.

The pile was a large spherical mass of pure graphite blocks, 4x4x16 inches, some of which had two drilled cavities. These were stacked so that there was a lattice with cavities equidistant in all three dimensions. Most of the cavities were filled with uranium oxide (UO2) pseudospheres, pressed in a 75 ton press the Columbia group brought with them. The press had been acquired from a salvage yard, where it had been retired from a career of pressing suet from meat scraps. The graphite blocks were machined to final size in a shop set up under the Stagg Field stands.

The Westinghouse cubes introduced above were also to become the pawns in a key incident which was vital to the success of the experiment and to the acceptance of the importance of inventory control. The urgency of completing the Pile required that a night shift be established to continue the piling of the graphite bricks into which the uranium oxide and metal lumps were imbedded. The metal cubes, being of greater contribution, were to be reserved for the central core area of the pile.

Dr. Alvin Graves was in charge of the night shift of high school student laborers, who stacked the pile. Dr. Graves and I operated on a drawing account basis. I set out the number of boxes of cubes he estimated he would need for the night, and in the morning I would find his signed receipt for the number used, which I then reconciled with the number remaining.

On one morning the number removed from the boxes was far less than the number signed for, and I reported the discrepancy to Dr. Zinn, who then ordered the last few layers of the pile torn up. This disclosed that a large region of the core consisted of drilled graphite blocks with empty cavities that should have been filled with cubes. Undoubtedly, this would have thrown off the calculations for predicting the behavior of the pile.

During this period, lurking in the background was the Chicago Area Office of the Army Engineer's Manhattan District, which was in the process of assuming control of the project. The first directive to reach me from that group was to record an inventory of uranium materials as of the last day of November, 1942.

This inventory process was thus to begin on Monday, November 30, My efforts to get the count under way were greatly impeded by the influx of a large group of staff and observers who were assembling in what had previously been a squash court to see the pile "go critical," which it did two days later. This was the world's first self-sustaining nuclear reaction, which led us into a new age.

One item we did not record in this initial inventory was the plutonium produced when the pile went critical; it was considered as de minimis (see discussion below in CIVILIANS AGAIN),

## BPID/MUF/?

The November 30 opening inventory record, presumed to reflect the total holdings of uranium materials, was established at a point in time when many groups had possession of different forms in different states of use or storage. This meant I had to receive written acknowledgments from all MetLab elements, some of whom I had never heard of before, and who had brought or received their holdings without coming through our records. Accordingly, for the next several months, each month-end inventory report brought out new items previously unreported. This condition stabilized after about six months, after which we began to recognize Losses(?). This was a phenomenon which still haunts the world of nuclear applications and has been characterized over the years as: BPID (book-physical inventory differences) or MUF (material unaccounted for) and some other even softer euphemisms.

One high point of this concern over losses(?) occurred in 1949(?) when the Chairman of the Joint Congressional Committee on Atomic Energy, Senator Bourke Hickenlooper, charged the USAEC with gross mismanagement over the loss of a "brown bottle" said to contain about 30 grams of enriched uranium missing from one of the shelves at the Argonne National Laboratory, which had now succeeded the MetLab. At this point, I was a member of the AEC staff, and took the heat at second hand, since our office managed the Argonne contract.

An elaborate structure of technical conjecture was ultimately devised to trace the "lost" material to recovery batches processed at Oak Ridge, Tennessee. Similar hypotheses have emerged over the years to explain "losses" at AEC and DOE contractor-operated plants in Apollo, PA. and Rocky Flats, CO.

My progression through the ranks of the AEC always found me in a direct or supervisory relationship with nuclear material inventory concerns. My subsequent activities in private industry, after leaving the USAEC in 1972, have also involved matters of material control, including transport security.

The counterpart of the secure transport from the Polk Street Railroad Freight Station, was a massive shipment of uranium oxide to the Mallinckrodt Chemical Works, near St. Louis, MO., on the day of Christmas Eve, 1942. I was ordered to dispatch this shipment via Railway Express, at the time the most expensive way of doing it. Despite my objection, I was cautioned that this was the only means of shipment that would satisfy security requirements.

Years later when I returned to Chicago, I was questioned by government auditors on the selection of the shipping method, and being unable to produce any evidence on the decision, I went down on the record as the one responsible.

For some strange reason these recollections in many cases have an overlay of alcoholic accompaniment. For example, I was advised at the Polk Street Station that frequently one or more of the corrugated cardboard cases of Canadian Club whiskey in temporary storage would tumble to the ground, shattering the contents. It was then necessary to carefully cut one corner open so that the liquid could be strained and collected, free of glass, and consumed by the warehouse personnel to reduce the fire hazard.

On the occasion mentioned above, when I dispatched the large REA shipment, I returned to the receiving room office to find a cocktail party which, in retrospect, was an administrative staff counterpart to the famous Wigner chianti bottle ceremony of December 2. A celebration was in progress built around bottles of Polish vodka provided by one Eddie Czuba. After accepting a paper cupful, I joined the rest of the group, who were standing, backs to the wall, to keep the room from spinning away. Millie reminds me that upon arriving home for the holiday dinner, I told her that the wind pushed me all the way home, and I promptly collapsed on the sofa, and thus ending the special dinner plans.

I'll pick up the thread of alcoholic allusions later in the New Mexico setting.

