



THE REDSTONE ARSENAL COMPLEX IN THE PRE-MISSILE ERA

A HISTORY OF HUNTSVILLE ARSENAL, GULF CHEMICAL
WARFARE DEPOT, AND REDSTONE ARSENAL

1941 -49



U.S. ARMY MISSILE COMMAND

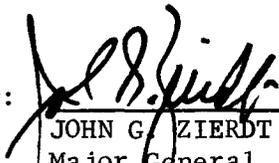
Redstone Arsenal, Alabama 35898

T H E R E D S T O N E A R S E N A L C O M P L E X
I N T H E P R E - M I S S I L E E R A

(A HISTORY OF HUNTSVILLE ARSENAL, GULF CHEMICAL
WARFARE DEPOT, AND REDSTONE ARSENAL, 1941-1949)

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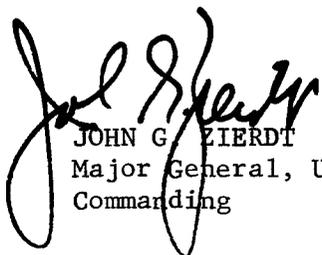
DEDICATION

Because of the significant part he played in the making of Arsenal history, it is only fitting that this memorial volume should be dedicated to Col. Carroll D. Hudson (USA, ret.), the first Commanding Officer at the original Redstone Arsenal and the only Commanding Officer at its predecessor, Redstone Ordnance Plant. Colonel Hudson wielded the shovel that first broke ground for the ammunition plant that was soon to become one of the most productive in the country. Covering much of the pre-missile era, his tenure as Commanding Officer, essentially unbroken from September 1941 to March 1946 and continuous from November 1948 to May 1952, has not thus far been equaled in length. And, in recognition of the high quality of his service at Redstone during World War II, the War Department awarded him the Legion of Merit.

FOREWORD

Redstone Arsenal is proud to contribute this volume to the growing collection of military history. Although its lifetime spans only a generation, Redstone Arsenal has achieved a permanent niche in history by developing the first U. S. satellite. While its spectacular successes in the missile field tend to overshadow its previous accomplishments, in the current public mind, the Arsenal also established a laudable record in World War II.

Despite the fact that we operate in a much more sophisticated environment today, I was greatly impressed, in scanning the early records of our installation, by the similarity between the issues facing managers then and now. I therefore directed that this volume be written, not only to preserve our heritage in concise form but also to profit from the experiences of our predecessors.



JOHN G. ZIERDT
Major General, USA
Commanding

PREFACE

To the Redstone "rocketeer" of today, the pre-missile era may seem remote, yet its vestiges constantly confront him as he pursues his daily routine. A sign warning of a contaminated area puzzles him if he does not remember that, in the past, this was Chemical Corps domain where the defunct Huntsville Arsenal once flourished as the principal activity on the reservation at which he now works. Or, driving by picturesque igloos, he may muse over their origin, but rarely will his hazy recollection resurrect their former guardian, the comparatively short-lived Gulf Chemical Warfare Depot. And the inscription "Siebert Arsenal" appearing on old maps of his familiar Redstone completely baffles him.

Consequently, as time goes on and memory dims, more and more queries concerning the 1940 period reach the historian, who must delve into the archives. The outcome is a volume of this nature, gleaned from installation histories. It depicts the Huntsville Arsenal and its virtual satellite, the Gulf Chemical Warfare Depot, and their Ordnance neighbor, Redstone Arsenal, until the latter absorbed both the former.

Written as the 25th anniversary of Redstone Arsenal approaches, this history recalls the rather modest beginnings of an installation that in a very short time achieved world-wide renown. It is a summary of the various Arsenal, Depot, and Plant histories listed in the bibliography. There has long been a need for a compilation of this sort, as no consolidated history, cutting across Technical Service

lines, has been issued under official auspices. It is the intent of the present undertaking, therefore, to "round out the picture" of the entire Arsenal's early days, emphasizing, of course, its wartime role.

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PART ONE

CHEMICAL ACTIVITIES

I. BEGINNINGS OF HUNTSVILLE ARSENAL

Site Selection

In early 1941 the Chemical Warfare Service had only one chemical manufacturing installation—Edgewood Arsenal, Maryland. As World War II drew closer to involving the United States, the Chief, Chemical Warfare Service requested the War Department to acquire additional facilities capable of furnishing an Army of 2,800,000 men with necessary offensive chemical munitions. Included in the supplemental appropriations that Congress passed to finance the Munitions Program of 30 June 1940 was over \$57,000,000 for the Chemical Warfare Service, of which more than \$53,000,000 was for procurement and supply.

The selection of Huntsville as the site for a CWS arsenal stemmed from a visit by Maj. Gen. Walter C. Baker, a former Chief of the Chemical Warfare Service. On 8 June 1941, Lt. Col. Charles E. Loucks, soon to be Executive Officer of OC CWS, and a civilian engineer visited Huntsville Arsenal. Upon returning to Washington, they filed a 20-page report with Maj. Gen. William N. Porter, Chief, Chemical Warfare Service. The following week-end, General Porter and Col. Paul X. English* reviewed the

*The Huntsville Arsenal Preliminary History identifies this officer as Gen. William A. English (then Colonel) and also as Col. William C. English. These identifications appear to be in error, however, as the preponderance of evidence indicates Col. Paul X. English, who was Executive Officer at OC CWS under General Baker and Chief, Industrial Service under General Porter. He was still Executive Officer on 5 July 1941 when he signed the memo to the Real Estate Board directing it to procure the land for the Chemical Warfare Arsenal at Huntsville. Before the end of World War II, he became a major general.

proposed location. From nine sites surveyed,* ranging from West Virginia to Missouri, the Chief, CWS recommended the one near Huntsville, Alabama, in an 18 June 1941 letter. Characterizing the Huntsville site as "more desirable, considering the matter as a whole, than any other location considered," he cited the availability of 33,000 acres of land "reasonably priced", the excellence of transportation facilities, labor conditions, construction materials, power supply from the Tennessee Valley Authority, operating personnel and raw materials, fuel, water supply, climate, health, living conditions, and sewage disposal. He conceded, however, that "as at all the sites seriously considered, it will be necessary to have a housing project."

Activation

Following the War Department's prompt approval of this recommendation, the Huntsville Times announced the selection of the site on 3 July 1941. The Office of the Quartermaster General issued the original construction authorization for Huntsville Arsenal on 17 July 1941.

Land Acquisition

The Chemical Warfare Service immediately took steps to acquire the land by condemnation proceedings. When the Office of the Quartermaster General filed a petition on 23 July 1941 to this effect, the United States District Court for the Northern District of Alabama, Northeastern

* Huntsville, Florence, and Tuscaloosa, Alabama; Kansas City and St. Louis, Missouri; Memphis, Tennessee; Toledo, Ohio; El Dorado, Arkansas; and Charleston, West Virginia.

Division, entered an order granting possession to the U. S. Government as of noon, 24 July 1941.

The general procedure involved in securing the land was for an impartial expert—in this case, the Federal Land Bank of New Orleans—acting as a consultant to the Government, to appraise each tract. Negotiations between an OQMG representative and the land owner then began. Generally the owners accepted the evaluation and only a small percentage of the cases had to be taken into individual condemnation suits. In general, it may be said that the acquisition of land was conducted in a very orderly and expeditious manner, and not one case is on record where operations or construction had to be delayed because land was not acquired in time. The Government saved considerable money by allowing owners to remain on their land until crops were harvested if this did not interfere with construction. The removal process was spread out, therefore, over a period of time. No specific relocation program was needed, as the community absorbed the major portion of those displaced. Many of the people who formerly lived on the land obtained work with the construction contractors at a considerable increase in their annual income.

First Contracts

On 16 July 1941 the War Department signed a cost-plus-fixed-fee contract with Whitman, Requardt, and Smith of Baltimore, Maryland, for architectural and engineering services. A second contract of the same type followed on 21 July 1941—this one being with C. G. Kershaw Contracting Co., Birmingham, Alabama; Walter Butler Co., St. Paul,

Minnesota; and Engineers Limited, San Francisco, California, for the construction of Huntsville Arsenal.

During July contractors arrived and set to work assembling machines and materials. Col. Rollo C. Ditto, the first Commanding Officer of Huntsville Arsenal,* arrived on 4 August 1941, and the next day, ground was broken for initial construction. According to one chronicler, "Huntsville became a bee hive of activity but lacked the corresponding orderliness." Thousands of workers streamed into the city, which did not have the facilities to accommodate them. For the duration, the Arsenal drew about 15,000 to 20,000 additional inhabitants to the town.

By 14 September 1941, temporary buildings on the Arsenal were complete, and the new occupants moved in. Previously, the Commanding Officer and his staff had operated from the Huntsville National Guard Armory and the Huntsville High School. Personnel matters were handled initially in the Chamber of Commerce office in Huntsville for about two weeks, 10-21 July 1941, and then in the Armory from 22 July—13 September 1941.

The initial plans for Huntsville Arsenal stipulated 11 manufacturing plants, four chemical-loading plants, plant storage, laboratories, shops, offices, a hospital, fire and police protection, a communications system, and utilities, including roads and railroads, necessary for the production, storage, and shipping of chemical munitions. Successive authorizations

* Apparently the first arrivals were Lt. L. A. Parks and Mr. E. P. Smith who came to Huntsville Armory about 10 July 1941 from Edgewood Arsenal. On 12 July, they hired a janitor, a messenger, and a mail clerk. Lieutenant Parks acted as Commanding Officer until a Captain Drennon arrived. He, in turn, was in command for two or three days until Colonel Ditto appeared.

expanded the original plans considerably. The end result was tantamount to a complete city, which was for all practical purposes self-sufficient.

Construction Funds

The first funds arrived on 24 July, amounting to about \$31.2 million, \$1.65 million of which was earmarked for the purchase of land. As it turned out, the construction called for under the original directive actually cost \$27 million, constituting a \$4 million saving. Subsequent construction directives nearly doubled the original allotment during the next 12 months. By 1942 all construction had been placed under the Corps of Engineers. A 2 January 1942 directive from them authorized the building of a CWS storage depot having facilities for the storage of 20 million units, mainly in 200 concrete igloos. A 4 March 1942 dispatch added 150 igloos, six storage warehouses, and a toxic gas storage yard. Later in the same month, on 18 March, over \$14.6 million was allotted for additional manufacturing and chemical-loading facilities. April instructions covered staff quarters, alcohol storage facilities, and troop housing. The directive received on 4 June 1942 was the last major authorization for manufacturing buildings and facilities. It amounted to almost \$7 million. This project, together with previous ones, completed Plants Areas Nos. 1 and 2. Plants Area No. 3, costing over \$4.1 million, contained 78 buildings comprising the facilities for filling HC^{*} smoke pots, hand grenades, and base ejection shells.

* Hexachlorethane, white smoke.

By September 1942, construction authorizations approached \$71.5 million, counting those for the Gulf Chemical Warfare Depot. Many and varied construction projects were in progress throughout 1942 and most of 1943. No unusual conditions arose during the construction period to hamper the work to any great extent. When the Corps of Engineers moved off the Arsenal, in mid-1943, it turned over to the Chemical Warfare Service the largest chemical warfare arsenal in the world. By the end of World War II, the cost of all construction, including land, totaled \$63,431,925.* The original contracts and change orders thereto were closed on 9 October 1943. After that, from time to time, various additions and alterations became necessary. One of these was a prisoner-of-war camp to accommodate 655 prisoners. The Corps of Engineers constructed the original camp for 250 prisoners, the remainder of the camp being completed by POW labor.

Layout

The facilities of the initial construction authorization, except the Incendiary Bomb Filling Plant, were laid out in an area approximately two miles southwest of Madkin Mountain in a systematic and orderly design,

*This figure appears in History of Huntsville Arsenal, July 1941 - August 1945, Volume I, page 34. The volume From Laboratory to Field of the U. S. Army in World War II series, however, lists the following breakdown for Huntsville Arsenal: land (22,890 acres) - \$1,205,174; construction - \$43,681,939; equipment and production machinery - \$8,392,394; other - \$5,151,693; for a total of \$58,431,200 as of 31 December 1945. Probably the Huntsville Arsenal history figure includes some of the costs of the Gulf Chemical Warfare Depot, which the official Chemical Corps history lists as \$832,000 for land (16,000 acres) and \$8,885,710 for construction, for a total of \$9,717,710. All other sources researched put the acreage of the GCWD within the 7,600-7,800 range, and this lower figure appears to be the correct one. It is not known what the 16,000 figure includes.

since the Arsenal area was considered to be outside the passive defense zone. All additional chemical and manufacturing facilities and required utilities were arranged in a new area approximately two miles south of Madkin Mountain, but were disposed in an irregular pattern since the Arsenal area was at that time included in the passive defense zone. The Incendiary Bomb Filling Plant was isolated in an area adjacent to the eastern slope of Madkin Mountain near the south end. When additional smoke munitions filling plants were authorized, they were located adjacent to the old Incendiary Bomb Filling Plant with the CN-DM* Plant. Appropriate utilities and other facilities were also included in this area, as was the Quartermaster laundry later.

