The Technical (T) Building at Mound

Genesis

In 1943 Monsanto Chemical Company accepted an assignment from the U. S. government to separate and purify the polonium-210 needed to build the initiators, code named "Urchin", for the first atomic bombs. Dr. Charles Thomas was the Director of Research for Monsanto with a research facility located on Nicholas Road in Dayton. In 1942 he was deputy chief of Division 8 of the National Defense Research Committee, a civilian organization chaired by Vannevar Bush that would promote and organize military technology. He came to Bush's attention after a trip with committee members Richard Tolson and James Bryant Conant, president of Harvard, to witness an underwater explosives test, and was subsequently offered co-directorship of the Manhattan Project with Dr. Robert Oppenhiemer, which would involve moving to Los Alamos, NM.

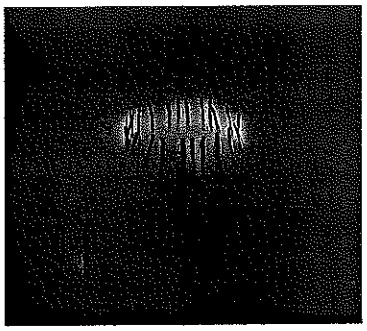
Vannevar Bush

James Bryant Conant

With his wife, a Talbot, firmly established in Oakwood society, a compromise was reached putting Thomas in charge of plutonium chemistry and metallurgy, plus separation of polonium-210 and fabrication of the initiator. During the war the polonium work was conducted at three locations in Dayton and one in Oakwood at the Runnymeade Playhouse, leased from Thomas' mother-in-law. In 1945, soon after the end of WW II, the government realized it would continue to need polonium initiators for its weapons' program. Mound Laboratory was built under Thomas' direction just south of Dayton, in Miamisburg, as the site where polonium was processed and the initiators were fabricated. Construction was started in 1947 and polonium processing began in 1949. Thomas believed in synergy among groups, probably as a result of his familiarity with the Los Alamos operation during the war, and had a hot food cafeteria constructed at Mound with only a half an hour for employee's lunch. This was to have far-reaching consequences in Mound's future, and must have been a good idea, lasting long after Thomas' death and through 5 different contractors at Mound right up to closure.

The Radioactive Component

Polonium-210 is a radioactive metal which decays via alpha particle emission to stable Lead-206. It has a half life of 138 days, and a thermal energy of 140 watts/gram. It occurs naturally in minute quantities (0.1 mg./metric ton of U-238) in the Uranium-238 decay chain, and was initially separated from naturally occurring material in the Dayton Project.



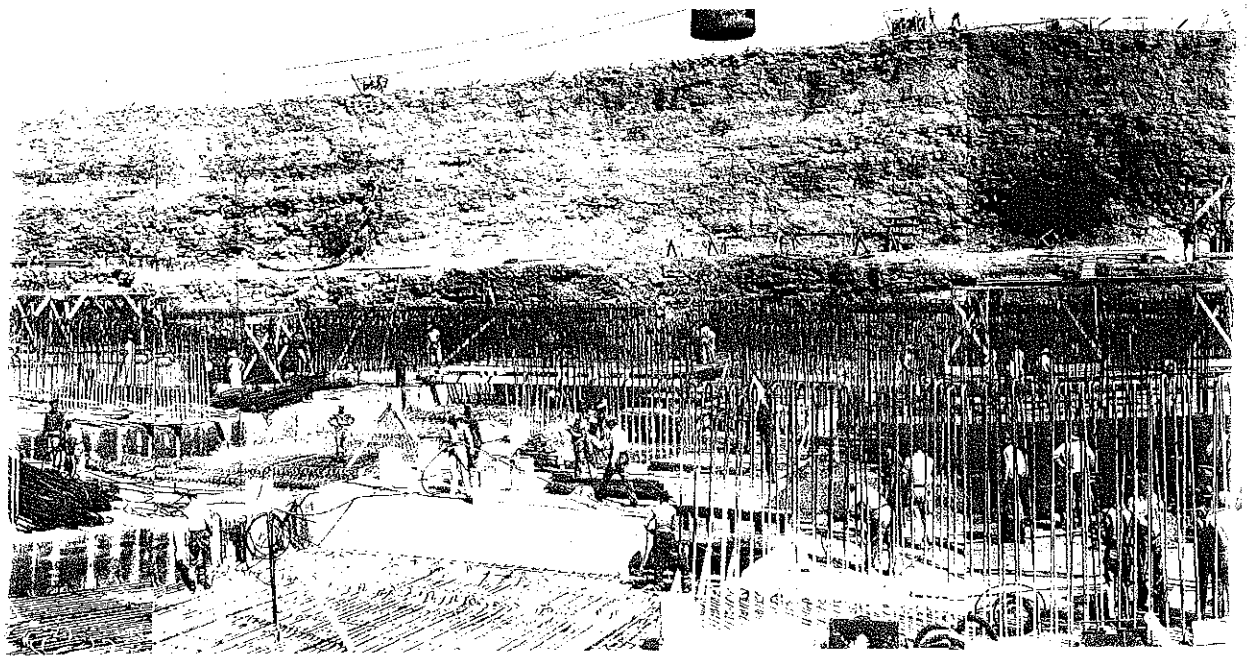
Polonium-210 is biologically hazardous and requires special handling. With the first large-scale quantities being separated in the Dayton Project and at Mound, an extensive biological evaluation program existed at Mound in the early years.