Now it came time to transport the CP-1 pile to a remote site in the Cook County Forest Preserve, known as the Argonne Forest. This and a few other sites in the preserves were named for the important sites of battles of WW I. Trips to the Argonne site were always a welcome respite from the rat race at Stagg Field.

By this time our uranium metal inventory had been greatly augmented by many shipments of Westinghouse cubes and new receipts of metal cylinders ("eggs") from the operations at Iowa State College. The rebuilt pile, now dubbed CP-2, had much more metal and less oxide than its predecessor at Stagg Field. After the pile was rebuilt at the Argonne site, much of the oxide component had been replaced by solid metal, and the disposition of the oxide became another critical juncture in my saga.

## WHY NOT GI JOE ?

It was at this point, the summer of 1943, that the MetLab had to give up its battle with my draft board. Some few months later the Manhattan District was able to get the word through that key personnel would be given special deferments, but I was in an early call, and the MetLab couldn't give the draft board other than vague statements about the importance of our project. Evidently, the Chicago Area Office of the Manhattan District found itself in the same boat, and one of its staff, James T. (Tommy) Harris was caught up by the draft during this same period. In later years, Tommy and I both served in the Chicago Operations Office of the United States Atomic Energy Commission.

Facing induction into the armed services, the MetLab director took steps to assure I would not be lost to the program. He sent me to the Area Engineer, Maj. A. V. Petersen, who outlined a plan of action. I was firstly to assure that upon induction I was assigned to the Army; secondly I was to forgo the 21 day furlough offered to inductees. Upon induction I should immediately phone and mail my serial number, so that I could be requisitioned by the Manhattan District. It was planned that I would be sent to Fort. Belvoir, Virginia, for the 90 day Officer Training School program and then be assigned to the Chicago Area Office.

A few days before my induction date we attended a farewell party for one of the MetLab employees who was being inducted, and who of course utilized the 21 day furlough. Much to his surprise, I was on KP duty at the reception center at Camp Grant, when he came through the line as a greener rookie.

The KP duty, my first weekend in the Army came about along with an escape from adverse assignment. On the morning after arrival at Camp Grant, we were given the Army Alpha exam, a general intelligence test. When we returned to our barracks after lunch we found a roster listing those men who had received passing grades and did not need glasses. This group was urged to volunteer for the newly formed Air Corps, an urging I of course couldn't follow. Furthermore this same group was also listed for KP duty for the entire weekend; no option for refusal of this privilege was offered.

KP duty was a new arduous experience for most of us, especially desk jockeys like me. The mess sergeant in charge made it plain to us that if the mess hall didn't pass inspection Saturday morning he would not get his weekend pass. This meant a thorough cleaning and policing both before and after breakfast, which in turn meant early rising Saturday morning.

By Sunday evening, we were on a troop train bound for Camp Gruber, near Muskogee, Oklahoma, and for some unknown reason I was designated acting corporal for one of the recruit groups in our car. I tried to pull rank on the Pullman

porter by asking him to give up his enclosed sleeping space at the end of the car. This was to no avail; he insisted he outranked me institutionally.

After an interminable train ride we arrived at Camp Gruber late evening and were taken directly to a brand new clean empty barracks building. In the morning we found that we were to become a headquarters artillery company for a new 32d (Rainbow) Division, destined to carry on the traditions of our WWI predecessors. That one had been given the name because it ended up having men from every State in the Union. This time, arrangements were being made to have this flavor in each unit to the extent practicable. This meant however, a lot of waiting for other groups to arrive to fill out the ranks, and thus compounded the usual diet of waiting and wondering that makes up Army life.

I was attached to this unit long enough to have one week-end pass to see the wonders of Muskogee and sent home a photograph of myself in uniform. The highlight of the week-end was placing my first long distance phone call to Millie.

On the very first day our group assembled around a howitzer, I was ordered to report to the Adjutant who handed me a packet and remarked that I must have special connections to be transferred to a cushy assignment in New York City (based on the imprimaturs of the Manhattan District on my transfer orders). The packet included Pullman tickets to Alexandria, Louisiana, the station serving Camp Claiborne, where I was to report to the Engineer Unit Training Center. I was also given extra copies of my order to be used later if I had to file claims for meal reimbursement, since, as he told me, the ones in the packet were based on the assumption that the train ride would be on schedule, which was most unlikely. Among other delays, our train had to give way to military transport and freight trains.

I arrived in Alexandria late one afternoon at the same time that a troop train from Fort Snelling, Minnesota pulled in on the opposite track. Finding an MP, I presented my special orders, but was told to fall in with the large contingent from the troop train, and joined them on a truck ride to the camp.

At the close of our indoctrination greeting by a captain, I approached him to show him my special orders. His response was that I should fall in with the rest of the group, and that any special orders would be examined after our basic training was completed.

Again, I was in a newly forming petroleum processing (?) unit and would find out what that meant after our basic training was completed. Ensued a period of hikes and calisthenics and the issuance of carbines.