An area of about eight acres on the right bank of Huntsville Spring Creek was set aside as a decontamination area known as the "boneyard." Here metal articles contaminated with mustard gas could be thoroughly decontaminated by burning in a wood or oil fire, if sufficient air was provided in long pipes or partially closed containers. Destruction or decomposition of Lewisite was not so effective.

Chain of Command

Huntsville Arsenal was a Class IV installation. As such, it was responsible to two superiors. The Fourth Service Command exercised administrative control over certain functions. The technical service—

* Chloroacetophenone-Diphenylaminechloroarsine. The former was the standard American tear gas. The latter was an added ingredient that caused nausea, pain in the chest, sneezing, coughing, headache, and other disorders. Known also as Adamsite and locally as "dirty mixture," it acted so rapidly that the victims were unable to pick up the grenades and throw them back, as they did occasionally with ordinary tear gas grenades.

in this case, the Chemical Warfare Service—controlled other functions. Until December 1944, the Industrial Division, Office of the Chief, Chemical Warfare Service, was Huntsville Arsenal's immediate "higher authority." After that date, a paper reorganization of OC CWS required Huntsville Arsenal to report to the Deputy Chief, CWS. Actually, no change in administration took place, as Arsenal and Industrial Division personnel continued to maintain their contacts on the same basis.

In November 1943, all service units supplied to the Chemical Warfare Service by the Fourth Service Command were united to form the 4468th Service Command Unit. The combining of the Medical Department, the Finance Department, and the Signal Corps into this unit was designed to facilitate administration of the Service Command personnel.

II. ORGANIZATION OF HUNTSVILLE ARSENAL

General Summary

Construction was the first order of business at Huntsville Arsenal but, so fast on its heels did production follow, prodded by the pressure of war, that the two programs overlapped for almost a year.

When the first Commanding Officer of Huntsville Arsenal arrived in August 1941, he immediately set up an organization to expedite construction. The initial organization was simple, consisting of an Engineering Division as its major element, and a number of specialized divisions such as Civilian Personnel, Adjutant, Procurement, and Signal. All reported directly to the Commanding Officer. By January 1942, the transition to the production phase began with the grouping of the major elements for operations, planning, and maintenance under the Chief of the Operations Division. The rest of the functions reported directly to the central coordinating agency, the Executive Office. The Executive Office controlled and coordinated the functions of the various divisions and staff offices in accordance with the directives of the War Department; the Chief, Chemical Warfare Service; the Fourth Service Command; and the Arsenal commander.

During 1942 a number of organizational changes took place. A basic concept underlying them was the "task force" principle. Application of this concept made for the self-sufficiency of each operating element in that each would have an engineering, personnel, property, transportation,

and storage section to support it. While this arrangement decentralized responsibility to lower echelons, it also increased administrative costs by duplicating some functions that had been assigned on an Arsenal-wide basis to operating and staff divisions.

Coordination between the Operations Division, Engineering Service Division, and the Procurement and Production Control Division became an exacting problem that was accentuated by the fact that production schedules, plant capacities, availability of personnel, and materiel were in a constant state of flux.

In September 1944, in an attempt to strengthen the production planning function, which ultimately determined the success or failure of the production organization of the Arsenal, the Commanding Officer established separate divisions for procurement and for production planning. When this reorganization did not fully meet expectations of efficient operation, the Operations Division absorbed all production planning in an effort to promote liaison between the two functions. The Chief of the Operations Division was then responsible for at least two major phases of the production program—planning and execution. After this March 1945 consolidation, efficiency appeared to improve.

Engineering Division

The Engineering Division, one of the original Huntsville Arsenal elements, was organized on 16 August 1941 with Lt. Col. W. J. Ungetheum as Chief. It operated from the State National Guard Armory in Huntsville until mid-September, when all Arsenal offices moved to Building T-158 in the temporary administration area. The division was specifically

charged with supervising and coordinating the work of the architect engineers, the prime contractor, and the Construction Quartermaster (later, Area Engineer); with supplying adequate designs for all production and utility facilities; with supervising the procurement of equipment; with inspecting all structures and process equipment; and with supervising all testing and test operations.

Operations Division

As of 16 January 1942, the Engineering Division was redesignated the Operations Division. The mission of the division included the completion of all authorized plants; the production of all munitions; advising the Procurement Division of the components required to meet production; and the maintenance of plants and utilities and operation of utilities plants.

On 28 February 1942, the Arsenal's first production emerged from a pilot line for M54 incendiary bombs set up in Warehouse 642. This production continued intermittently, as components were available, until 21 April 1942, when fire destroyed the entire plant and equipment.

On the morning of 8 December 1941, General Ditto, now promoted, announced to his staff that the date of initial operation of the first H^{*} plant was April 1942 instead of July. This goal was met when, on 7 April 1942, the first mustard gas was made at Plant No. 1, Building 311.

When the first H Plant went into operation, the Chemical Plants Department was set up under Operations to supervise the construction

* CWS symbol for crude mustard gas.

and operation of all chemical manufacturing plants. At about the same time, all munitions filling plants, with the exception of the Incendiary Bomb Filling Plant, came under the new Munition Filling Plants Department headed by Maj. R. L. Swindler. The Incendiary Bomb Filling Plant, later renamed Grenade Filling Plant, reported to the Chief of Operations until July 1942 when it too went under the Munition Filling Plants Department. In August 1942, with the authorization of smoke munitions filling plants and a tear gas (CN-DM) plant, it joined those plants to form the Smoke and Incendiary Loading Department.

Col. L. W. Greene was appointed Chief of Operations on 15 June 1942 when Colonel Ungetheum transferred to Rocky Mountain Arsenal.

Engineering Service

Early in March 1942, the Operations Division organized an Engineering Service Department to operate utilities and maintain equipment in buildings on the Arsenal. On 15 June 1942, this function became a separate and parallel division under Lt. Col. R. A. Phelps. The division thus performed many of the duties ordinarily performed by the Post Engineer or the Quartermaster Officer, such as the operation of the Tennessee River Docks, a sawmill, a limestone quarry, and a rock crusher. A special function was the handling of contaminated wastes and rejected toxic-filled munitions.

The first Engineering Service Department office was set up in Building 427, a maintenance shop, on 26 March 1942. (Division headquarters was later in Building 432, Plants Area No. 1.) Among its first tasks was to provide water and electric power and steam supplies for

new plants. The first central steam station was not yet complete when the first manufacturing plant began operation. Therefore, three 125-horsepower Scotch marine boilers, installed on temporary settings at strategic locations, supplied steam during the summer of 1942.

As the Allied forces increased their use of screening and signaling smoke, Huntsville Arsenal expanded its facilities for making these munitions. Adequate supplies of steam and compressed air were essential to these plants, but manufacturers of compressors, boilers, and stokers were swamped with orders of equal or greater importance. Nevertheless, relying on the resourcefulness of its employees, the Arsenal set out to equip a central station air compressor plant and a steam plant. Some ingenious scavenging brought boilers to Huntsville from Birmingham, where they had been built in 1903. Stokers to fit these boilers were found in a plant in Yonkers, New York, where they had been installed in 1905. "Nitrate Plant No. 1," standing idle at Sheffield, Alabama, since World War I, contained seven 4-stage Nordberg compressors designed to compress hydrogen or ammonia to a pressure of 1,400 p.s.i. After being brought to Huntsville and re-worked into 2-stage machines, these compressors furnished 235 pounds of central air for the plants manufacturing smoke munitions.

Property

The Property Division was activated in July 1941, when Lt. L. A. Parks was appointed Property Officer. After August 1941, the Property Officer also had the additional duty of being Acting Quartermaster. The initial assets consisted of a small amount of storage space in a

barn on Jordan Lane and one truck. By October 1941, a receiving and checking department began to emerge as a separate function, as did a stock record section. In February 1942, the Delivery Department began operating in the Wynn Jones barn near the old Motor Pool on Rideout Road, and in March 1942, regular warehousing of materials began in Plants Area No. 1. A Salvage Yard was organized in April 1942. Beginning as a pile of lumber not far north of the junction of Martin and Mills Roads, the yard covered eight acres by the end of the war.

Huntsville Arsenal was selected as the first CWS arsenal to use War Department Shipping Documents, a new method for the transfer of property accountability. The Smoke and Incendiary Loading Department Branch Property Office, activated on 9 November 1942, pioneered this effort.

Transportation

The Commanding Officer, Colonel Ditto, started the transportation workload at Huntsville Arsenal by bringing with him Chevrolet passenger car #12103, the first vehicle at the Arsenal. The transportation function was originally included in the Property and Acting Quartermaster Division, in September 1941.

In April 1942, the Transportation Division was activated as a separate organization, with Maj. Roy A. Burt as its first Chief. By the end of 1943, the division had 436 vehicles, 7 diesel locomotives, and about 225 cars of rolling stock.

The Huntsville Arsenal Railroad was among the first construction work begun on the arsenal so that it could deliver heavy equipment and

supplies to other construction areas. The first track was laid in September 1941. Two classification yards, one for the Southern Railroad on the west side and one for the Nashville, Chattanooga, and St. Louis Railroad on the east side, were completed in November 1941. Tracks connected the two yards, about seven miles apart, through the proposed plants area in December 1941. The lines to the Gulf Chemical Warfare Depot and to Redstone Arsenal were also completed in December 1941. The distance to the Depot was about six miles, and to Redstone Arsenal, about 10 miles. The complete system consisted of about 75 miles of track. The west classification yard was closed down in August 1943.

Finance

All funds allotted for the operation of the Arsenal were spent by the Procurement and Production Control Division. Activated in July 1941 as the Procurement, Cost, and Fiscal Division, production control was combined with it in April 1942. The fiscal and cost function was separated from the Procurement Division in October 1942 and set up as a Fiscal Division with Capt. I. M. Breller as Chief. Payroll functions were the responsibility of the division until March 1943 when they were transferred to the Civilian Personnel Division. Prior to activation of a Finance Office at Huntsville Arsenal, also in March 1943, the Fiscal Division processed all commercial accounts for payment to the Atlanta Finance Officer.

The Arsenal's financial growth was rapid. The original operating allotment of 12 July 1941 was \$17,000, and the original allocation for the first manufacturing order was \$1 million on 5 October 1941. By

FY 1944, there was an allotment of \$30 million to cover manufacturing orders from the CWS, exclusive of allotments from other services or special overhead funds. Payrolls ran approximately \$1 million a month. With the growth of activities, the Arsenal sold certain manufactured items and by-products which entailed some adjustments in the usual "one way" accounting system. Receipts for such sales totaled about \$1 million in 1943.

The Finance Office paid the accounts for services and commodities of Huntsville Arsenal, the Gulf Chemical Warfare Depot, Redstone Arsenal, and the Area Engineer. This included all military personnel, civilian personnel, and commercial accounts. The office issued all war bonds bought by personnel of the two Arsenals and the Depot. It also collected all funds from and had charge of the post laundry and all salvage sales.

Military Police

On 28 August 1941, the 222nd Military Police Company arrived from Edgewood Arsenal, with a strength of 4 officers and 80 enlisted men. On 11 April 1942, the Military Police Detachment was activated at Huntsville Arsenal with a strength of 1 officer and 93 enlisted men. These outfits operated under a battalion setup until 1 July 1942, when the Corps of Military Police Detachment was activated, consolidating the organizations.

Medical Detachment

Also on 28 August 1941, a Medical Detachment of six men arrived and was assigned to the 222nd Military Police Company for administration.

The first sick call on post was held in a tent on 6 September 1941.* On 8 November 1941, the first sick call was held in Building T-144, which had been designated the Post Hospital. The hospital moved to Building 117 on 1 May 1942, and the first nurse reported for duty on 16 May. The Industrial Medical Service was established on 25 May, and the Dental Clinic opened on 10 June in Building 117. The first baby was born in the Station Hospital on 16 August 1942. Huntsville Arsenal provided hospital facilities for Redstone Arsenal, which maintained only an industrial dispensary that did not provide bed care. The Medical Department was under the supervision of Headquarters, Fourth Service Command, Atlanta, Georgia.

As Huntsville Arsenal was located in one of the most malarious areas in Alabama, a malaria control program was started on 1 October 1941. The TVA system had created large areas of water surface that extended into the arsenal area, providing an excellent breeding ground for anopheles mosquitoes. Mosquito control thus required varied measures, some of which were carried out by POW's. The control of industrial wastes also presented several problems. Many of the chemical processes used on the arsenal produced waste products of an unusual nature that required special treatment in order to hold stream pollution to a minimum.

*The Huntsville Arsenal Preliminary History says the first sick call was on 1 September. The History of Huntsville Arsenal, 1941 - 1945, says 6 September, after the first medical officer arrived on 4 September.

Intelligence

As the Construction Quartermaster (later, the Area Engineer) was responsible for the security of Huntsville Arsenal until its completion, the former activated a guard force and a fire department and performed the duties normally expected of a post intelligence office. In January 1942, Lt. Col. A. T. Brice was assigned to the newly activated Safety and Military Intelligence Division. The peak of construction was reached in February when 15,000 construction workers were employed by Kershaw Butler Engineers, Ltd. Since this type of work, especially in wartime, attracted a large number of "floaters," many of whom had criminal records, the Area Engineer had plenty to do. As the CWS took over plant jurisdiction, it activated a Civilian Auxiliary Military Police in April 1942, and assumed control of the Fire Department in June and July.