Cherenkov radiation creates the blue glow around this self-lit photo of Polonium-210 plated on platinum foils. These 24 foils contain 25 milligrams of Po-210.

The Building

The production work was carried out in the Technical (T) Building, an underground building built to withstand the most powerful conventional weapon in the U.S. arsenal: a 2,000 lb. semi-armor piercing jet-assisted torpedo. This reinforced concrete building was built by digging out the side of a hill over the Miami River, constructing the building, and backfilling to cover the building.

It has 16 ft. thick walls and roof, with an 8 ft. thick floor. There are no drains through the floor; all waste liquids are collected in sumps and pumped up to the surface, except the highly contaminated process waste which was transferred to the Hydrolysis House (HH) through glass pipes which ran through a 6 ft. diameter concrete tunnel connected at the level of the lower floor. This tunnel is probably the genesis of a persistent rumor of a tunnel connecting Mound with Wright Patterson Air Force Base. The inside dimensions of the building are 150 ft. by 350 ft., or about 1 acre on each of the two floors. Each floor is divided into three sections by two 30 inch thick firewalls.



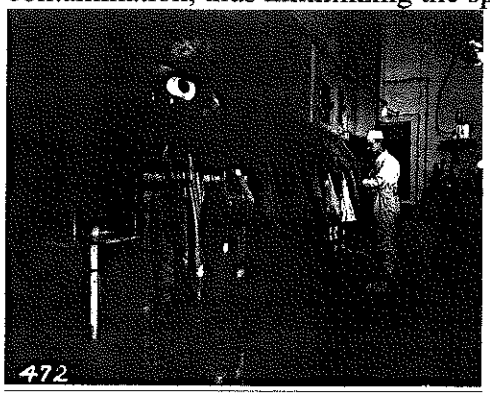
There is an elevator/stairway tower at each end of the building and a truck tunnel on the level of the upper, or operating, floor. The truck tunnel incorporates a series of three heavy steel blast doors and two "dog-legs" to protect the interior of the building from blast waves and sliding munitions with a steel-covered opening in the floor to allow large equipment to be lowered/raised by an overhead crane on a rail.

Ventilation air enters through a shaft in the middle of the north wall and exits up through shafts at the ends of the building and then to a 200 ft. exhaust stack. Each of these air shafts has a blast deflector to reduce the effects of external shock waves on the operations in the building. The supply air could be filtered through activated carbon to remove radioactive and chemical contaminates. The exhaust air was filtered to trap radioactive particles.

T building was designed and equipped to be operated for a month by 200 people without any supply or service from outside. These features included large water reservoirs, electric generators, fuel tanks, air compressor, steam generator, operating supplies, spare parts, office and janitorial supplies,

The building was divided into two areas: uncontaminated/clean/"cold" and potentially contaminated/ "hot". The north one third of each floor was uncontaminated, while the south 2/3 contained the polonium processing

laboratories and the supporting equipment. Access to the "hot" side was through locker and change rooms that had toilets, hand wash sinks and showers. The ventilation system maintained the pressure in the building lower than the pressure outside and kept the pressure on the "hot" side lower than that on the "cold" side. The polonium processing work was performed in cells or in gloveboxes. The pressure in these spaces was maintained below the pressure in the surrounding laboratories, which was kept lower than the pressure in the corridors. This system ensured that air flowed from the uncontaminated areas toward the areas of higher contamination, thus minimizing the spread of airborne radioactivity.



If the area around Mound Laboratory were contaminated with radioactive, chemical or biological materials, the T building staff members could decontaminate themselves by removing their clothing and passing through a series of small shower rooms on their way into their work areas in the building.

Most of the polonium handling operations were housed inside plywood gloveboxes (similar to incubators, but somewhat larger). The gloveboxes were arranged in a row of three to twelve units which were connected to one another. This line of gloveboxes was built into a wooden wall which separated the operating, or low-risk, area from a high-risk service corridor behind the glovebox line. Each glovebox was exhausted through a high efficiency particulate filter and this air was then sent to a filter bank before being released at the top of the stack.