Mail call a few weeks later brought me a postcard from Oak Ridge, Tennessee, asking why I had not reported to the Engineer Unit Training Center. I decided to make an end run and asked to see the Chaplain, who appeared to believe my remonstrances of being sidetracked and indicated he would look into the matter. On

the morning our group was taken to the firing range to qualify I was dragged back to the Adjutant's office to be handed a Confidential envelope, which he asked me to open. It contained train and Pullman tickets for a train which had already left Alexandria that morning. He told me to be ready next morning to be taken to meet the next day's departure. I returned to the barracks to clean my carbine, which had been fired by others also, and to pack for the trip.

As luck would have it someone in our barracks reported a theft from his foot locker and we were all assembled for a shakedown inspection. Some form of Army logic was brought into play; because I had spent so much time and effort packing my barracks bag, I was exempted from the shakedown. Dropped off at the train station early enough to have my tickets approved and to enjoy the waiting room, I placed a collect call to Maj. Peterson, who instructed me to change to civilian clothes before reporting to his office at Stagg Field. When I hung up from the call, the coin return gushed out a bonanza of change which must have exceeded three dollars.

When I reported to Maj. Peterson, I was the only enlisted man in the unit. He told me that since the dismissal of my successor, the MetLab required me to resume my inventory control assignment, I would have to forgo any officer training, and would be on special assignment in my old position at the MetLab.

What had clinched the removal of my successor, was his arranging a freight car shipment of CP 1 uranium oxide lumps which he packaged in slatted wooden crates. Upon arrival in the St. Louis area, the floor of the freight car was a beach of uranium oxide powder.

During the ensuing period our operations were moved to a National Guard armory in Jackson Park, and Millie and I moved to an unfurnished apartment about 800 feet away from the Armory. We had to pay the son of the recently departed tenant for the furniture left in the apartment in order to get the lease. We had visions of getting it all back from the disposal of an ancient massive upright piano, having in mind that Millie's family had just gotten a handsome price for their baby grand.

In the end, however, we had to pay to have the monster carted away. As to the rest of the chattels, we turned the whole lot over to a used furniture dealer. In today's antique market, they would represent a magnanimous total value, but we had no way or place to keep them.

One incident/accident during the armory period, presaged the Three Mile Island debacle. One of the materials we were recycling to Mallinckrodt was uranium metal grindings from the group which was producing prototype pure metal slugs of the kind to be used in the plutonium production piles. The grindings in the form of a sludge were packaged in the same clamp-lid airtight metal cans in which oxide powder had been received in earlier days. The cans were stored on shelves in our stock room awaiting the accumulation of practical shipping lot sizes. Inside the cans the finely divided uranium was becoming oxidized, thereby causing the separation

of the water components. The hydrogen accumulation generated a heat buildup to the point of explosive combustion and several of the cans on the shelf caught fire and scattered uranium oxide dust throughout the area. The immediate concern was one of dealing with the Chicago Fire Department, since we were a very secret project in a military site. Although the fire was promptly contained, the clean up process took a lot of innovation and probably unknown exposure to personnel which would not be tolerated today.

This incident, in turn, led to another activity, which today would raise the hackles of environmentalists. A small brick oven was erected in the parking area adjacent to the armory building. In this oven, in open iron pans, we roasted the wet grindings which had previously been sealed in the cans for shipment. When completely dry, these residues were shipped for recovery of the uranium values.

Sometime during this period I was given my first furlough to the extent of eight days, plus three days traveling time (recall that our apartment was about 800 feet from the armory entrance).

In the spring of 1944. the project's need for trained personnel was aided by the sudden cancellation of the Army's Specialized Training Program, which was being conducted at many college campuses. Our Project personnel recruiters had first pick and many scientifically trained men were being picked up. Those who were assigned to the University of Chicago MetLab had to go through an interesting metamorphosis because of the need to conceal the military interest in the project. These poor sheep were herded into a small hotel (the Mir-a-Mar) and not permitted out until they had acquired civilian clothes. Whereupon they were assigned to the various worksites around the University of Chicago campus or the Argonne Forest Site.

I recall one ludicrous experience I had, when it was necessary for me to report to the Army's dental clinic in Chicago's Civic Opera Building. I was driven to my mother's house to change into uniform, thence to the clinic, and the reverse process to return to my office in civilian clothes. Ludicrous, I felt, since many of the patients in the clinic waiting room were civilians, and my garb was of no consequence. Incidentally, we were issued special orders, stamped CONFIDENTIAL, ordering us into civilian clothes. With that marking we, of course couldn't show them to anyone outside those project officials who had a "need to know. "This nonsense all vanished suddenly on Memorial Day of 1944, when we were all ordered into uniform, to the great relief of all, especially those members of our families who were aware of our special situation.

It was in September of 1944 that Millie left her civilian employment in the textile business, and joined my organization as a civilian auditor for the Chicago Area Office. She was to stay on in this activity, even after I left Chicago. She learned things about the operations that she couldn't confide in me, and there was, of course, a vice versa. For example, in the course of her work in auditing payroll of the

Met.Lab, she discovered that Leo Szilard maintained a checking account at the Chase Bank. This connoted the need for a hefty balance; this was apparently not a problem for him since his payroll checks never cleared with any promptness. Also when I was in New Mexico and Millie was living in her parents home, she carpooled with one of the MetLab scientists who was active in the efforts to prevent the use of the bomb on civilian populations.

