The 42d Chemical Laboratory Company in World War II:
A Chemical Reminiscence

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A version of this article originally appeared in the Winter 2002 (Volume 20, Number 4, page 13) issue of *Chemical Heritage*.

World War II was one of the grimmest events in history. Yet to a fortunate few, "it was a good war," as the phrase goes. I was one of those few who were selected, by chance, for a military assignment in which I could use my professional training as a chemist and chemical engineer.

In 1942, I graduated from the Cooper Union in Manhattan, where I attended night school classes while working during the day for the then well-known consulting firm of Foster D. Snell in the old *Brooklyn Eagle* building, with a bachelor's in chemical engineering. After my draft number was selected in August 1943, I was sent to Camp Sibert in Alabama for basic training in the Chemical Warfare Service (CWS).

Basic training had a bad name. Yet to a kid from Brooklyn whose only previous experience with firearms was Coney Island pellet guns, it was fascinating. Like most basic training courses, CWS basic included the elements of infantry training: how to crawl under barbed wire (on your back), fire small arms, and do close-order drill—which I regarded as a sort of mass square dance.

The heart of our training was chemical warfare (CW). We learned to identify CW agents: phosgene smelled of new-mown hay; lewisite of geraniums; and mustard gas of, well, mustard. The principal method for laying down poison gas was the 4.2-inch chemical mortar. This rifle-bore mortar, equivalent to a 105-millimeter artillery piece, could accurately shoot shells loaded with either a chemical warfare agent or a high explosive. The 4.2 mortars were organized in military units that were designated as chemical mortar battalions. In both the European and the Southern Pacific campaigns, the 4.2 mortars, firing high explosives, were used against the enemy with great effectiveness.

Smoke generation and napalm were also the responsibility of the CWS. Before this time, smoke had been generated from hazardous materials such as titanium tetrachloride and chlorsulfonic acid. During my time with the CWS, there was a method for generating smoke as a petroleum aerosol, a system developed by V. K. LaMer, a physical chemist at Columbia University. Oil-tank trucks equipped with the aerosol-generating equipment were used to make smoke in the field. Napalm, at that time, was an aluminum soap of **na**phthenic and **palm**itic acids (thus **na** plus **palm)**. Making jelled gasoline for flamethrowers and bombs was a matter of stirring the correct proportion of napalm into gasoline.

Defense against poison gas had three prongs: gas masks, impregnated protective uniforms, and decontamination. Protective uniforms were prepared (in modified commercial dry-cleaning machines) by drenching the garments in a kerosene solution of a wax binder and an organic compound containing free chlorine (such as Halazone). The chlorine trapped in the fabric would oxidize and neutralize any liquid vesicants—blistering agents—that came into contact with the uniforms. Treated uniforms in storage were monitored periodically for available chlorine by iodometric titration. Bleaching powder—calcium hypochlorite—was used to decontaminate nonvolatile liquid vesicants on the ground.

After basic training, I was sent (with a small group of other Camp Sibert graduates) to a military embarkation port in California. While conversing in our private Pullman car, we discovered that most of us were chemists. After a stay in California, our little group boarded a military transport to zigzag across the South Pacific to Milne Bay at the southeastern tip of New Guinea. Following a month's stay in rain-soaked tents under the palm trees of a Lever Brothers coconut oil plantation, our group shipped out again in the empty hold of a Liberty Ship (U.S. cargo ships designed to be built quickly and economically for the war effort) to Brisbane, Australia.

En route on the Coral Sea, we heard of the Allied invasion of Europe—D Day—on 6 June 1944. After a night in an Army reception center on the grounds of a former Brisbane race-track, we were welcomed to the antipodes by the shrill scream of a kookaburra, the down under equiva-lent of a rooster crowing at dawn. Soon, a truck pulled up and took us to our ultimate destination: the 42d Chemical Laboratory Company.

The CWS of World War II had its origins in World War I. The German use of chlorine on the Western Front led the United States to form the American Gas Service, which trained the American expeditionary force in the use of and defense against poison gas. In 1920, Congress authorized creation of the CWS as a permanent branch of the Army with the mission of preparing effective offensive poison gas and defensive methods.

In World War II, the CWS commissioned a new type of unit, the chemical laboratory company (CLC). In all, three CLCs were organized and designated as the 41st, 42d, and 43d.[1] These companies were staffed mainly with graduate and postgraduate chemists and biologists. The CLCs trained in the identification of CW agents and tested the effectiveness of defensive equipment. The ancillary staff maintained a machine shop, the glassblowing equipment, and the experimental animals employed to test the effectiveness of new CW agents. It was intended that a field CLC would be a self-sustaining unit able to function independently for long periods. A CLC's operating base was a semimobile laboratory with close access to the front. In the event of an enemy poison gas attack, its principal mission was to get poison gas samples from the field for rapid identification and evaluation. The CLC also analyzed and evaluated captured enemy CW protective equipment and related materiel and furnished general scientific assistance to the local command.