The Post Intelligence Officer was responsible for all investigations in any case where enemy activity was suspected. He also handled cases normally thought of as police work. Reported incidents varied from minor theft of personal property to acts of sabotage.

Safety

The Industrial Safety Division was activated on 31 October 1942, with 1st Lt. Walter T. Harper, Jr., assigned as Chief. The division supervised accident prevention throughout the Arsenal. Although most personnel at the Arsenal were inexperienced in plant work, and, moreover, many could not read or write, they nevertheless became instilled with safety consciousness.

Special safety equipment included such protective items as gas masks, rubber aprons, flame-resistant clothing, impregnated clothing for protection against mustard, special goggles, gloves, and toe guards. Special impervious clothing was designed that permitted no ventilation, but this could be worn only for short periods. Frequent fire drills were held, and all personnel were required to demonstrate proficiency with the gas mask and to go through the gas chamber periodically. All personnel had to carry masks in designated zones.

The fire hazard at Huntsville Arsenal was quite different from that in most industrial plants. Plants Areas 1 and 2 each contained a building that presented a considerable fire hazard, as did the whole Smoke Incendiary Loading Department. Another hazard not generally associated with an industrial plant arose from the large amount of grassy area on the arsenal. During the dry season, grass fires constituted a serious problem. Many fires were started from locomotives passing on the tracks near the arsenal.

There were eight fatalities in the Operations Division—seven civilians and one officer—from the start of operations through July 1945. In colored smoke operations, out of a total of 177 recorded fires, 149 of them occurred with yellow mix. Sixteen explosions occurred in pressing violet mix, as compared to one or two explosions in each of the other colors. During 1942-43, until filling equipment and the ventilation system were improved, the mustard filling plant was the source of most of the lost-time accidents. The immediate application of M-4 and M-5 ointments for mustard burns and BAL (British

Anti-Lewisite) ointment for Lewisite proved very effective as decontaminating measures, however.

Inspection

The Inspection Office at Huntsville Arsenal was established on 1 February 1942. It was this office's responsibility to inspect incoming materials to be used in the manufacturing processes at the Arsenal and to inspect all chemical agents and munitions manufactured at the Arsenal to insure that they met specifications. It proof-fired incendiary bombs manufactured by Huntsville Arsenal and by five outside manufacturers and proof-tested all chemical mortars issued for field use.

Among the main accomplishments of the office was the development of an arsenic waste disposal system, a field disposition method for 4.2-inch chemical mortar live duds, a static bomb proof-testing method, and an accelerated ageing test method.

The first 4.2-inch chemical mortar shells were proof-fired at the Arsenal in January 1943. In May 1943, an Air Corps Detachment, consisting of three officers, three enlisted men, and two planes—a B-26 and an L-20—was stationed at Huntsville Arsenal. Its mission was incendiary proofing. M47 100-pound IM^{*}-filled bombs were the first dropped. Static firing also began with this type of bomb. An additional proofing range, known as the South Bombing Range, was completed about this time. By July 1943 a 500-foot concrete bombing mat was finished, and the first skate tests and 4,000-foot drop tests on M50 incendiary bombs were conducted.

* Isobutyl methacrylate, polymer AE, a substance used to thicken gasoline for incendiary purposes.

A simulated village, consisting of some 50 wooden shacks with three streets—one of large stone, one of gravel, and one of dirt—had been constructed. Known as "Little Tokyo," this village was used in testing the M47's. In addition, two 4.2-inch chemical mortar ranges with prepared positions, observation dugouts, and range communications were completed, and proofing of the mortars began in August 1943. During the first two months of 1944, with most of the shacks in Little Tokyo obliterated, a 200-foot wooden structural target was erected for the proofing of 500-pound M76 incendiary bombs. It was during this period that the bomb was first static-fired and a method of dud disposal developed for it.

Judge Advocate

Lt. Col. Heber H. Rice was appointed Staff Judge Advocate on 3 October 1942. One of his first acts was to try to obtain jurisdiction over Huntsville Arsenal for the U. S. Government from the State of Alabama. In response, the Governor of Alabama issued a patent, dated 9 November 1942, ceding exclusive jurisdiction of Huntsville Arsenal and the contiguous Redstone Ordnance Plant to the Federal Government, except for 63 of the approximately 300 tracts contained within the reservation. After further negotiation, a final patent, dated 9 April 1943, ceded exclusive jurisdiction to the whole reservation. This prevented conflicting jurisdictional claims from arising, such as would have been the case if the city and the state had continued to exercise rights on the reservation concerning such things as building permits, hunting license fees, and similar matters.

When the Legal Division was established on 8 February 1943, Colonel Rice became Chief of it, in addition to being Staff Judge Advocate.

Signal

The telephone equipment and plant for the Arsenal and Depot were valued at \$190,500 at the end of the war. Of this amount, switchboards accounted for \$24,275; power plants \$6,000; and outside plant, \$131,000. The cost of labor for outside plant construction was \$173,719.73,* of which the Southern Bell Telephone and Telegraph Co. was paid \$68,129.20 and the Area Engineer was reimbursed \$104,590.53 for labor used in buried cable installation. Installation, moves, and temporary service furnished by Southern Bell amounted to \$77,904.02. Thus, the cost of the Huntsville Arsenal and Gulf Depot telephone system amounted to \$251,623.75, exclusive of material used, labor, and civilian personnel on Signal Corps payrolls.

Of the 170,000 feet of telephone cable installed by the end of the war, 35,000 feet was aerial and 135,000 was buried. In one instance, a cable buried in low swampy land was discovered to be going slowly out of service. Telephone, telegraph, and TWX service to Redstone Ordnance Plant was imperiled, as was all service to the Gulf Depot. The impaired cable was found to be under several feet of water near a creek that was aerially spanned. Since the cable could not be repaired while under water, a valve was inserted in the aerial cable above the creek, and

* This and the following figures are those given in the Huntsville Arsenal Preliminary History. The breakdown for labor as given adds up to \$172,719.73, however, making a total of \$250,623.75. It is not known whether the error is in the total or one of the lesser amounts.

nitrogen was forced into the cable at a sufficient pressure to counteract the pressure of the water seeping into the cable from a hole caused by electrolytic action on a factory defect in the cable. The cable remained in service in this state for 11 weeks, until it could be replaced by an aerial cable.

Public Relations

From the construction days of August 1941 until April 1943, Huntsville Arsenal was practically without a public relations program. Relations with "outside citizens" and news services were at a very low ebb. The editor of a local newspaper reportedly instructed his staff to quit calling the Arsenal for items of potential interest because a telephone request drew only a mild kind of insult. As the Chemical Warfare Service operated on a rather secret basis, Arsenal officials were necessarily reluctant to give out information of any kind. Since practices and procedures were not clearly defined as to what to say and what not to say, a "say nothing" policy prevailed. After a Public Relations Officer was appointed in April 1943, relations steadily improved.

Supply

In October 1944, the Ordnance Department designated Huntsville Arsenal as a key supply point for requisitioning, storing, and issuing automotive spare parts and supplies. Redstone Arsenal, the Resident Engineer at Redstone Arsenal, Gulf Chemical Warfare Depot, Courtland (Ala.) Air Base, and Gulf Ordnance Works at Aberdeen, Mississippi, drew on Huntsville Arsenal for their supplies.

Post Exchange

An innovation in the Post Exchange operation was the cultivation of a truck garden, products from which were used in the cafeteria and sold in the PX. Another venture was a pig-raising project. The PX owned 90 hogs, fed mostly by swill from kitchens. The pigs were to provide pork for the cafeterias. A farmer was employed to care for the hogs and tend the "Victory Garden." Operative during 1943 and the spring of 1944, the farm was discontinued in May 1944 as being too costly, the loss on it amounting to \$576.13.

Personnel

The labor supply was not so abundant as first thought, although the difference between the potential labor force and the employed in the Limestone-Madison County area was 6,321, 16 per cent of whom were women. Skilled clerical help was not available; the more technically skilled people were migrating to the higher-paying coastal areas; the contractors building the Arsenal paid higher wages than civil service; and the agricultural community did not produce many skilled craftsmen. Lack of good transportation and cheap housing facilities^{*} compounded the problem.

*On-post civilian barracks were opened on 1 December 1942. By the end of 1946, 47 families of civilian employees, 24 single men, and 21 single women occupied these quarters. The figures remained substantially the same for 1947. There were eight Government housing projects in Huntsville with the following number of units; namely, Westlawn—295; Madison Heights—185; Brookfield—83; Gwyn Home Site—10; Mayfair—112; Haven Manor—38; Farley (later, Redstone Park)—300; and Binford Court—220. Two of these projects—Redstone Park (white) and Binford Court (colored)—were always full, renting for about \$25 per unit. The other major housing projects were Government-sponsored but privately owned. The Madison Heights project, for example, was never fully rented because rents were higher than most workers could afford.

Scarcity of labor at one point necessitated using 115 prisoners of war in redistribution and salvage operations.

The earliest records of Arsenal personnel, dating back to March 1942, showed a strength of 699 civilian and 185 military personnel.

Early in 1942, the Civil Service Commission notified the Arsenal that it could no longer furnish applicants for existing vacancies, so the Arsenal proceeded to locate its own employees. Selected applicants were sent to Edgewood Arsenal for training in the methods of munition and gas manufacture. This group became the cadre for training other personnel, mostly on the job.

When the Arsenal opened, all ungraded employees were hired at temporary rates of pay based on grades at Edgewood Arsenal, pending the results of a local wage survey. It was not until August 1943 that the Army Service Forces accepted the Arsenal's proposal for its wage structure.

The initial need for civilian personnel was limited to engineers and officer workers, but, as production units were activated, the need for production, maintenance, and more administrative types accelerated rapidly until Huntsville Arsenal reached its peak of 6,707 employees* in May 1944. Over 90 per cent of the work force was civilian.

The distribution of the types of workers was fairly constant in that approximately 9 per cent of the personnel were unskilled; 48 per cent semiskilled; 18 per cent skilled; and 25 per cent administrative or graded

*There were some 15,000 employees on the Arsenal in January 1943, counting contractor personnel and the Area Engineer people engaged in construction. Also, the Arsenal was operating on a 24-hour basis at that time. See also page 18.

employees. A representative sample recorded in September 1944 showed 26 per cent white female, 11 per cent colored female, 52 per cent white male, and 11 per cent colored male. For a long time, the Arsenal maintained a working ratio of white and colored employees almost equal to the population ratios.

Military strength reached its zenith (580) in October 1942. In December 1943, a number of WAC's arrived for administrative duty. Enlisted men were used primarily as security forces. None worked on production or maintenance projects.

As of 1 May 1945, approximately 700 employees were on military furlough or had resigned to enter the armed forces. This amounted to about 12 per cent of the work force.

Commanders

Commanders of Huntsville Arsenal and their dates of service:

Col. Rollo C. Ditto (Brig. Gen. as of October 1941)	4 August 1941—24 May 1943
Col. Geoffrey Marshall	24 May 1943—3 August 1945
Col. E. C. Wallington	3 August 1945—20 July 1946
Col. Sterling E. Whitesides, Jr.	20 July 1946—22 December 1947
Col. James M. McMillin	22 December 1947—22 February 1949
Lt. Col. Allen H. Williams	22 February 1949—30 June 1949

III. WARTIME WORKLOAD

Huntsville, like the other CWS arsenals, manufactured toxic agents, smoke, and incendiary materiel, and with these filled shells, grenades, pots, and bombs supplied, usually, by the Ordnance Department. Representative munitions are discussed below.

Mustard Gas

Chlorine Plants

Two chlorine plants generated chlorine for the manufacture of mustard gas (usually referred to as "H"). Each plant could produce 50 tons of gaseous chlorine or 45 tons of liquid chlorine and 56 tons of 50 per cent caustic soda per 24 hours. The fusion plant, which cooked 50 per cent caustic into solid caustic, could produce 75 tons a day, although rated at only 65. Preliminary operations began in May 1942, with production continuing until July 1945.

Manufacturing

Six mustard manufacturing plants^{*} were constructed at Huntsville Arsenal. The first four plants were in Plants Area No. 1, and the others in Plants Area No. 2. Each plant consisted of a sulfur monochloride building, an ethylene generator building, and a mustard

* All the plants began operating in 1942 in sequence, the exact dates being 7 April, 8 May, 28 May, 16 June, 20 September, and 22 November 1942.

reactor^{*} building. The original design of each plant was for the manufacture of 24 tons of Levinstein H but it was soon found that 40 tons a day could be achieved. The mustard manufacturing plants were shut down between 23 and 28 May 1943, and production officially ceased on 28 May 1943. But, in June 1945, the Arsenal was alerted for possible resumption of mustard manufacturing and in July, Plants 2, 3, and 4 were readied for this eventuality. In fact, five batches of sulfur monochloride had already been prepared, and further work was awaiting the arrival of alcohol when all preparations were halted, then canceled, by the imminence of the Japanese surrender.