We both took the admonitions about secrecy so seriously, that she did not know the end purpose of our project until it was announced to the staff by Arthur Compton on Hiroshima Day. I also regret, that I took seriously the prohibition on taking record papers when I left the Project and later when I left the Atomic Energy Commission, especially when I later found that most of my colleagues ignored these prohibitions. The records I left behind would be very useful today in constructing these recollections.

The end of 1944 saw the whole project move into high gear with the rapid growth of the development sites (Oak Ridge, Los Alamos and Hanford) and most of the former ASTP soldiers were ordered to those sites. One comrade. Cpl. Montgomery, and I were the only two reassigned to Los Alamos, and we were scheduled to depart the first week of January, 1945. The only thing I can recall about the train trip to New Mexico, was that our destination was Lamy. The Santa Fe Railway did not carry passengers to Santa Fe. We were met by a WAC chauffeur who took us at breakneck speed to the office at Santa Fe (P.O.Box 1663) to check in and then on to the thirty-one mile climb to Los Alamos.

During our brief stay on "the Hill" as it was called, one incident I recall was that there was a fire in the single mens' dorm and many of us barracks dwellers volunteered to help fight the fire and liberate the stores of bottled spirits to be found in the rooms.

At the end of January, I was transported to the Trinity Site, on the edge of the Alamogordo Bombing Range, and found myself Aide to the Post Engineer, Capt. Samuel P. Davalos. Our detachment of Engineers, detached from the Special Engineers Detachment (SED) on the Hill was designated a Special Services Detachment, and many of my correspondents, who were in the service wondered what I was doing in an "entertainment" unit, which was the role of most SSD groups.

Life on The Hill was isolated; life at Trinity was penal. No phone calls were permitted; all mail was censored on the Hill, both incoming and outgoing, and those few who, for example, received mail written in Yiddish, had to wait for the censors to get translation help. For us at Trinity, there was the additional delay because all of our mail was routed through the Hill and there was only one mail run per week.

Apparently, our higher authorities felt that these severe steps of isolation were adequate to protect security about our activities; we were never given any briefings

or instructions about contact with the outer world. This might even explain my assignment to the unit, since my experience at the MetLab made me the only member of our detachment who knew the true nature of the explosive material (plutonium) we were going to test.

Our unit finally consisted of about 40 craftsmen specialists, recruited from all over the Army. Some of the rougher types "chose" this assignment instead of the "brig." We had cat-skinners, high linemen (electrical), carpenters, plumbers and helpers for all of the above.

Since Capt. Sam was perpetually on the road procuring our supplies and equipment, I was nominally in charge of the detachment, but under the watchful and critical eye of the base commander, Lt. Howard C. Bush. who commanded the MP detachment and was responsible for the site. I also doubled as our Detachment's clerk and prepared all the records required, including ultimately, a letter of commendation to each member of the Detachment, including myself.

Among the special duties that fell to me, was a lonely drive; my first attempt to operate a 4x4 weapons carrier, to a cattle loading railroad siding to officially receive a large steel bottle (Jumbo) which was intended to contain the plutonium test weapon and to conserve the precious material in case the test fizzled. I bumped along the path cut into the sand and came upon a wide white flat expanse. At which point I gunned the engine. To my surprise I experienced the effect of driving into water. I had entered a bed of pure gypsum. At any rate, I found the siding and the flat car containing Jumbo, which was subsequently hauled to its home in the test range on a trailer mounted on 24.00 by 26 tires, the largest I had ever seen.

Another special duty was accompanying Capt. Davalos to accept the test tower and climbing with him to the top platform to test the winch which would later raise the test weapon to its final resting place.

About a month after our arrival at Trinity, I fell ill with some kind of flu. The only medical coverage available was in the form of a corpsman (rumored to have started a medical education) supervised by Lt. Bush. In addition, or perhaps along with doses of medicinal brandy, I was given large (over-)doses of sulfa, which made me sicker and probably initiated my acquaintance with tinnitus. It was to the point that I was to be transferred to the station hospital on the Hill. This was scheduled for the next regular run for return of beer cases to the Hill, some of which had to be left behind to provide me with room for my stretcher bed. Arriving at the Hill, and after unloading the beer cases, I was finally admitted to the hospital, diagnosed as a sulfa overdose, and spent the week of my birthday there.

On the trip back we made our second stop at a favorite restaurant in Belen, where our dollar food vouchers bought a king size flank steak with all the trimmings.

The only other departures from the Trinity site, were the occasions when I joined up with MP Jeep patrols, and one business trip to pick up some special equipment

at Fort Bliss, Texas. On one occasion, not having taken any liquids for the long desert patrols we finally staggered into the almost ghost town of San Antonio, New Mexico, (understood to be the birthplace of Conrad Hilton). Here, we were able to slake our thirst with ample containers of beer.

The reader will notice that there is a rivulet of alcohol running through these reminiscences, and indeed that is what seemed to lubricate the morale and motivations of the troops. There was even a nexus involving other vital fluids.

The water produced by the well on the site was so hard that the only way to produce a lather was to use LAVA soap; it was certainly not potable. So it was that one of our two cooks, who usually ended up with most of the payroll cash after the final round of crap games and poker sessions, volunteered on his day off to drive our tank truck to and from Socorro, the nearest town, to bring back 500 gallons of drinking water and one gallon of spirits. The latter was usually four bottles of something of the order of Four Roses blended bourbon and one bottle of a premium bourbon, which he and I shared, distributing the first four to the troops. Incidentally, he owned a tavern in Milwaukee, which Millie and I visited on our furlough.