Polonium-210 Production, Processing and Purification

Extremely pure bismuth, with a silver content less than 0.1 ppm, was cast into cylindrical slugs about an inch in diameter by 6" long and weighing 3 lb. Each slug was encased in an aluminum can, which was welded shut. Batches of slugs were irradiated in a nuclear reactor to create polonium by the reaction: Bi-209 + a neutron yielded Bi-210m which decayed to Po-210, which has a half life of 138 days and a thermal output of 140 watts/gram. After irradiation, the slugs were discharged from the reactor and held in a pool while the activation products in the aluminum jacket decayed and the Bi-210m decayed into polonium.

12 Foot Deep Slug Storage Pool

The slugs were shipped to Mound from Hanford, WA, by rail in stainless steel casks with an inner layer of lead. A railroad siding ran into the lower area of Mound Laboratory. Here the casks were transferred to a truck and moved into the T building tunnel and to the low-risk, or "hot", dock. The casks were moved onto the dock, opened and unloaded with tongs. All personnel working in T Building gathered to unload the casks, with each working about a minute to keep individual neutron/gamma exposures within limits. The slugs were placed into metal buckets which were lowered into a pool in the adjoining room and stored until they were processed.

Slugs were processed in batches of twenty four. They were loaded into a shielded transporter in the pool, which was then moved into a nearby room and placed over the entrance of a dissolver. The slugs were slid into an inclined glass pipe that served as the dissolver. Hydrochloric acid was introduced to remove the aluminum jackets. The spent acid was drained into a waste collection tank and then a mixture of hydrochloric and nitric acids was used to dissolve the bismuth slugs. This solution was heated and formic acid was used to destroy the nitric acid. The hydrochloric acid solution was then passed through a one pound bed of bismuth

powder, thereby making the concentration of polonium be 72 times higher than it was in the slugs. This process was called "scrubbing". The bed was dissolved in a mixture of nitric and hydrochloric acids, which was transferred to the Purification Section. All of the acid processing steps described above were conducted in Pyrex glass piping or in glass-lined steel vessels. The whole operation was conducted in a shielded cell (called a concentration cell) with leaded glass windows. Valves were turned with extension rods which went through seals in the window wall. The cell was 15' high by 10' wide by 40' long. Pumps were not used to move liquids, rather most transfers were effected by pulling a vacuum on the receiving vessel and allowing atmospheric pressure to push the liquid into the receiving vessel.

Polonium Purification

These operations were conducted in wooden gloveboxes on the second floor. The first step was to destroy the nitric acid. Then the batch was divided into several smaller parts by passing a portion through a small bed of powdered bismuth. This step increases the ratio of polonium to bismuth by a factor of 10. The bismuth bed was dissolved in a mixture of hydrochloric acid and hydrogen peroxide, the polonium was precipitated with stannous chloride, filtered and washed with hydrochloric acid. The polonium was again dissolved in hydrochloric acid and hydrogen peroxide and then precipitated with ammonium hydroxide. This step removed the small amounts of silver. The polonium hydroxide was dissolved in 3N nitric acid and transferred to a 100 ml volumetric flask. This flask was assayed in a radioelectric cell and stored in a lead-lined safe.

Polonium Electroplating

The final purification step was electro-deposition from 1.5N Nitric acid solution onto platinum gauze cathodes. The plated gauzes were removed from the plating bath, rinsed in distilled water, and then in acetone and air dried. The gauzes were placed in individual metal tubes (nickel or tantalum) which were then placed in Pyrex test tubes and connected to a vacuum manifold. The system was evacuated and back filled with helium three times to remove all the air. The test tubes were sealed with a torch, creating a glass ampoule. The ampoules were removed from the glovebox line by passing each one into a plastic test tube, which was sealed with a rubber stopper and transferred to the Inventory Laboratory.

Initiator Production

These operations were conducted by the Y Group, also located on the second floor of T Building. As needed, the glass ampoules were transferred to one of several initiator production lines, which were housed in wooden gloveboxes similar to those described above. A platinum gauze was placed in a small tantalum tube held in a quartz vessel. This was evacuated and then heated by a RF heater. The polonium was distilled from the platinum into the initiator part. This unit was sealed, decontaminated and removed from the glovebox line.

Initiator Production started in 1949 and continued through mid-1969. Polonium neutron source production and commercial sales of polonium continued through 1972.

The Dormant Years

With the end of polonium-210 work at Mound, the polonium-210 related equipment was removed from T-Building over a three year period ending in 1975. The initial instructions from Dr. R. E. Vallée were to "remove all non-load bearing walls and HVAC" to make any use of the resultant clean space impossible without major project funding status. This defeated "squatters" taking over the space piecemeal and creating difficulties should the space be needed quickly for a major project. Tritium work was foremost in Dr. Vallée's eye. As a result, the first floor center section was unobstructed from one end of the building to the other, and became a table tennis Mecca with several tables. Non-polonium work continued on the "cold" side of the building, so the building itself was never put in a stand-by condition, with the former "hot" side areas clean of radioactivity and ready for occupancy. The filter banks and stack remained, making the building ideal for a mission involving radioactive material.