Filling

Construction of two mustard gas filling plants was authorized on 24 July 1941, and after Pearl Harbor a third was authorized but was never completed, being ultimately adapted for incendiary oil munitions filling. The first H filling plant, Building 471, was ready in March 1942. The first item scheduled for production was 105-mm M60 shells. These were first produced in April 1942 and were filled with mustard gas manufactured at Huntsville Arsenal. Both the H filling plants operated until March 1944, at which time they were placed in standby. The No. 2 Plant, Building 481, was reactivated in October 1944 to fill an M70 bomb schedule. Deactivated in January 1945, it reopened in August to fill 5,556 more M70 bombs. The fact that mustard gas was

* Soon after the mustard gas manufacturing plants began operation, it became evident that the renewal of reactor coils was proving costly and time-consuming. The Engineering Service Division was able to develop a new coil, at little additional cost, with triple the life of the old coil.

never used in the war made for much variance in the program and schedules.

Employees working with mustard gas had to wear special clothing and take extra precautions to avoid burns. Prompt action was mandatory because no preventive measures were known to be effective between the 10-15 minutes after exposure and some 24 hours later when blisters developed and were treated as any second degree burn. Nor was any preventive treatment known for irritations of the eyes and respiratory passages following exposure to low vapor concentrations of mustard. Workers had to bathe and change clothing before being allowed to leave the plants.

The filling of M47A2 bombs began in October 1942, but as the assembly lines for filling shells were not adequate for filling bombs, the setup soon proved unsatisfactory. With fatigue and forgetfulness often present, it was not long until some operator tried to drop two charges into one bomb. This dumped several gallons of mustard on the floor and thoroughly contaminated the conveyor rolls and adjacent equipment. Since the equipment and concrete floors were very difficult to decontaminate, the situation went from bad to worse despite safety devices installed on the filling machines. Consequently, the filling equipment became contaminated to the point that it was always "hot." Many employees suffered from severe cases of eye and throat irritations. Eye irritations reduced vision to a fraction of normal, and there was no cure except rest. Throat irritations produced a dry cough that kept many an employee awake at night. In December 1942 and January 1943, some 30 new officers from Officer Candidate School were assigned to the plant to bolster the supervisors, who had been pretty well exhausted. These officers then worked

themselves so strenuously that a number had to be hospitalized for general debility and eye and respiratory irritations.

The filling of the Navy bomb MK42, begun in January 1943, was the most hazardous operation undertaken in mustard filling. The bombs tilted easily on their assembly-line pallets, and also their screw closures tended to leak. The net result was a large number of "hot" bombs. By the time 11,856 bombs were filled, the incidence of incapacitated employees had risen so high that the plant was closed for cleanup. The filling equipment, conveyors, piping, and air ductwork were all scrapped to permit a complete rehabilitation of the space.

Lewisite

Thionyl Chloride

Only one Thionyl Chloride Plant was constructed at Huntsville Arsenal. Its purpose was to supply a drying and chlorinating agent to be used in the treatment of crude Lewisite, to decrease sludge formation. Completed in April 1943, it was erected in Plants Area No. 2 adjacent to Chlorine Plant No. 2. Designed to produce three and one third tons of thionyl chloride a day, it could produce as much as five tons a day. Production began on 15 March 1943, was discontinued on 4 October 1943, and was never resumed.

Arsenic Trichloride

Another plant contributing to the manufacture of Lewisite was the Arsenic Trichloride Plant. Consisting of an arsenic trichloride reactor

building, a sulfur monochloride manufacturing plant, and a sulfur dioxide disposal system, the plant had a capacity of about 30 tons a day. It began operating on 20 March 1943 and continued until 11 November, when it was placed in standby. Subsequently its equipment was removed to make way for a plasticized white phosphorus plant.

The Arsenal originally intended to have six Lewisite plants but actually operated only four. Plants No. 5 and No. 6 were completed except for minor items of equipment but were never activated, so the equipment was removed for other use. Plant No. 1 began operating in November 1942, followed by Plant No. 2 in December, and Plants No. 3 and No. 4 about May 1943. Plant No. 4 was not operated continuously because of a shortage of arsenic trichloride. All manufacturing operations were permanently halted on 30 October 1943, and the plants were declared surplus in 1944.

Phosgene

One plant was involved in manufacturing phosgene. Its facilities included a carbon monoxide-generating plant, a catalyser building, a ton-container filling shed, various storage tanks, and an office and locker room building. The expected output was 30 tons a day, but production attained during one month averaged better than 40 tons a day. Production lasted about a year, from 11 February 1944 to 17 January 1945.

The phosgene filling plant was located some 50 yards from the manufacturing plant. It had storage space for about 800 empty bombs. It had six filling stations, each capable of filling 40 bombs each 8-hour shift. Filling of 500-pound M78 bombs lasted from 15-27 April 1944. Filling of

1,000-pound M79 bombs started on 28 April, continuing until 17 January 1945, when all the phosgene was used up.

White Phosphorus

Huntsville Arsenal had one White Phosphorus Filling Plant, occupying an area approximately 1,000 feet wide and 2,000 feet long on the west side of Plants Area No. 1. Construction began in November 1941, and operation started on 15 May 1942, ceasing on 14 August 1945. Ten different munitions were filled during that time, including artillery and mortar shells, grenades, and igniter tubes.

The work in the filling department could be quite hazardous, requiring protective clothing. For example, in filling M15 hand grenades, the white phosphorus was apt to flare out on the operators. Practically every operation was a hand operation in this program, which caused the White Phosphorus Filling Plant to have many difficulties.

A number of accidents also occurred during the filling of the M46, M47A1, and M47A2 100-pound bomb. The oil used in leakage testing of the bomb left vapor in it, and when the "phossy" water was put into the bomb before filling, the vapor often ignited with a loud report.

The white phosphorus plant trained its personnel to do several different jobs, however, so this rotation formed a relief system for the more hazardous and difficult operations.

Until September 1943, all phosphorus-filled components were salvaged to reclaim the phosphorus. The empty containers were then sent to the disposal pit for decontamination by burning. However, the labor cost made this practice prohibitive; and after accidents occurred, all phosphorus-

filled rejects were sent to the "boneyard," where the phosphorus was burned.

Carbonyl Iron

The Carbonyl Iron Plant at Huntsville Arsenal was established solely to serve as a standby plant in the event that the only successful plant then in operation, that of the General Aniline Works at Grasselli, New Jersey, should be put out of action. The H. K. Ferguson Co., awarded a contract on 22 October 1942, erected 17 buildings to house the plant. Then a plant at Shreveport, Louisiana, was dismantled, and the equipment, plus some additional, was moved to Huntsville Arsenal and installed. This happened because the low-pressure plant that the Ferrolite Corporation had constructed at Shreveport failed to produce. The Defense Plant Corporation then took it over, transferred it to the Chemical Warfare Service, and moved it to Huntsville Arsenal. General Aniline was retained to redesign the plant for pressure operation and to render technical assistance until it was in successful production.

Located in Plants Area No. 2 near Chlorine Plant No. 2, from which it obtained the hydrogen necessary for its processes, the plant had a daily capacity of 1,500 pounds of carbonyl iron. Instructions were to produce 125,000 pounds of carbonyl iron and then put the plant into standby. Production began on 9 July 1943. When the quota was reached on 26 October 1943, the plant was shut down.

White Smoke Munitions

Pots

Production of the M4 white smoke pot began in Building 638 in

November 1942 and ended in August 1943. The designed daily capacity of this plant was 7,500, but construction of a larger line, Building 1050, which began operation in May 1943, almost doubled this to 13,500. Production stopped abruptly on 17 August 1943 when fire destroyed Building 648. Two thousand rejected pots stored in Warehouse 648 were ignited when a girl employee, dismantling pots, threw an ignited fuze lighter into a pile of starter cups, resulting in the death of the girl and the loss of the building and its contents. In January 1944, production was resumed, to run until April 1944, when an improved pot, the M4A2, replaced the M4.

Production of M4A2 pots halted in November 1944, to be resumed in May 1945. The rate was 90,000 pots per month until V-J Day.

First-run production of the M1 smoke pot lasted from 22 March 1943 to 30 April 1943. The second run extended from 10 August 1943 to 15 January 1944. The designed capacity at Building 668-2 was 9,000 pots a day and 18,000 pots at Building 1050. Output reached 21,000 per day at the latter after remodeling.

Shells

The M89 smoke shell was a 75-mm^{*} artillery munition initially developed at the request of the British. Production of these shells was very erratic and troublesome throughout 1943. As there was no gun

* The History of Huntsville Arsenal from July 1941 to August 1945 lists the M89 as 76-mm and the M88 as 75-mm. The Redstone histories reverse the sizes. In the absence of technical documents to solve the conflict, the Redstone version has been adopted because of the evidence presented.

available at Redstone Arsenal to test the munition, there was a delay of several weeks between manufacture and proof-testing, which left the production people "in the dark" as to what their problems were. Early in 1944, a group of officers made a trip to a Canadian plant that was successfully producing the shell. The know-how gained there and the acquisition of local proofing facilities generally simplified matters. When production, having ceased in the spring of 1944, was resumed in June, a successful shell was attained and a considerable number of units produced throughout the rest of the year.

The M88 shell was also an HC smoke shell, of 76-mm diameter, designed to be fired from an artillery weapon. Preparations began for the production of the shell in June 1944. As the work was largely a repetition of that done in the previous year for production of the M89, production techniques were well developed. Production ended in November 1944, the largest number of shells—98,032—having been produced in August.

Grenades

Another white smoke munition was the M20 rifle grenade. Initial production averaged 6,000 grenades per shift. Improved methods and equipment upped this figure to 15,000. Production started in December 1943 and continued intermittently until February 1945.

Canisters

Late in 1942, Huntsville Arsenal received a rush order to prepare thousands of smoke canisters for immediate use by troops in the field. First tests of the canister revealed that the metal case did not admit

sufficient air for efficient combustion, but it was found that three series of holes in each can would permit satisfactory burning. To the Engineering Service Division fell the task of punching holes in the many thousands of cans already shipped in. Laborers, carpenters, painters, and anyone else who could swing a hammer and handle a punch were put to work on a 3-shift, 7-day basis. Result: the canisters were shipped to the field ahead of the production schedule.

Tear Gas

There were 243,020 M7 CN (tear gas) grenades produced at Huntsville Arsenal during the December 1943—April 1944 period when these were manufactured. M6 CN-DM grenades totaled 252,348 during the two months (April-May 1944) that they were manufactured.

Incendiaries

By 30 June 1945, four different types of incendiary oil munitions had been produced at the Incendiary Oil Plant—M47A2, M4 cluster (M69), M76, and the M19 cluster (M69). M76 bombs were filled with PTI gel.* The bombs were placed in open storage and, during the warmer months, the gel within the bombs warmed up and expanded to such a degree that the burster well collapsed. Subsequent experimentation revealed that, if a bomb was subjected to a temperature of 150^oF. for three hours, collapsing of the burster would very often take place.

Fires originating in PTI gel, often spontaneously, were exceedingly

*An incendiary fuel based mainly on "goop" and IM gasoline. "Goop" was a mixture of magnesium particles and asphalt used in incendiary bombs.

difficult to extinguish. Experiments with various materials showed that a 50-weight oil was most effective. The oil had to be applied immediately, however, for if the fire got too hot, the oil also would ignite.

The M54 thermate incendiary was a 4-pound bomb manufactured at Huntsville Arsenal for less than two months. The main processing building, activated for production on 12 March 1942, burned down on 21 April 1942 and was not rebuilt. Pine Bluff Arsenal and National Fireworks manufactured the munition after that.

The AN-M14 grenade was a modified thermate incendiary that could generate enough heat to melt through a sheet of 3/8-inch steel. Huntsville Arsenal had facilities for producing 12,000 of these per 8-hour shift. Production ran from August through December 1943.

Colored Smoke

Grenades

The daily capacity of the M16 colored smoke grenade plant was about 15,000 grenades per 24-hour work period. The program, begun in October 1942, continued until 16 November 1943 when the M18 grenade replaced it. The same production facilities and equipment were used. As the shift officer's log book laconically stated, "Personnel were instructed to clean the area from noon until 2:15 p.m. when the order was received to begin production of M18's." The first M18 colored smoke grenade (violet) was produced that same day; the last, on 8 May 1945. The fill and press building could produce 6,000 grenades per 8-hour shift and 10,000 could be assembled during the same time.

The dye used in the grenades colored the workers' clothing and stained the skin. Reportedly, it was not uncommon to see people of rainbow hues walking around Huntsville. In addition to the discoloration nuisance, dust on the M16 line was always a health hazard, and the danger of fire and/or explosions was constantly present. Therefore, persons working in colored smoke were paid one grade higher than the corresponding job in other types of work. The extra pay helped to compensate for the danger, the dusty conditions, and the almost indelible dye. Fires were numerous, as many as 11 in two hours being recorded when yellow grenades were being made.

The greatest contribution to colored smoke manufacture was obtained when oil was introduced into the dye before mixing the other components with it. This process of oiling the dye allowed the mix to be packed into the grenade without spurting and decreased the dust hazard to a very great extent. It also sped up production tremendously because of the ease of handling the mix.

The first M23 rifle grenade (red) streamer was produced on 30 April 1944. The plant making it, capable of producing 6,000 grenades and packing 10,000 per 8-hour shift, shut down at the end of hostilities. Until September 1944, all M23's were filled by hand, resulting in uneven fills. This, in turn, caused an erratic burning time. Satisfactory results were obtained when M18 mixing, filling, and pressing equipment was used to manufacture M23's.