As to the hard water situation, it led to a hilarious anecdote, when we began to anticipate a large influx of important guests. It was decided to bring in a water softening assembly. With our top priority, the first component to arrive was a large air express shipment of bags of Zeolite, which lay in the warehouse awaiting the receipt a few weeks later of the mechanical equipment. Upon installation it was found that the effect on the water was minimal. It turned out that the powers that be, concerned about anything that might reveal the location of the site, refused to give the supplier a sample of our water. When they were finally prevailed upon to remedy this, we found the need for a very different assembly.

Another fluid element involved our receipt of tank trucks of motor fuel delivered from a Socorro gas station in a tank truck usually piloted by a woman driver. This provided the only source of romantic bragging by some of the senior MP non-coms, who boasted of their conquests.

In the middle of May, we finally entered an activity, which presaged the purpose of Trinity. We erected a low wooden platform, on which a high explosives team from Los Alamos stacked and then detonated a large stack of the high explosive, RDX. This was done to test and validate camera and other monitoring installations which had been set up around the base.

Then began an accelerating pace of activity and influx of new military and civilian personnel from Los Alamos, for whom we completed barracks and laboratory buildings.

This all culminated on the weekend beginning with Friday, July 13. On the night of July 15, we all assembled in the open area where we set up our movie screen. The lightning displays from a nearby storm lit up the background behind the screen and

lent an ominous tension to those in the group who knew the purpose of the test to come. Security of information was such, that I'm sure none of my detachment were aware of the nature of the test.

Just before dawn, we were roused out of our barracks by a PA announcement. We were told to anticipate an explosion from the tower which would provide a bright light display. We were instructed to lie face down, feet pointing to the tower, and not to look in the direction of the bright light until instructed. Soon began a PA countdown By Prof. Samuel Allison. At ZERO, slightly after dawn had broken, the area was diffused with the brightness of full day.

A few seconds later came a loud report, like a rifle shot magnified thousands of levels, and a rush of wind from the direction of the tower. On this occasion, the loss from inventory of the plutonium in the exploded device was recorded in an official document signed by General Farrell.

The next flurry of activity included the progression toward the site of an Army tank in which Dr. Fermi was riding. At the base camp there was much jubilation and discussion by the assembled teams of specialists, which continued into the mess hall for breakfast.

Soon there was an exodus of the visitors, and our base complement faced the task of cleanup and closedown. One of the bonuses from the closedown, was the confiscation by our fire chief of a supply of laboratory alcohol, which he designated a fire hazard and stored in the fire station. He enlisted the assistance of volunteers in our group to help dispose of this fire hazard. This involved our assembling in the fire station with any liquid suitable for diluting the alcohol to a level safe for human consumption. This precipitated a run on the PX for fruit juices and soft drinks, and large gatherings in the fire station. I recall one occasion, when the Post commander was serving as the sole salesman in the PX, when I came by to purchase some grapefruit juice.

In early September, I was given a furlough, which got me back to Chicago to join Millie at her mother's house and to take in the radio broadcasts of the World's Series, I never returned to Trinity. Back at Los Alamos, I was assigned to a supply unit. In the course of that assignment, I was able to accumulate a new supply of white underwear, which the Army shipped to my mother's home in a wooden crate which had an tare weight of over 100 pounds. As fate would have it, that entire crate disappeared from our basement storeroom, and I never got to use these prized souvenirs.

I found that Millie could join me at Los Alamos if she could find employment on the base. Since she was already on the Manhattan District payroll, this was a rather simple requirement. She did arrive shortly before Christmas, and we had a second honeymoon at the La Fonda Hotel in Santa Fe.

Millie's assignment was in the Payroll Office, where her clientele consisted of a large number of hourly employes, all named Martinez.

Our quarters were one room in the married soldier's dorm, which provided us with two cots and one dresser. We augmented these furnishings with an unauthorized electric hot plate, with which Millie performed gastronomic miracles. We also took advantage of the low priced, but high quality menus at the Service Club, which was presided over by a chef who had served in the Waldorf Astoria.

Our Commissary, was a shopper's paradise. Items generally rationed to the civilian population were available here without ration coupons, and we were able to send reverse CARE packages to the folks back in Chicago. The only commodity subject to limit was chili powder (five pound to a customer).

Early in our stay at Los Alamos, Millie found she was pregnant, which, of course, pleased us greatly. By early April, when I was scheduled for discharge, she made her first air trip, to San Diego to visit her brother, Raymond, who was in the Navy. She then flew to El Paso, to escort me home after discharge from Fort Bliss.

It may or may not have been one of those pregnancy pangs, but while she was with Raymond in La Jolla they had just missed the strawberry harvest festival. So the one thing we sought in El Paso was a strawberry dessert. The closest we came was in getting a cherry ice cream sundae.

On our flights to Chicago, It was I who had to use the airsick bags. Fortunately, we were not seated together all of the time.

On arrival at my mother's apartment, where we were to stay for a while, my mother asked if she could entice us with a dish of strawberries and sour cream!