Ingarfield **Lab of the 42d CLC in Brisbane. Living quarters and lab buildings had no numbers, just names.**

From today's perspective, it is fascinating to pick up the CWS operating manual and read the official list of equipment that a CLC had to work with in 1942: chemicals, flasks, beakers, burettes, condensers, graduates, balances, various tubings, burners, and furnaces. There is no mention of pH meters, spectrometers, chromatographs, microprocessors, or any of the other high-tech equipment found in today's laboratories. Yet, using classical methods of analysis, the CLCs managed to get some useful results.

The 42d CLC came into being in May 1941 at Edgewood Arsenal, Maryland. After a training period, the original 42d embarked from the West Coast on 21 November 1941 for "PLUM," a code name for the Philippines. Still at sea when the Japanese bombed Pearl Harbor and the Philippines, the convoy diverted course to Brisbane, Australia, where it docked on 22 December 1941. The 42d was not to reach the Philippines until June 1945—3½ years later.

By June 1944 when I arrived, the 42d had been in Brisbane more than 2½ years. Some of the men had married Sheilas (a common local term for Australian women), had children, and lived off base. The base of the 42d was actually two large, formerly private, homes in Clayton, an upscale

The author with his pet wallaby in Brisbane

Brisbane neighborhood where many homes had private tennis courts. One building was for living quarters and mess hall, while the other housed the laboratory and animal quarters. Wallabies and cockatoos were common pets.

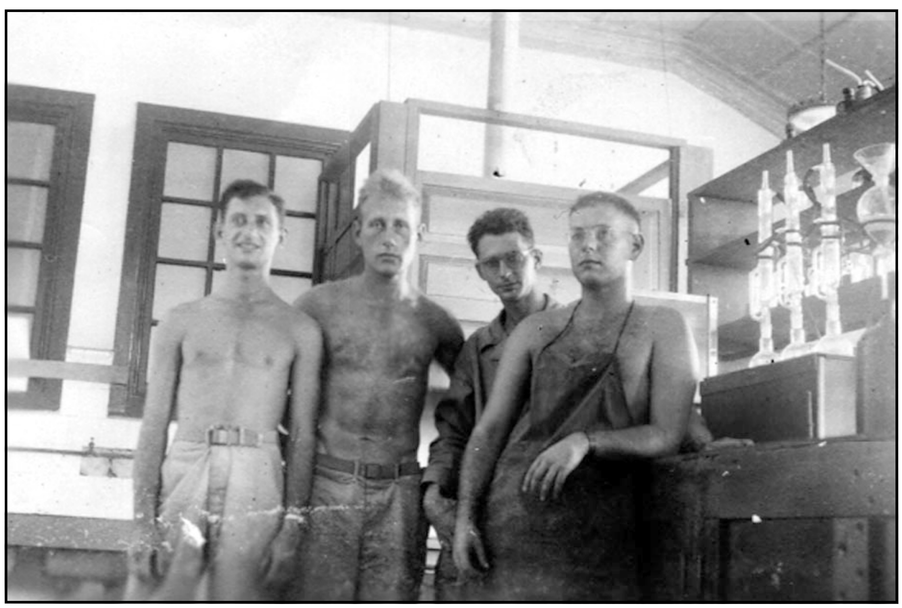
When the 42d first arrived unexpectedly in Brisbane in December 1941, no facilities had been prepared for their work. Nevertheless, the company soon organized itself into a working unit and produced useful results. Most, but not all, of the work required expertise in gas warfare. One early assignment from the Quartermaster Corps was to turn 100,000 pounds of fatigue uniforms into camouflage suits for the soldiers fighting on the islands. Using local materials, the 42d produced a dye and a procedure for a quick process to do the job. Another project studied the physical properties of CWS agents at high altitudes and low temperatures. Problems of water purification, rust inhibitors, skin dye for personal camouflage, and improved methods for using napalm are but a few examples of the developmental projects undertaken. In the analytical department, analyses of defective ordnance components, captured enemy explosives, soap and solder flux, and many other materials helped smooth our Pacific war effort.

My initial assignments were analyses of captured Japanese materiel. On one Pacific island, there was a cache of 55-gallon drums containing a watery, purplish liquid with a smell reminiscent of Teaberry chewing gum. Analysis found methyl salicylate and traces of a soluble iron salt in aqueous dispersion. The iron and salicylate reacted to form a purple compound. No literature was found with the drums, and the purpose of the liquid remained a mystery (perhaps it was a liniment). On another island, drums of a viscous, inflammable liquid were discovered. Distillation and qualitative tests (remembered from my course in organic qualitative analysis) showed that the liquid was benzene thickened with a methacrylate polymer. The liquid was probably intended for flamethrowers.