Manufacture of M22 rifle grenades began on 14 March 1944. The plant used for this purpose was the same as that used for the M16 and M18 hand grenades. Production of this grenade continued until April 1945, when

the yellow grenades posed some difficulties. The flaming was traced to the primer being used by Ordnance. A newly developed primer, called the M45, allowed production to resume on 9 July 1945.

Canisters

The M2 105-mm canisters for colored smokes were produced at Huntsville Arsenal for shipment to Redstone Arsenal, where they were assembled into base ejection shells, three canisters per shell. The final product was used by artillery for signal and identification purposes. The production of the M2 canisters began with the manufacture of red canisters on 4 May 1943. The violet followed on 6 May 1943, next came the green and orange on 9 May, and finally the yellow on 12 May 1943. Average production for an 8-hour day, based on 125 assigned to the entire operation, yielded 4,000 each for orange and violet; 4,700 green; 5,200 red; and 3,200 yellow. The lower amount for yellow was caused by the fire hazard involved while running the yellow mix. As Ordnance requirements for colored shells decreased in 1945, the final M2 colored canister was produced at Huntsville Arsenal on 5 July 1945.

The buildings used in the manufacture of M3 and M4 colored smoke canisters were scattered over a 12-acre area. This dispersion was a double precaution against fire and explosions and enemy attack. These canisters, to be used in the base ejection 155-mm Ordnance shell, were also assembled by Redstone Arsenal. The completed munitions contained three M3 cylindrical canisters and one M4 truncated cone canister. Production of both canisters began in February 1944 and ended in April 1945. They came in four colors—red, green, violet, and yellow.

Refuzing

All hand grenades produced prior to July 1944 had been fuzed with M200 fuzes, which proved unsatisfactory in the field. As these fuzes were not waterproof, the percentage of duds in the field was excessive, particularly among grenades shipped to the Pacific Theater of Operations. The munitions were returned to Huntsville Arsenal for installation of an improved fuze, the M201. The refuzing program began in June 1944 and continued sporadically until July 1945. The daily production varied greatly, depending on the type of grenade being run and the number of personnel available. A crew of 80 people (35 on the defuzing line and 45 on the refuzing line) could normally run 10,000-12,000 M14's per 8-hour shift; 7,500-10,000 M8's; or 7,500-10,000 M18's.

Stenciling

Each bomb, shell, or grenade filled had to be marked to indicate size, contents, lot, manufacture, and date. Original operating directives stipulated that this would be done by paint stenciling with spun copper or Monel stencils, but ordinary use by inexperienced operators proved hard on such stencils, which cost from \$17 to \$200 each. Engineering Service Division shops developed a galvanized sheet metal stencil costing about \$15. Stencil paper masks, with figures and lettering cut on a machine for insertion in a pre-formed slot, allowed the stencil to be used continuously since only the paper inserts had to be changed for different marking.

FRED Project

In January 1945, at the request of the Army Air Forces, the Chief of the Chemical Warfare Service directed Huntsville Arsenal to test liquid propellants and methods of using them in connection with the launching of JB-2 bombs. The JB-2 bomb was similar to the German V-1 bomb. The program, known as the "FRED Project," was to consider hydrogen peroxide nitromethane and associated catalysts, and fuming nitric acid and aniline. The Engineering Branch ended its investigations in September 1945.

IV. REVIEW OF WAR RECORD

Administrative Problems

At the end of the war, Huntsville Arsenal listed its major problems. Those pertaining to personnel concerned the shortage of skills, the lack of trained managers, both military and civilian, the generally poor physical capabilities of the workers available, the converting of agricultural personnel into industrial operators and supervisors, frequent changes of personnel, and transportation difficulties that resulted in absenteeism.

Administrative problems centered around inadequate local policies, over- and under-direction, coordination with higher authority, dual control by OC CWS and the Fourth Service Command, necessity of developing administrative procedures, lack of the best type of organization, and difficulties created by required reports.

Of all the nontechnical obstacles to efficient production, absenteeism probably ranked first. Appeals to patriotism and disciplinary action alleviated the problem but little. Apparently excessive absenteeism was due mostly to transportation problems and shift work seven days a week. Absenteeism decreased markedly after the Arsenal adopted a 6-day week and discontinued the third shift.

The organization of Huntsville Arsenal differed basically from that of the other three CWS arsenals (Edgewood, Pine Bluff, and Rocky Mountain), which were organized on the basis of separating operations

according to mission, each mission being self-supporting, if possible, with service elements so located that they could support the most missions.

Responsible officials at the Arsenal at the time believed that the ultimate in organization could not be accomplished at Huntsville Arsenal because qualified personnel capable of directing and assuming responsibility for the accomplishment of major objectives were not available. In view of the scarcity of managerial personnel, the Commanding Officer felt that a very close personal control by the commander was necessary for satisfactory administration. The policy was established to treat many situations individually, instead of formulating overall policies and requiring that these policies be administered at lower echelons.

To the organization and methods specialist, it might seem that many of the principles of organization were violated for a specific or general reason. It is possible that the full importance of a good organization as a management tool was not recognized by management throughout the operation of Huntsville Arsenal as a manufacturing installation. Many unknown factors undoubtedly entered into decisions made concerning organization, but it is probably true that personalities involved frequently determined the organizational structures that were approved. This is contrary to the usual counsel of organizational experts who recommend that an organization be developed first and that key personnel be obtained to fit the organization.

Considerable difficulty stemmed from the constant fluctuation in personnel, resulting from frequent transfers of officers, creation of new jobs, drafting of civilians, and high turnover rates occasioned

by the expansion of numerous other facilities that also had production goals to meet. Even though care was exercised in the selection of key officer and civilian personnel, the fact that such personnel frequently departed and that the mission of the organization, particularly the procurement program, was subject to change without notice, created a condition which, in the opinion of the Arsenal commander, eliminated much of the possibility of delegating responsibility.

However, the retention of decision-making at higher echelons, even on minor matters, prevented untrained personnel from getting the necessary experience that would eventually have enabled them to accept the responsibility that should have been delegated to them.

An interesting sidelight concerning management bottlenecks pertained to the requirement that forms at Huntsville Arsenal had to be approved by the Control Division, Office of the Chief, CWS. Sometimes eight or ten indorsements were needed to secure approval of an operating form. This situation reportedly proved very disheartening to Huntsville Arsenal personnel who were aware that Redstone Arsenal had been delegated the authority to approve local forms.

War Department and Army Service Forces policies on maintenance, repairs, and utilities caused considerable confusion at Huntsville Arsenal for these functions and affected the ability to make effective, timely decisions. Operations and available personnel at a post such as Huntsville Arsenal were radically different from those at a "normal" troop post, camp, or station. Policies, directives, and regulations prepared to apply to the latter type of installation were either not applicable to a manufacturing arsenal or had to be interpreted so

broadly that their effectiveness was entirely lost.

Having two "masters" was not an expediting factor. Considerable time and energy were spent in determining which had jurisdiction in certain matters—the service command or the technical service. The Arsenal's verdict on this matter: "Actual experience at this installation has demonstrated that dual operations, supervision, and administration are expensive, duplicating, and should be avoided if possible."

The Arsenal also pointed to poor coordination between services, "particularly with respect to the Ordnance Department." In the majority of cases, orders received from Ordnance and OC CWS did not agree as to the quantity of production. This caused considerable administrative expense to correct and much waste in operating units due to administrative indecision. The Arsenal attributed the predicament to a lack of coordination between staff offices of the chiefs of the technical services.

Operational Problems

The speed with which the Army built its war machine and attendant manufacturing facilities was a major factor in winning the war. However, construction forces, in their desire for speed, gave little consideration to the problems of operation and maintenance. This resulted in the replacement or revision of much of the original equipment and in the use of excessive operating personnel.

Production difficulties arose from having to develop, from basic design or, in some cases, from "scratch," efficient production facilities; lack of adequate engineering in basic production equipment design; new production procedures; many types of end items to produce; the type of

product, which presented many physical hazards; short-term operations (one and two months), including emergency requests; lack of a large program from which economies of mass production could be achieved; faulty components; and the dispersion of plants.

Original design of the operating lines included practically no facilities for storage of components. (The mustard, white phosphorus, and M69 — M74 filling plants were exceptions.) This condition made frequent deliveries on closely coordinated schedules necessary, to insure uninterrupted line production. One of the big problems was the disposal of obsolete and excess material. This occupied a considerable portion of storage space needed for current items. Igloo storage proved very unsatisfactory for current items because of the igloos' geographical location, their size and shape, and the dampness in them that tended to deteriorate any stored material.

The dispersal of warehouses, magazines, and igloos over many square miles tended to make supervision difficult. Also, most of the warehouses were ground level, and this necessitated much additional labor in loading and unloading materials. The lack of materials handling equipment such as lift trucks, conveyors, and carts seriously hindered proper handling.

The Arsenal, like many another organization, was not free from packaging problems. The non-standard packaging of components received from district contractors caused many troubles. For example, parts for the E46 cluster, particularly the clamp, were usually thrown into an empty truck with no marking and no uniform stacking. The person who opened the doors of the trailer when it arrived at the Arsenal courted

danger by running the risk of having the entire load shift upon him. In addition to this, three times as many people and many more hours were required to unload the truck. Many of the heavy parts were shipped in light wrapping paper and poorly constructed corrugated cartons, containing no marking and thus forestalling uniform storage in warehouses. Such shipments often resulted in "lost" parts simply through inability to identify them. Improper packaging also allowed metal components to rust and become absolutely unusable.

In April 1942 when Huntsville Arsenal started to manufacture, production was dependent on the supply of components, available trained personnel, and the successful operation of the manufacturing plant or filling line. There were no schedules to meet or forecasts to make. The prevailing idea was to produce everything possible. This policy continued until May 1943. After that, definite schedules had to be established so that end items produced at the various arsenals would balance in a satisfactory manner.

In forecasting production schedules, the usual procedure was to call a meeting of all interested division and department chiefs to discuss capabilities and requirements. A Redstone Arsenal representative always attended to assist in coordinating delivery of Ordnance components for filling with CWS material and to schedule Ordnance production consistent with line operations at both Arsenals.

According to official production reports, by the end of the war Huntsville Arsenal produced munitions having a value of \$134,589,951.86. In recognition of its production record, the Arsenal received the Army-Navy "E" Award four times, the first on 31 October 1942.

Summary

During its lifetime, the Arsenal produced many new munitions and did some development work with good result. The Chief, CWS frequently requested Huntsville Arsenal to perform difficult production tasks to meet emergency conditions. While economy may have been sacrificed to expediency in some cases, the work was generally accomplished in sufficient time to meet the requirements of the situation. Taking into account the fact that very little experience was available upon which to base design, organization, or operation, the results achieved were remarkable. Although many things could have been done in a more unhurried atmosphere to improve administration and operation, wartime conditions did not permit a refined study of each situation before reaching a decision. But the fact remains that critical production dates were advanced and met. Production was doubled, tripled, or cut back as schedules changed rapidly to conform to changes in Army requirements. The large number and different types of items educated much emergency effort. It may be safely stated that Huntsville Arsenal was truly the industrial pioneer of the Chemical Warfare Service. The experience gained, both in the construction and operating phases, perhaps equaled its contribution in the production field in that it formed the basis for the success of later CWS arsenals.

V. DEMOBILIZATION, 1945

Impact on Mission and Manpower

The major effect of V-E Day on Huntsville Arsenal was that production schedules for certain smoke munitions were altered to meet new requirements and increased emphasis was placed on the production of white phosphorus munitions, mustard bombs, and incendiary bombs. There were no personnel reductions.

The impact of V-J Day was the immediate stoppage of all production activities except certain work in the Field Equipment Repair Shop and Chlorine Plant No. 1. On 20 August 1945, the Chief, Chemical Warfare Service issued instructions to put certain plants in "standby storage" and others in "standby under power." On 11 September this policy was changed to place all plants in standby storage, thereby reducing the Arsenal's workload considerably. Lacking sufficient time to process reduction-in-force papers on personnel no longer needed, the Arsenal placed many on furlough pending the development of RIF procedures. A case in point was the Operations Division. On 9 August 1945, it had 2,197 per diem employees and 152 per annum employees. On 25 October, it had 59 and 36, respectively.

How to effect an equitable reduction in force while some divisions were reducing rapidly, others maintaining their former strength, and some were increasing, posed a real problem. As already seen, the Operations Division cut back drastically, but Personnel, Transportation and Property proceeded more gradually. The Gulf Depot was acquiring

additional activities, however, and a gas mask assembly plant was to be in operation by January 1946. Since the entire Arsenal, including the Depot, was one competitive area, the trick was to conduct a reduction in force without upsetting the functions of those organizations with work to be done. The demobilization picture was further confused by the return of a large number of veterans with re-employment rights. A number of voluntary resignations after 14 August offset this to some extent. Another complicating factor was that resignations and transfers of Civilian Personnel Division employees exceeded the need for reduction, leaving barely enough people to do the work and necessitating some overtime. The division's 109 civilian employees on hand on 9 August had dwindled to 52 by 1 January 1946.

The Fiscal Division suffered a hardship in demobilization because RIF quotas applied to this division took no consideration of the fact that fiscal matters—including records, accounts, and liquidations of obligations—would lag the rest of the demobilization program by about 120 days.