## CIVILIANS AGAIN

While the United States Congress began to wrestle with the problems of how to control the genie which had escaped from the atomic nucleus, I had to contemplate my career trampoline. At the MetLab I had functioned as a soldier in a civilian occupation. At Trinity, I was a line NCO on a mixed military/contractor operation. Upon my return to Los Alamos, I was assigned to a supply unit (pure military) and under strong pressure to enlist for a regular Army hitch, which I resisted.

On balance, I felt a strong pull to return to the MetLab, which was at that point being transformed into a permanent Argonne National Laboratory. I did want to return to the great group of young scientists and technicians and to be involved in the pioneering work of exploiting the new force. In addition, what re-employment rights I had as a returning veteran had to be asserted to the University of Chicago.

I contacted Walter Zinn, who appeared to be the head of the new Laboratory, and thus the legal successor to my last civilian employer. He expressed a desire to place me, but pointed out that in the current fluid state of metamorphosis, it might be some time before a place for me could be designated.

I then contacted Max Rodin, one of the few SED members who had stayed with the Chicago Area Office of the Manhattan District when the rest of us were scattered to Oak Ridge. Hanford or Los Alamos. Max indicated that a position as a civilian employee, such as he had acquired in the Chicago Area Office, might be in the cards for me, which would involve, among other duties, overview of inventory control of nuclear materials.

There were, of course, financial imperatives. since our first child was on the way, and a steady income was needed.

And so it was that on July 19, 1946 I was entered on the Federal payroll, to join Millie, whose Federal Service began on September 4, 1944 and continued at Los Alamos from December 20, 1945.

As of January 1, 1947, our Area Office was designated the Chicago Operations Office of the new United States Atomic Energy Commission, and our new Manager was Alfonso Tammaro. Our temporary home was located in the Museum of Science and Industry on the lake front. Here we shared space with some of the business operations of the new Argonne National Laboratory, while we both waited for our new administration buildings (Quonset huts) to be completed at the new laboratory site near Lemont, Illinois.

It was at this location where I sat in on the first formal meeting to kick off the United States Navy's joint project with the AEC to plan the first nuclear powered submarine, the Nautilus. In attendance was a reluctant Westinghouse team, headed by Charles Weaver, later to become a vice president, and Dr. W. Shoup, their chief

scientist. Representing the Navy was Capt. Hyman Rickover.

The Westinghouse team needed to be convinced that embarking in this new mysterious environment would be a better use of their efforts than improving electric motors. This may have been a pose, because the project was launched shortly after the meeting.

My further involvement consisted of being nominally in charge (on my division's organization chart) of the succession of Navy officers who were stationed at Argonne to "observe" the laboratory's contribution on behalf of Rick. Among this group were Ed Bauser, later to become executive director of the Congressional Joint Committee on Atomic Energy, and Eli Roth, later to become assistant director of the U. S. Arms Control and Disarmament Agency. My "control" of these worthies was of the character elucidated at a Congressional budget hearing a few years later, when the Chief of Naval Operations was reminded that he was Admiral Rickover's supervisor, to which he responded that:" nobody supervises Rickover."

It was in this setting that I had my first administrative tangle with plutonium. It came to pass that the Chemistry Department of the University of Chicago requested its Argonne National Laboratory to irradiate a small quantity of uranium sulfate in the reactor at Site A (the original Forest Preserve site of the Laboratory) It was our responsibility to approve the request. Our lawyers got wind of the activity and asked us to look at the legal implications. we had to admit that the process would produce some (immeasurable) quantity of plutonium, but we pleaded for the application of the legal principle of de minimis. (the law does not concern itself with trifles). But they held fast, stating that the definition of special nuclear material in the Atomic Energy Act did not permit the application of that principle, and the University could receive a loan of the resultant plutonium/ uranium mixture if they were properly licensed to possess special nuclear material. As a result, a several page contract was executed and was given the designation of AEC license SNM-1.

In this period, the University of Chicago's Graduate School of Business announced a new evening MBA program, which I was eager to join, since I had already accumulated comparable credits. Employees of the University's Argonne National Laboratory were given special access to the program, with expenses paid for them under our contract. When I contacted President Kimpton, my former supervisor to arrange sponsosrship, he diverted me to a comparable program given by the same faculty in a new Program of Executive Development for Federal Personnel, which I completed in July of 1960.

A serendipitous benefit came to me from the workings of carpooling from our home in Chicago's far southeast side to the Argonne National Laboratory site near Lemont, Illinois, where our AEC Operations Office was assigned part of an administration building. I was able to share in the synergy obtaining from a mix which included some of the Laboratory's senior research staff. This exposure ben-

efited all members of the pool, but for me it provided a priceless enhancement to the horizons my multifaceted duties required. The group pooled the expertise and knowledge of: Paul Fields (physical chemistry); Leonard Goodman (molecular beam); Arnold Grunwald (reactor engineering); David Jacobson (computer science); Stanley Siegel (spectroscopy) and occasionally visiting experts in related fields.

In addition to being in the line for control and accounting for materials assigned to the activities of the COO, my division administered the technical information and classification functions for the organization. Later were added such programs as technology transfer to private industry, training of foreign scientists and engineers at the ANL, and coordination of visits by foreign government teams and individuals.