A problem of mineral analysis was that it required liquids of varying density for physical separation by flotation. One dense liquid needed was methylene iodide, which was not available in Australia. It was synthesized by first preparing a large batch of iodoform which was then reduced to methylene iodide. Obtaining chemical reagents was a constant problem. Those requisitioned from the United States involved many delivery uncertainties and delays. One time, we ordered 10 grams of dithizone, a reagent used for trace analysis of heavy metals. Dithizone is a very fluffy substance: 10 grams would fill a large jar. Several months later, a truck pulled up and began unloading 5-gallon, widemouthed carboys, each filled with dithizone; 100 *pounds* had been ordered owing to a clerical error. We distributed dithizone to every laboratory in Australia.

The CWS had a large cache of CW agents stored in 2-ton tanks in the Australian outback. The 42d had the task of inspecting and maintaining the tanks. This was a very desirable mission, although it was somewhat hazardous. A convoy of trucks and jeeps loaded with C rations and apparatus set out for a two-day trek to the dump. Using protective suits that encased the entire body, the team inspected the tanks and took samples for later quality-control analysis in the laboratory back at Brisbane.

Meanwhile, there was fierce fighting up north. On 20 October 1944, U.S. forces landed in the Philippines, and by 3 March, Manila was occupied. It was time for the 42d to move back to its original destination. Laboratory equipment and reagents were packed in crates. Somehow we had acquired a large supply of 1-pound cubes of metallic sodium in hermetically sealed tins; these were not to be taken to Manila. There was too much sodium to employ the laboratory method of disposal: dissolving sodium shavings in alcohol. Fortunately, Brisbane is near the sea. Getting the use of a fast boat, we sped



The author (on the right) in the Manila lab with his colleagues. Because of the heat and humidity, the scientists are wearing typical "lab dress."

over the Pacific Ocean, hurling punctured sodium cans over the stern. The huge eruptions of yellow flame and the sodium cans skimming over the surface made an impressive display.

In June 1945, exactly one year after I reached Australia, the 42d sailed to Manila—3½ years late. Manila was a devastated city, destroyed by heavy artillery fire. The beautiful palms that lined broad boulevards were gone. Our new laboratory occupied the former U.S. Department of Agriculture Bureau of Animal Research Station on the banks of the Pasig River that flowed through the center of Manila. The building was more or less intact, but all apparatus and equipment were gone; only the benches and tiled walls and floors remained.

By this time the war was almost over, and the supply of captured Japanese materiel dried up. However, some local technical problems were presented to the 42d. One problem was some suspected counterfeit coins. In anticipation of liberation, the government had minted a large quantity of Filipino specie, including silver coins equivalent to quarters and half-dollars. Many of the new silver coins did not ring true, suggesting that they were counterfeit. Samples of the suspect coins were submitted to the 42d for examination. Quantitative analysis for silver by both gravimetric and volumetric methods using silver chloride precipitation and the Volhard titration method with potassium thiocyanate showed the correct 90 percent of silver. Electrolytic and volumetric analysis for copper also found the correct 10 percent. However, close physical examination of the coins showed a thin sandwich layer of slag in each "counterfeit" coin. Apparently, the alloying process had been faulty, and it was the layer of impurity that deadened the ring rather than counterfeiting.

The author en route to Japan with his pet monkey. The monkey jumped ship and was last seen swimming back toward the Philippines.

For this and other efforts, the Philippine government later awarded the 42d the Philippine Presidential Unit Citation Badge "for exceptionally meritorious conduct in the performance of outstanding service."

Victory Over Japan (VJ) Day was 6 August 1945. With no more official work, the 42d cadre was told that they could undertake any research project they wished. The local Army command organized an Armed Forces Institute to give academic courses to the troops. I helped organize the institute and taught math courses, for which I received a commendation.

One day, I heard that soldiers were needed in Japan. Replacements were required for the 82d Chemical Mortar Battalion that was assigned to occupation duty in Japan. This battalion, unlike the 42d, saw heavy fighting in the jungles of the South Pacific and suffered many casualties. With the war over, I felt that I might as well complete my tour in Japan. For the first time in my Army career, I volunteered and was joined by several friends from the 42d. After several months of occupying Japan in the pleasant seaside town of Mito (only lightly bombed) with weekend trips to Tokyo and nearby hot spring spas in the mountains, I boarded a final transport for return to the United States. This time there was no zigzagging; we took the great circle route to California. I was discharged in February 1946 at Fort Dix, New Jersey, and headed home to Brooklyn.

Endnote

[1]Poison gas was used extensively in World War I, and it is believed that Japan used it in China in World War II. The three Chemical Laboratory Companies were commissioned with the expectation that poison gas might be used and that the United States must be prepared to counter it scientifically. Fortunately (if that word can be applied to any aspect of World War II) poison gas was not used. But if it had been, the CLCs were ready.