In the procurement area, the main problem was the delay in getting decisions from using divisions as to whether or not material on order could be canceled. This in turn was a direct result of the indecision as to what the Arsenal's status would be. If a clear-cut picture could have been furnished before V-J Day, contract terminations could have been made faster, with a saving to the Government.

V-J Day and the period of demobilization brought a period of increased activity for the Property Division, as a double mission remained for completion. Early in 1945, the division began an

inventory of all maintenance and supply warehouses and the return of all stock cards to the stock records section as accountable records. The complete shutdown of manufacturing activities made hundreds of components surplus, and several thousands of maintenance items became surplus because of the curtailment of maintenance activities resulting from the shutdown of manufacturing plants. Declaration of surplus property of all kinds had begun with the institution of the Redistribution and Salvage Program in 1943.

In order to expedite this two-fold mission, the Property Division requisitioned personnel from other divisions, particularly Operations. This influx of personnel lasted until early October, when a peak strength of 340 was reached. After that the division had to reduce to meet its December ceiling of 200 civilians.

The Property Division had anticipated that, very soon after V-J Day, the shipment of component items, maintenance, and general operating supplies would cease as soon as shipments which were already en route had been received. It did not expect that termination inventories would be shipped to Huntsville Arsenal from CWS contractors and plants. However, it was soon learned that several million dollars' worth of "goop" which remained from the M74 program would be shipped from a Chrysler Corporation plant at Evansville, Indiana, and it was necessary to lay out additional open storage areas for this material. Several new areas were selected, none of which was near the railroad tracks, so that considerable hauling was necessary.

After the war, an additional duty given to the Safety Division was the investigation and compilation of claims submitted by Arsenal

personnel against the Government for injuries sustained by them in the course of their employment.

The Medical Department encountered extra work when it had to administer termination physical examinations to thousands of employees who were leaving the Arsenal. This assignment generated a greater workload for the Medical Department than it had had during full-scale production.

Signal operations decreased significantly after V-J Day. The use of Government-owned teletypewriter equipment was discontinued in December 1945 because of reduced telegraphic traffic. Also, one shift was eliminated at the Gulf Depot, but this affected only one employee.

A perplexing element impeding the demobilization of the Transportation Division was the lack of accurate information concerning the mission and extent of operations for the Arsenal as a whole after V-J Day. At first, the division made personnel reductions on the assumption that, should cut-backs be made too quickly, those that were left could work some overtime if necessary. Then an order practically eliminated overtime. In some cases, personnel had to be called back when others resigned. The greatest problem was trying to coordinate activities with other divisions, whose requirements were also indefinite.

Apparently, from the beginning of the construction of Huntsville Arsenal, the function and place of the Arsenal in the postwar era was unknown. At least, the governing factors were not available prior to V-J Day. Therefore, local plans had to be developed rapidly after the policies of higher authority were clearly outlined. As these policies evolved gradually, attendant lost time and inefficiency resulted.

However, in view of the sudden end of the war and the impact of the atomic bomb on political and military thinking, a certain amount of confusion concerning the future of an installation of this type was perhaps inevitable.

Another demobilization problem that arose was the lack of understanding by employees and townspeople of RIF procedures followed in civil service. The use of efficiency ratings in determining retention points brought numerous complaints about the emphasis placed on these ratings as compared with seniority and about the accuracy and fairness of such ratings. Pressure from veterans' organizations created numerous problems for the Commanding Officer in connection with discharging and employing veterans.

As a result of uncertainty as to the duration of their jobs and a general letdown after the war, it became more difficult to obtain a good day's work from some employees. This made demobilization costs higher than would have been the case if all employees performed according to their best ability. This situation was most apparent in the various maintenance and construction trades and labor groups.

Demobilization of military personnel appeared to be too slow in that insufficient work was available to keep all officers busy enough to justify their presence. Some officers were extremely busy, especially those engaged in standby work, property disposal, and personnel work, while others, particularly those assigned to production activities, had little or nothing to do.

Effect on Activities and Facilities

After all manufacturing plants were ordered placed in standby storage, the Chief, Engineering Service Division appointed a survey board to inspect every plant on the Arsenal. All equipment was put into the proper condition so that it could stand idle for a long period without deterioration. Buildings were repaired so that they could withstand vacancy. The survey board had covered the entire Arsenal and Gulf Depot by 1 October 1945. By 30 November, the actual work was complete.

Prior to V-J Day, about 100,000 M54 thermate cluster bombs were stored at the Gulf CW Depot. Although obsolete, they were not destroyed because of the shortage of labor. The return of many munitions and materiel to Huntsville Arsenal placed a premium on storage space. As the igloos were needed for other items, the destruction program was started, being complete by 5 November 1945.

A burning area for the M54 incendiaries was located in an isolated section of the Arsenal, near the east boundary and about one mile south of Huntsville Spring Creek. Some years before the establishment of Huntsville Arsenal, the Tennessee Valley Authority, in prospecting the area for gravel, had dug out a number of pits about 15 feet deep and about 25 yards wide and 100-200 yards long. These pits were ideal for disposal of debris after destruction.

Crews of men loaded bombs from the igloos to flatbed 1½-ton trucks for transportation to the burning area two miles away. There, an unboxing line was set up. A roller conveyor facilitated movement of the boxed bombs. Four men unloaded boxed bombs off the truck and onto the conveyor. As the boxed cluster passed down the line, other crew members

broke the banding straps, pried off the nailed top, opened the inner metal box, and removed the bomb cluster. Another flatbed truck then carried the cluster to the burning site about 500 yards away.

At the burning site, clusters stacked in two parallel and immediately adjacent rows about 100 yards long were ready for firing at the end of each day. To minimize the hazards of the operation, two grenades were wired tightly to a cluster near the center of one of the rows. A cord about 200 yards long was firmly tied to the safety pin rings. When all persons had retired at least 300 yards, the officer in charge of the operation pinched the cotter safety pins with a pliers so that they might be pulled without breaking the cord. He then went to the extreme end of the cord, and the grenades set the clusters afire. It took about 15 minutes for 2,500 clusters to burn. As explosive powder was present in some of the clusters, burning material was scattered over a wide area.

An interesting sidelight concerns the disposition of empty boxes. During the first week of the destruction operation, empty wooden boxes were hauled about four miles to the salvage yard for public sale. The demand was good. The second week, civilian trucks were permitted to load at the unboxing line, so that only the unsold boxes had to be crated to the salvage yard. Soon, all boxes were loaded directly onto civilian trucks as buyers vied with each other to obtain them. The extreme shortage of building lumber created the demand. Consequently, many postwar houses in Huntsville were floored and sheeted with former M54 containers. It was estimated that receipts for box sales (25¢ a box) paid for the cost of carrying out the destruction program.

With the cessation of manufacturing, the demand for electrical

energy dropped from 17,000 kw to 3,000 kw and later to 2,000 kw. As an economy move, one of the two primary substations at the TVA taps was removed from service. In October 1945, the turbo-electric generators at Huntsville Arsenal were shut down and placed in standby storage.

The Office of the Chief, Chemical Warfare Service on 13 October 1945 authorized the establishment of a gas mask assembly line, to be shipped from Johnson and Johnson Co. On 6 November six foremen were hired to begin training in the gas mask program. Building 481 housed the operation, which began in January 1946.

Immediately following the war, there was a general demand for the return to civilian enterprise of the lands and facilities taken over by the Army during the emergency. Before this could be done, the Army had to decide what facilities and properties should be retained for peacetime use as insurance against another war.

On 21 May 1945, the Chief, Chemical Warfare Service, had appointed a survey board headed by Col. Harry W. Spraker to study this matter and make recommendations. This board, on 23 June 1945, recommended the retention of Huntsville Arsenal in toto for primary production of smoke materiel and emergency production of chemical agents. Later directives from CWS indicated that any lands not required for the operation of the peacetime program should be leased for agricultural use. By early 1946, the Post Engineer had leased more than 5,000 acres for the growing of small grains. On 9 January 1946, CWS arsenal commanders meeting in Washington decided to lease to private enterprise any facility not required for postwar use, provided such leases were advantageous to the Government and were so drawn that the Army could quickly recover

possession if necessary, and provided that the lessee should make no changes in manufacturing facilities that would prevent their rapid conversion to their original purpose.

VI. GULF CHEMICAL WARFARE DEPOT

Since Gulf Chemical Warfare Depot and Huntsville Arsenal operations were so closely intertwined, a description of the former's activities seems appropriate at this point before proceeding with the Arsenal's postwar history.

Authorization

On 21 July 1941, the Zone Construction Quartermaster, Atlanta, Georgia, submitted a report^{*} covering plans for the acquisition of land on which to build Huntsville Arsenal. Of the 32,244 acres of land comprising this tract, 7,756 acres were to be used for construction of a depot area, to be located in the extreme south portion, the Tennessee River forming the southern boundary. By mid-December 1941, plans for the project were completed.

On 2 January 1942, the Chief, Plants Section, Engineering Branch, Office, Chief of Engineers, authorized the Division Engineer, South Atlantic Division, to proceed with the construction of a CWS depot at Huntsville, Alabama, which was to have facilities for storage of 20 million units, at an estimated cost of about \$4.8 million.

*"Preliminary Plans for Acquisition of Siebert [sic] Arsenal, Huntsville Ordnance, Madison County, Alabama." The Chemical Warfare Service first proposed Sibert Arsenal as the name of its new arsenal in Huntsville in honor of Gen. William L. Sibert, who established the first Chemical Warfare Service in World War I. However, since a Chemical Warfare Service training center was being contemplated for Gadsden, Alabama, the general's home town, the name Sibert was saved for it.

On 14 February 1942, the Adjutant General authorized the Chief of Engineers to begin construction of the Huntsville Chemical Warfare Depot as part of the Depot Storage Program, at an estimated cost of about \$9.2 million, with more storage facilities than previously planned.* The Depot was to be an exempted station under the direct control of the Chief, CWS.

Framework of Operations

Immediately before his Huntsville assignment, General Ditto was Commanding Officer at the Pittsburgh Chemical Warfare Procurement District, where his Property, Transportation, and Fiscal Officer was 1st Lt. William C. Behrenberg. In November 1941, the general invited the lieutenant to come to Huntsville in December to consider being the officer in charge of the Depot Storage Division. On 7 December 1941, Pearl Harbor Day, the general and the lieutenant toured the site of the proposed Depot.

On 15 January 1942, Lieutenant Behrenberg reported for duty as Chief, Storage Division, Huntsville Arsenal. When, on 6 March 1942, the Depot was activated as a separate post, to be known as Huntsville Chemical Warfare Depot, now Captain Behrenberg assumed command of it, being the only officer assigned. On 1 October 1942, General Ditto was designated as Commanding General, Huntsville Chemical Warfare Depot in addition to his other duties as Commanding General of Huntsville Arsenal,

* See pp. 5-6.

whereupon Captain Behrenberg became Executive Officer of the Depot. To avoid confusion with the Arsenal, the War Department changed the name of the Depot on 10 August 1943 to Gulf Chemical Warfare Depot. The word "Warfare" was dropped from its title as of 2 August 1946, and, effective 25 September 1946, the Depot was classified as a Class II installation under the Chief of the Chemical Corps. The Depot and the Arsenal continued to share the same commander until 15 January 1947, however, when the Depot was abolished as a separate entity and its functions transferred to the Arsenal.

The mission of the Depot was the receipt, storage, and shipment of CWS materiel. Coming from all CWS arsenals, procurement districts, and other depots, such materiel included all types of CWS munitions, bulk chemicals, decontaminating apparatuses, and protective materials.

The Depot covered approximately 12 square miles. While it was being built, its headquarters was at first established in a temporary barracks building at Huntsville Arsenal. Its permanent headquarters was an old mansion, originally owned by James Cooper, that was built in 1818 and added onto in 1840. The Depot boasted 12 miles of railroad track, plus spurs, two water-treatment plants, and dock facilities on the Tennessee River. The Engineering Service Division of Huntsville Arsenal, not the Depot, operated these facilities. By 1943 the Depot maintained seven warehouses, 370 igloos, 55 above-ground magazines, and many outdoor storage areas for various types of bombs and chemicals.

Fifteen civilians were hired in March 1942. Two more officers and 93 civilians had joined the Depot by the end of May 1942. The organizational structure was a Commanding Officer, Executive Officer, and Adjutant.

Each of the officers performed multiple functions; for example, the Executive Officer was also Property Officer, Stock Control Officer, and Transportation Officer. Officer strength reached a peak of 17 in late 1944. Civilian strength crested at 656 in July 1944.

Reorganization took place at various times as additional officers reported for duty. These reorganizations redistributed the workload to relieve overburdened officers of multiple functions. The principal reorganization occurred in March 1945, when the Depot was organized along the lines prescribed in Army Service Forces Manual 417.

Complete decentralization was not achieved until April 1945. At that time the organization consisted of a Commanding Officer, an Executive Officer, and the following divisions: Administrative, Control, Fiscal, Stock Control, Transportation, Storage, and Military Training. The chiefs of the various divisions reported to the Commanding Officer through the Executive Officer.

Huntsville Arsenal provided service and support in the areas of civilian personnel recruiting and processing, intelligence and security, safety, and public relations. The Depot did maintain its own Civilian Training Branch, however. The Post Engineer, Huntsville Arsenal, performed all utilities functions and some maintenance and repair.