The itinerary for visiting groups often included the Dresden Nuclear Power Station, the world's first commercial unit, built by GE for the Commonwealth Edison Company, the utility serving the Chicago area. On occasion during construction I was able to bring Millie and her father for a private Saturday tour, in the course of which, we climbed to the top of the dome.

This tour and orientation function took a lot of my own time, by my choice, and gave me many interesting experiences. I often arranged functions at which the foreign dignitaries, up to the level of reigning sovereigns, were to be received at the Laboratory (sometimes by Commissioners). I also frequently brought some of these interesting people home to meet our family.

Two incidents involved "heavy sedans" which we had acquired from the Treasury Dept's. BATF. One involved a Cadillac in which I drove an eastern European delegation from the Dresden Nuclear Station to O'Hare airport. One of the members dozing with his head leaning back on the back shelf showed signs of distress. We were lucky enough to find that the first doctor's office we encountered was that of a woman who spoke Polish, which was one of the languages used by the victim. It turned out that a part of the exhaust system, the resonator, which was housed in the rear was leaking carbon-monoxide into the back shelf area of the car. Fortunately, the victim had recovered by the time we got to the airport for his flight.

The other incident involved a Buick, which I used to take a distinguished Swedish official to dinner in the western suburbs, accompanied by my deputy, Syd Gaarder. Since Syd lived in the western suburbs, I turned the car over to him to take the visitor back to the Argonne Guest House, and was driven home by one of the car pool drivers. I neglected to give Syd the car keys, which in fact were not needed for the ignition switch. When he arrived at the Argonne gate, he was subjected to one of the random car searches, and was unable to open the trunk, and unable to prove that the car was a Government car.

Over the years there were many memorable encounters in this area of hosting dignitaries. One recollection is of the day that I hosted both Sir John Cockroft of the UK and Lew Kowarsky of the French program. Sir John had been the top man

in the British program; Kowarsky was the hero who escaped from the French laboratories and crossed the English Channel in a small boat with the French supply of heavy water.*

Kowarsky who was assigned by Cockroft to the Canadian program during the war, had never met Cockroft, so I arranged the introduction.. One French connection incident stands out. Two high ranking officials coming for a tour of the Argonne Lab. were scheduled to arrive on a late evening flight from the west coast with their wives and be put up at the Lab's guest house. We arranged a social reception at the guest house, complete with a magnum of French champagne. At the last minute, we were advised by Washington that the "wives" were really traveling companions. We did the reception, but somehow, the magnum was never opened.

A more somber memory revolves around the visit of a high level Soviet delegation. I was requested through channels to try to provide the delegation leader with a supply of a new leukemia treatment drug for one of his young grandchildren. Through my connections with the local community hospital and the Argonne Cancer Research Hospital. I was able to comply. This probably involved technical violations of federal and state regulations, but I never heard any further on the matter.

A pleasant recollection from the visit of another Soviet team inbolved my arranging to take a group to Wrigley Field as guests of the Chicago Cubs. We were given prime seats, and the group enjoyed their first experience of watching the American version of a game (which they, of course had invented.)

In summary, many visitors from all over the world came through-some who were the heads of their nations' nuclear programs, and some who were destined for such roles in the future. In that connection, I became the AEC liaison for the International School established at Argonne. I remember one occcasion when I introduced Abba Eban, Israel's Minister of Education, as the commencement speaker for one of the classes.

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*Another heavy water anecdote involves Neils Bohr, who kept his supply in a beer bottle, to protect it from seizure by the Germans when they invaded Denmark. When he escaped to Sweden, he mistakenly took a bottle of beer instead. The correct bottle was later rescued by the Danish underground . Still another anecdote about Bohr's more successful efforts to thwart Germans involved a number of gold Nobel medals entrusted to him by scientists fleeing Europe, among them.being Jay Franck, who related this story at lunch one day at the MetLab. Bohr had dissolved the medals in aqua regia and put the jar of clear liquid among the reagents on his laboratory shelves. He later arranged for the recovery of the metal and arranged with the Institute to recast it into replacement medals and return themto the honorees. As Franck pointed out, the newmedals were symbolically more priceless because they represented a high order of shared experience and accomplishment.

My transfer to Washington, in fact, was the outcome of an assignment I took on with the International School to organize a special international symposium on nuclear material safeguards at Argonne, at the behest of the Headquarters division, headed by Delmar Crowson, a retired general. In due course I was transferred to Crowson's division.

Some of my last activities in the Chicago area revolved around the 25th anniversary of the CP-1 experiment, in December of 1967. On involved my appearance on a local TV show, one of whose guests was the then fading movie personality, Constance Bennett.

That 25th anniversary was observed by the University of Chicago with a symposium involving many of the important members of the CP-1 group and other luminaries of the scientific and political world, including a telephone address by President Lyndon Johnson. The University hosted a banquet at which one of the principal speakers was Crawford Greenewalt (then Chairman of duPont) who had been the "official" observer at the December 2, 1942 demonstration. He also had been the personal host for a private dinner in Washington during the 20th anniversary observance, which was part of a joint Atomic Industrial Forum/ American Nuclear Society conference.

It was during the banquet of the 1962 Conference that Millie asked Norm Hilberry, who was seated at our table, to autograph our program booklet. He acceded on condition that I would autograph his copy. This started a chain reaction, which resulted in an historic document containing the autographs of all the then present survivors of the CP-1 group, which has been reproduced in many publications.