As of 1 April 1945, the CWS augmented the Depot's mission by directing the Depot to receive, store, and issue gas mask spare parts. The Indianapolis Chemical Warfare Depot had previously performed this mission.

The Depot had no office buildings designed as such. As already noted, the Administrative Building was a converted residence, and warehouses provided other office space. There were no garages, but a small barn

served the same purpose at the quarters reserved for occupancy by the Commanding Officer. A shed provided accommodations for five more cars.

Operations

The Gulf Chemical Warfare Depot's operations usually proceeded along the following pattern. When the Depot received advance notice of arriving shipments, it planned warehousing by assigning space for storing, designating the type and amount of equipment to be used in unloading, and determining the number of men required for each operation. In doing this, the Storage, Stock Control, and Transportation Divisions exercised the closest cooperation. As soon as supplies were unloaded, a checker entered the location of each lot on a sheet which he turned in to the officer in charge of the branch concerned—Munitions, Warehouse, or Toxic Gas Yard. The information was then entered on a stock location card, chart, or plot and sent to the Stock Control Division for incorporation into the records. Pallets or dunnage were used in storing all supplies, whether inside or outside.

The Toxic Gas Yard was the first of the Depot's branches to go into operation. It received a shipment of 500,000 pounds of mustard gas in 55-gallon drums early in 1942. This shipment came before any storage space was constructed and when there were only "15 to 30" employees at the Depot. Other chemicals received during this early period were phosgene, carbon tetrachloride, and white phosphorus. Toxic yard records were kept in a shed located in one of the drum yards, and during the high water of 1942, this shed became flooded and all records were rendered useless.

The Munitions Branch went into operation in August 1942. Igloo and

magazine construction was completed in October. Records for both this branch and the toxic yards were kept by one man, equipped with a portable typewriter, who traveled from point to point recording operations. The locator system consisted of manila folders, one for each item, that listed the complete nomenclature and the place of storage.

The warehouses were also completed in October 1942; however, supplies were being shipped in before the roofing was all on. One of the first warehouse operations was reworking bombs for Huntsville Arsenal.

Originally all materials were handled by labor^{*} only, but after July 1943, the introduction of mechanical equipment, such as fork-lift trucks, tractors, and trailers, materially cut down handling costs and reduced labor by about 20 per cent.

One of the first attempts at mechanization was the use of a motor-driven conveyor belt in storing M6 and M8 bomb clusters. This proved impractical without stacking equipment. Too much material piled up at the igloo since the men could not stack fast enough to keep up with the belt.

The main access roads into the Depot, igloo areas, and warehouse areas were hard-surfaced early in 1942. In May 1942, Huntsville Arsenal lent five trucks, and the Depot's equipment was augmented by a locomotive crane in June. Some fork lifts were acquired in October 1942, as were warehouse tractors. Semi-finished, hard-standing open storage pits, with hard-surfaced access roads, were finished in May 1943. Wooden loading and unloading docks at railroad spurs were built in 1944. Prior to this, railroad cars were unloaded by backing trucks to the car doors.

* According to one account, "whiskey and manpower." Reportedly the only piece of equipment assigned upon establishment of the Depot was one Ford station wagon.

Two more open storage areas, with semi-finished storage pits and graveled access roads, were completed in 1945.

Each of the Storage Division's four branches had an officer, a civilian superintendent, and one or two field foremen. Each crew was under the direct charge of a "gang boss." The officer and superintendent preplanned a day's operation and gave job tickets to the "gang bosses." This ticket explained the operation in detail and served as a time sheet when it was filled in by the foreman. In order to avoid loss of time from transferring from one job to another, one gang was kept on a single job for an entire day if at all possible. An inspection crew opened freight cars on arrival and inspected the packing and bracing. When necessary, they sorted the material as to classification.

The Depot completed a cycle inventory about every four months. In addition, special inventories and spot checks were made when requested. Inventories were taken by item. The stock records and stock on hand, especially in the ammunition area, were not always in agreement. At times adjustments ran as high as 30 per cent. Upon occasion, adjustments made after one inventory had to be reversed after the next inventory. Improvements in the locator system yielded greater accuracy, however.

On 13 August 1945, upon instructions from the Chief, Chemical Warfare Service, the Depot discontinued processing ammunition for shipment and returned such ammunition to stock. Since the Depot assumed that it would receive a large quantity of material from production plants, ports of embarkation, and overseas, it expected to continue postwar operation and made no immediate demobilization plans.

As anticipated, storage activities remained busy. The average

tonnage in November 1945 was 869.3 tons a day. Most of this accrued from munition shipments that had been diverted en route to ports or that were being returned from ports or overseas. Another contributing factor was the inactivation of the Indianapolis Chemical Warfare Depot and the assignment of its mission to the Gulf Depot on 1 October 1945. Indianapolis was concerned with the storage and issue of all spare parts for CWS items. Movement of material from Indianapolis began on 1 November 1945. A Classification Branch, to classify, segregate, and process returned material for salvage or other disposition, had already been established in August.

As of 31 December 1945, the Gulf Depot employed 629 civilians and 17 military. By 30 June 1946, only 379 civilians and 10 officers remained on the rolls, the residue from cutbacks. To conserve personnel, the Depot and Huntsville Arsenal consolidated their redistribution and salvage and fiscal activities. Civilian authorizations soon increased at the Depot, however, in order to segregate and classify all ammunition and decontaminate foreign war gases, and by December 1946, employees numbered 554, plus 11 officers. As already stated, effective 15 January 1947, the Arsenal absorbed the Depot.

VII. THE POSTWAR YEARS, 1946-1947

Ups and Downs

A graphic depiction of Huntsville Arsenal's life cycle would resemble a bell-shaped curve—roughly, four years of buildup followed by four years of phasedown. Personnel ceilings were lowered beginning in January 1946, but authorizations crept up again by June 1946. After V-J Day, Arsenal officials assumed that further production operations would not be undertaken in the foreseeable future, as higher echelons stressed the necessity of rapid reversion to a complete standby status. Consequently, Production Division employees were dropped from the rolls as quickly as the Personnel Division could complete termination processing.

On the other hand, the Property Division, having suffered a drastic curtailment of personnel as of 31 December 1945, acquired a gigantic new workload. This was the added responsibility of receiving, storing, and issuing all components for the Gas Mask Assembly Plant scheduled to begin operation in March. Approximately 750 carloads of new, used, and salvage components arrived at Huntsville Arsenal in the six months after V-J Day. These were unloaded into whatever space was available at the time.

A second responsibility of considerable magnitude was added when Huntsville Arsenal was designated as a storage center for vast quantities of production equipment to be placed in war reserve. Thus, practically every available building was put into service as a storage warehouse—manufacturing plants, fire halls, and open sheds.

The main effort of the Arsenal in 1946 was directed toward rapid completion of the standby program. The July 1946 ceiling on per diem workers, however, allowed only a relatively few laborers and craftsmen to do the job. A November allotment of 392 more civilians sped up operations in the Engineering Service; Property; Redistribution, Salvage and Surplus Property; and Transportation Divisions, where the main standby effort was concentrated. Another minor retarding factor was that at no time did the Arsenal completely shut down production operation schedules, as various programs, such as gas mask assembly, fifth echelon repair, and toxic gas transfer, were in progress.

There was no change in the land area of Huntsville Arsenal and the Gulf Depot except for 475 acres of land in the southeast corner of the reservation taken over by Redstone Arsenal, for the building of Line 6, on 20 March 1945.

Surplus Property

Indicative of the demobilization turmoil succeeding V-J Day was the plight the Redistribution and Salvage Section of the Property Division found itself in in early 1946. It had declared most of the surplus property to the disposal agencies by 1 January 1946, only to find that 90 per cent of the declarations were incorrect. This snafu resulted from a failure to tag or identify surplus property and separate it from stock property. So, in February 1946, the Arsenal withdrew all the declarations it had made to the War Assets Administration and started to tag the property properly, correct errors in nomenclature, and redeclare.

Natural Disasters

Two natural disasters affected Huntsville Arsenal in early 1946. During the last few months of 1945, rains were particularly heavy in the Tennessee River watershed area above the Arsenal. On 9 January the river reached flood stage at 566 feet above sea level and stayed above this level for six days. All roads to the Gulf Chemical Warfare Depot were blocked, and employees at the Water Treatment Plant went to and from their work by boat. After the water receded on 16 January, the major damage found was a washout of about 100 yards of macadam highway and 300 yards of railroad track leading to the Huntsville Arsenal docks on the Tennessee River. The railroad was repaired in five days.

During the afternoon of Sunday, 7 April 1946, at 1725 hours, a hail storm swept diagonally across the Arsenal from northwest to southeast. It was of a severity never before seen in north Alabama, and during its 12 minutes' duration, the wind velocity reached cyclonic proportions. A terrific shower of hail fell, some of the largest stones being over three inches in diameter. They were of such size and were traveling so rapidly that, in some places, they penetrated roofing, one-inch-thick decking, and the ceiling below. Over 4,000 windowpanes were broken, and 700 buildings suffered damaged roofs, some of them a total loss. Also, the approximately 15 miles of outdoor steam pipes on the Arsenal took an awful beating. In some cases, the hail tore the entire covering from the pipe. The total damage cost \$102,000 to repair. The need for repair to buildings was so urgent that 58 more men were hired for 60 days to repair the storm damage. No work was done immediately on

the steam lines because the Corps of Engineers did not allocate funds for repairs. This delay caused additional expense. For example, heavy rainstorms soaked the insulation on the pipes, increasing the steam loads in the plants. On one occasion, a rainstorm, lasting about 30 minutes, caused the excess burning of about 20 tons of coal within a few hours. Repairs of all kinds were completed during the year.

Leasing of Chlorine Plants

Perhaps the most "newsworthy" event of mid-1946 was the leasing of Chlorine Manufacturing Plants No. 1 and No. 2 to the Solvay Process Division of the Allied Chemical and Dye Corporation of Solvay, New York, in September. Climaxing several months of negotiations, this 5-year lease provided that the lessee would put the plants in an operating condition and that, upon expiration of the lease, Solvay would place all facilities in a standby condition, thereby saving the Government many thousands of dollars in standby processing. The Government would furnish utilities—steam, water, electricity, and telephone service—at a pro rata cost. This arrangement was calculated to work to the advantage of the Government in that greatly increased demands occasioned by operation of the chlorine plants would lower unit costs for that portion of utilities used by the Arsenal, since only a few more employees would be required.

However, inclusion of this clause meant that a detailed cost system, not otherwise required, had to be instituted by the Arsenal, necessitating additional clerical manhours at a time when such manhours were critically short. A flat rate system, based upon previous experience, would have prevented this situation. Also, the terms of the lease were so

general that the contract was often referred to as a "gentlemen's agreement" between the Government and the corporation, leaving much leeway for different interpretations.

One Solvay plant began operating on 14 December 1946 and the other in May 1947. As a result, steam usage on the Arsenal increased from 30,000 pounds per hour to 100,000 pounds; pumpage of industrial water rose from 1 million to 11 million gallons per day; and electricity consumption amounted to 16,000 kw as compared to the previous 2,000.

Austerity

In the last half of 1946, lack of funds became a limiting factor in Arsenal management decisions. Previously, adequate funds had existed for nearly every activity, but the availability of personnel was the limiting factor. Now the reverse was true.

The shortage of per annum employees hampered the operation of the Arsenal. Because of its vast size and the dispersion of its manufacturing and storage areas, Huntsville Arsenal required an unusually large guard and fire force. (At one time, more than 700 people were engaged in such activities.) Therefore, a large number of its per annum employees had to be committed to such services.

The workload in the Civilian Personnel Division remained high as personnel cuts became more drastic. Reduction-in-force procedures were changed to permit War Department agencies to separate employees instead of carrying Retention Groups A-1 and A-2 on 1-year furloughs and Groups A-3 through B-1 on 90-day furloughs.

Depot Absorbed

Effective 15 January 1947, with the discontinuance of the 9711th Technical Service Unit-Chemical Corps Detachment 2, the Gulf Chemical Depot ceased to exist as a separate organization. After that date, it was incorporated into Huntsville Arsenal, its functions being performed by the newly established Gulf Chemical Depot Division, renamed "Activity" on 26 March. This was part of a general consolidation move at the Arsenal as activity decreased and personnel strength declined.

Reorganization

The organizational structure that had evolved by 26 March 1947 featured three primary activities: Administrative and Maintenance, Depot, and Inspection. The Administrative and Maintenance Activity included the Adjutant; Redistribution, Salvage and Surplus Property; Production and Procurement Planning; Property; Engineering Service; Internal Security; Special Services; Post Inspector; Civilian Personnel; Transportation; Finance; Post Engineer; Signal; Surgeon; Public Relations; and Fiscal. The Control Division established on that date reported directly to the Commanding Officer. The Security and Intelligence Division, created on 21 April, and containing internal security as a branch, came under the jurisdiction of the Executive Office. On 7 April, the Property Division was transferred to the Gulf Chemical Depot Activity. But, effective 15 September 1947, the Property Division was reassigned to the Administrative and Maintenance Activity.*

* See also page 75.