In early 1968 we became Silver Spring residents, and I worked at the Germantown facility until my early retirement in 1972, which was made possible by Crowson.

One of my duties in the Headquarters involved the verification of the integrity of packages of special nuclear material shipped between nuclear facilities. There was of course special concern about packages being shipped abroad. On special cases of exports it was my duty to personally inspect outbound packages. It was on one such occasion that I met at Dundalk (Baltimore) harbor with Sam Edlow who was exporting plutonium to a European destination. Shortly thereafter, as a member of a field inspection team, at a Westinghouse plant, I was able to observe weighable quantities of plutonium metal, and thus returned to the plutonium trail.

After retiring, I connected with Sam Edlow, who was in the process of establishing a travel agency, and I did some grunt work and administrative assistance in that effort.

Edlow's principal activity, then as now, was transport of nuclear material, and when the federal regulatory bodies began to impose security rules, I was lured back into that field. One of my first assignments for the company was to ride shotgun on

an air-truck shipment of plutonium from West Valley, New York, to the Hanford facility of the AEC. One of my last assignments as an Edlow full time employee was to ride shotgun on an air shipment from The Netherlands to Oak Ridge. In between, I helped the company set up, and managed a system for secure transport of special nuclear materials between major AEC facilities.

As part of my duties, which I assigned to myself, was occasional surveillance of the field operations, which included trailing, at a safe distance, the contractor convoys. On some of these assignments, Millie joined me in rental cars (so that the convoy crews would not suspect a couple of tourists following the same route). This operation caught the interest of the producers of PBS' NOVA programs, and one of the broadcasts featured a lot of footage covering our operations.

At the outset, we contracted with Brinks, one of the largest armored car operators, to provide vehicles and road crews to transport the materials. Things appeared to be off to a great start, until Sam Edlow and I met in Chicago with the top corporate officers to sign the agreements. Lo and behold, the word had come down from the chairman of Brinks parent company, Pittston, that the company was to have nothing to do with the nuclear power industry. It turned out that Pittston's principal business was coal mining, and that was that. We were able to line up regional companies, with the attendant delay until they could procure large vehicles and train staff.

For a brief period we continued to operate under these new conditions. Then when we were in full swing again, the AEC decided to take over the entire function. The elements of these systems today are not much different from the 1942 transports to the MetLab as described above.

## THE ANIMAL KINGDOM

At Stagg Field I encountered a family of lead pigs— hollow cylinders in which foil samples were inserted to be measured for decay of the radioactivity inducedwhen they resided in the piles. The lead was necessary to shield out the ambient radioactivity. The first of these cylinders was named, "Piglet" from the A. A. Milne stories; its companions were then, of course, named "Heffalump" and "Roo."

Also at Stagg Field, someone discovered two vintage raccoon coats abandoned in the squash court locker room. These items were put at the disposal of the two security guards, Messrs. Ball and Bergen, who were stationed outdoors, at the entrance to the field, to control access.

At Trinity, our official mascot was a scruffy little mongrel dog, to whom I applied the name, "Pav-loff," because of his relationship to a steel triangle. The triangle, which hung at the entrance to the mess hall was used to summon the troops to meals. Something about the sound frequencies of the ringing annoyed the beast and he would jump up to bite the horizontal leg. In due course, the triangle was supplanted by a recorded bugle call played on the newly installed PA system. Of course, as in all cases involving installation of new technology, the two systems were used together during an introductory period. As a result, even after the triangle was removed, Pav-loff would still jump up to bite the now vanished triangle whenever the bugle call was sounded, hence the origin of my name for the dog.

My relationship with Topper was more personal. Topper was a handsome brown cavalry horse used by the MPs for site patrols until the full complement of jeeps arrived. On Sundays, we foot soldiers were given the privilege of cantering around the sandy site, providing we undertook the task of currying the assigned mount. Topper seemed to take an immediate liking to me, demonstrated by firmly planting one of his hooves on my toe, as I stood applying the currycomb. This often made for some discomfort if he hadselected my left foot just before I was ready to mount. However, if riding is a good form of exercise, it was mine, along with the arm exercise required for the comb.

Of the specimens of wild life we encountered, the one who aroused the most interest was a badger which the MP s had captured and brought in to occupy a small cage near the mess hall. His presence was disturbing to Pav-loff, who snapped at the prisoner though the cage wire and was rewarded by getting his nose scratched. The badger was around for just a few days; I don't recall how or why he left or escaped.

Two other visitors arrived in lifeless form. One was an antelope, which was dressed down to provide us with a taste of venison(?) The culprit had apparently trespassed an area where the patrols were doing target practice. The other case

involved a beef cattle specimen, apparently one left over from a grazing herd which had been ordered removed from the site. The encounter was reported as one in which the animal had run into one of the patrol Jeeps; it took the driver more than a mile of maneuvering to bring his vehicle into the proper impact orientation. Nevertheless. we had a welcome addition to our meat supply.

On one occasion, an artificial bird, a bomber on a night run from the Alamogordo Bombing Range, dropped a dummy bomb which nearly hit our gasoline pump island and gave many of us a scare. Of course it was somewhat of a flour sack, several orders of magnitude less hazardous than the items to be dropped later on Hiroshima and Nagasaki.