Curtailed Operations

Most of the Arsenal's early 1947 effort was directed toward readying the Arsenal for standby status. Some reduced activity continued, however. In January 1947, the Fifth Echelon Repair Shops were given an order to manufacture 135,510 M7A1 CN (tear gas) grenades. After the Shops manufactured 1,000, the program was transferred to Edgewood Arsenal.

In March the Shops began a program of demilitarizing M4 smoke pots,* but the operation closed down in June because the reduction in force left no one to do the work.

Toxic gas operations involved those actions necessary for public safety. This included transfer of British mustard gas from 55-gallon drums and land mines to Type "D" ton containers. The transfer of German mustard gas from bombs to such containers began in February 1947. Numerous advances in the handling of foreign toxics, particularly German, were made, thereby avoiding serious injury to any employee. Two employees won awards for devising tools—a scoop to remove TNT from German mustard bombs, and a wrench to remove the protective cap from Green Ring Three bombs.

Demilitarization of lead spitter fuzes, accomplished in January 1947, yielded 5,000 pounds of lead. Some 845,400 M200A1 and M200A2 fuzes were melted down into 56,162 pounds of zinc alloy diecast. Over 3,000 155-mm white phosphorus shells had been salvaged by June 1947. The entire program, involving 10,835 shells, was completed on 10 October.

* A somewhat ironic sidelight to a safety inspection by an Army-Navy Explosives Board Representative in March 1947 was a smoke pot fire that erupted during his visit.

The Property Division shipped 8,264 tons of material and received 66,716 tons. As gas mask hose tubes in bulk storage were deteriorating rapidly, 20 men worked for 75 days to rebox two million of them. About \$300,000 worth of war reserve components was declared surplus or salvage.

Beginning in February 1947, 200 Third Army area motor vehicles within a radius of 150 miles of Huntsville were satellited on the motor pool for field maintenance.

Work continued on preparing buildings and equipment for standby storage. In general, this meant preservation against corrosion, weathering, and other effects of time and disuse. Although all the buildings in Plants Area No. 3 were worked over in 1946, all the unused facilities in Plants Areas No. 1 and 2 remained untouched. In order to complete the program before funds expired in June 1947, the Arsenal hired 165 temporary per diem workers.

On 29 April 1947, the installation was authorized to reopen a 25-bed station hospital effective 4 May. After that, patients were not transferred to other hospitals except for major surgery.

The Redistribution, Salvage and Surplus Property Division declared \$67,851 worth of property surplus from January-June 1947. During this same six months, it withdrew \$5,265,033 worth from surplus. The value of surplus property shipped during this period was \$1,107,315. What it could not sell, the Arsenal planned to donate to educational institutions, veterans' organizations, or other deserving activities. Farm land under lease in June 1947 covered 7,120.39 acres.

Combined disbursements for Huntsville Arsenal and Redstone Arsenal

amounted to \$3,431,167.91 for the period January-June 1947. During the six months, the Payroll Section issued 6,114 payroll checks, totaling \$642,347, to per annum employees, and 17,777 checks, totaling \$1,203,633, to per diem employees.

Civilian personnel strength was at such a low level by 13 June 1947 that military personnel had to take over the security of the Arsenal. At that time there were three officers and 46 enlisted men. They manned four fire stations, Gate No. 1, two prowl cars, and the radio room. Additional personnel arrived by the end of the month, however.

In short, this was a period of downward adjustments and lowered morale generally.

More Leases

Building 481, formerly devoted to the manufacture of gas masks, was leased to Keller Motors Corporation (formerly Dixie Motor Car Corporation) in August 1947. This was a 15-year lease with a recovery clause, in case of national emergency. Either the Government or some other agency would furnish utilities on a pro rata basis. The plant was to be used for manufacturing, assembling, testing, and selling automobiles and related products.

The Calabama Chemical Company leased Buildings 754, 755, and 756, which were originally designed for the manufacture of thionyl chloride. The company planned to manufacture organic chemicals, insecticides, and related products during the term of this 15-year lease. The Arsenal permitted Fine Organics, Inc., to store surplus materials in Building 721 under a 5-year lease signed on 17 July 1947.

Arsenal Declared Surplus

The most significant development of 1947 was the receipt of verbal notification on 30 September that Huntsville Arsenal was being declared surplus to the needs of the Department of the Army. This decision occasioned a complete change in planning for future operations, as the prime mission of the Arsenal became expeditious removal of production facilities and all stocks of munitions and materiel. The first phase of deactivation concentrated on removal of all spare parts stocks from Depot storage locations to Edgewood Arsenal, Maryland. The second phase consisted of inspection and classification of large quantities of stored munitions and materials to determine serviceable stocks for shipment to other Chemical Corps installations. The third phase centered on the determination of priority schedules in the shipment of serviceable stocks, production facilities, and manufacturing components. The inspection phase uncovered large quantities of unserviceable items for disposal.

Reoriented Activities

The deadline date for complete deactivation of the Arsenal was March-June 1949. All planned work, including renovation, demilitarization, and segregation and classification of munitions and materiel, was speeded up to achieve this. Also, all procurement planning schedules had to be transferred to other arsenals.

On 30 October, most personnel of the divisions of the Administrative and Maintenance Activity and the Inspection Activity were made part of the Depot Activity for personnel accounting purposes. Also included were Control and Security and Intelligence. Excepted categories in the

Engineering Service area were those engaged in lessee utilities, stand-by plant maintenance, and railroad track maintenance.

The Depot Activity made tentative plans for the deactivation of its Spare Parts Section and the reassignment of the latter's mission to the Eastern Chemical Depot, Army Chemical Center, Maryland. The Depot Activity received 43,570 tons of general supplies and 716 tons of ammunition. It shipped 3,022 and 3,896 of each respective category.

The Munitions Section embarked on a renovation program for M76 500-pound incendiary bombs in October, but bad weather caused it to be suspended in December 1947. The program of transferring foreign toxics from 9,338 bombs to ton containers was completed in November 1947. The demilitarization of M4A2 smoke pots started on 14 October 1947. On 15 December, a program was begun to refuze and repack 7,091 such pots.

On 1 July 1947, there were about 4,000 tons of industrial reserve machine tools and equipment stored by the Property Division. During the rest of the year 29 more tons came in, while 86 tons were shipped out. Also during this period, 108 tons of miscellaneous manufacturing components and 9,500 tons of miscellaneous equipment and supplies arrived. Outgoing tonnage was less—1,913 tons of miscellaneous manufacturing components, 288 tons of excess supplies and equipment, and 41 tons of miscellaneous equipment.

The total tons of surplus and salvage property shipped from July-December 1947 was 9,513. Property declared surplus during this time was valued at \$2,627.22. The value of that withdrawn from surplus was \$102,839.23. The value of property donated to educational institutions amounted to \$2,062,267.87. Combined disbursements for the two Arsenals totaled \$2,620,990.75.

VIII. DEACTIVATION, 1948-1949

The artist who drew the cover for the 1948 Huntsville Arsenal History pictured a black, swirling tornado, its funnel labeled "Deactivation," striking at the topography of Huntsville Arsenal. Before 1948 apparently it was not abundantly clear to the rank-and-file employee that the entire Arsenal would be affected. Even the management seemed to cherish some hope that the depot function would be saved, judging from the fact that personnel working in other organizations were assigned to it for accounting purposes.

Arsenal Excess

On 29 December 1947, however, this notion was dissipated. At that time the Director of Services, Supply, and Procurement advised the Chief, Chemical Corps of the Secretary of the Army's decision to declare the Huntsville installation excess to the needs of the Chemical Corps. The Chemical Corps then requested the Arsenal to submit plans for decontaminating the mustard gas plants and the white phosphorus plant and all the other contaminated areas on the installation. In addition, the Arsenal was to suggest plans for demilitarizing the M17 bomb and Lewisite gas.

The Depot Activity received first priority in the clearance program as it was to be deactivated by 1 September 1948. The installation began immediately to execute instructions in connection with shipment of spare parts to the Eastern Chemical Depot, shipment of Depot stocks to other

Chemical Corps installations, shipment of manufacturing components and industrial reserve production equipment, and disposal of salvage and surplus property by sale and by donation. The Army allotted \$1.5 million as transportation funds for the Depot Activity and \$600,000 for Property Division shipments.

The Arsenal informed the Corps of Engineers of 1,143 buildings and structures that would remain at the installation to be disposed of by the War Assets Administration. On 30 April 1948, the WAA declined to assume jurisdiction of the installation since vast amounts of equipment and large areas of contaminated property were still present. The WAA maintained that Huntsville Arsenal was not surplus property within the meaning of the Surplus Property Act of October 3, 1944. Since the Chemical Corps could not comply with all the requirements of the War Assets Administration before 1 March 1949, the jurisdiction of Huntsville Arsenal remained the responsibility of the Department of the Army. Lt. Col. Allen H. Williams, Executive Officer, was designated as coordinator of all activities concerned with the deactivation and disposition of Huntsville Arsenal.

The Redistribution, Salvage and Surplus Property Division was discontinued in April 1948 and replaced by the Salvage Division and the Surplus Property Division.

Buildup for Phaseout

The increased workload called for an increase in personnel strength, which the Chief, Chemical Corps granted, whereupon the Personnel Division began to hire again. For instance, in the Property Division, the personnel

ceiling was raised from 17 per annum employees to 35 and from 42 per diem employees to 82. Fiscal operations were augmented by the receipt of the Special Project Transportation Service allowance already mentioned, the billing and collecting concerning lessees, and a \$270,000 allotment to cover the costs of demilitarization and other preparation for the sale or salvage of military supplies, equipment, and materiel. Even the Motor Pool felt the impact of the deactivation buildup. It acquired 12 more vehicles in June 1948. On 25 February 1948, a fire had destroyed its third echelon maintenance shop (Bldg 446), including all shop tools, equipment, and four motor vehicles. Also in February, Redstone Arsenal transferred 79 railway system cars to Huntsville Arsenal.

Fires

The Arsenal suffered further fire damage in March 1948 when an electrical storm set off some 3,600 smoke pots in Depot Area 853, resulting in about \$10,800 worth of damage. A far greater loss was sustained in the next month. On 29 April, the Universal Tire and Tube Corporation of Birmingham began moving M17 and E36 clusters that they had contracted to demilitarize. The first cluster they loaded became armed and exploded, setting off other bombs. The estimated damage was \$310,837. On 4 October, an M17 bomb exploded in Building 669 and destroyed the whole building. Another M17 exploded on 17 November 1948, igniting a fire that burned the top off Building 666.

Mid-1948 Status

The Property Division shipped 28,995 tons of material during the January-June 1948 period and received 3,033.9 tons. A new procedure adopted during this period was to load shipments directly from the magazines and igloos instead of from railheads. This practice reduced time and expense. In shipping spare parts to the Eastern Chemical Depot, the Depot Activity classified shipments of bins and box pallets only as Category I, II, or III on accompanying lists. Final shipping documents, prepared as time permitted, gave detailed information as to stock number, nomenclature, and unit weight.

In 1948, the Arsenal had 1,163,940 square feet of open storage space and 16,158 square feet of closed storage space allocated to the Treasury Department for storing strategic materials* which, at that time, amounted to 186,593.36 tons.

The Salvage Division made contract sales totaling \$261,364 for the six months. The Surplus Property Division declared \$30,121 worth of property to the War Assets Administration during January-June 1948 and withdrew property valued at \$102,846. The value of property donated to educational institutions was \$314,429.

Bryant-Harper & Company, Inc., leased Buildings 413, 414, and 415 to recover white phosphorus from white phosphorus-filled munitions. This was a 5-year lease, revocable at will by the Secretary of the Army.

Land rented as of June 1948 totaled 12,651.82 acres with an annual

*Such as bauxite and manganese ores, magnesium scrap, and zinc oxide.

revenue of \$17,081.50. Of this, 4,000 acres were in grain; 2,700 were in hay; 4,400 were in grazing; and the rest was non-productive.

The Toxic Branch worked with the Technical Escort Detachment on the German rocket demilitarization program that began in March 1948 and continued until May, when it was suspended in order to begin the M1 toxic gas set demilitarization program.

The demilitarization of M4A2 smoke pots was completed in March 1948, as was the M78 phosgene bomb renovation program.

By 30 June 1948, the vast bulk of deactivation work not related to demilitarization, decontamination, or destruction had been accomplished. Arsenal shipments consisting of industrial reserve and production equipment and facilities were completed despite the fact that in many instances the preliminaries entailed complete disassembly of installed machinery in addition to the normal preparations for shipping. Two more bomb renovation programs—the M47 and the M76 —were completed in the early summer, on 2 July and 6 August, respectively.

Accountability for the 4.2-inch chemical mortar shells and accessories stored in the Depot area was transferred to the Commanding Officer, Redstone Arsenal.

Demilitarization Programs

In mid-1948, the immediate goal was to finish all demilitarization programs by 31 March 1949. The largest project was the M17 incendiary cluster. The Engineering Service Division was responsible for building and installing the machinery for demilitarizing the M17. With the help

of machinists from the Army Chemical Center, the first machinery was ready in June 1948. The machinery used in this program was entirely designed and fabricated at Huntsville Arsenal. Since similar equipment had not been used in industrial or military processes, no experience in its operation was available. Because of the March 1949 deadline, full-scale production was in effect almost from the outset, without the benefit of the usual pilot run. This required large quantities of spare parts for machinery not entirely perfected for full-scale production. As better machinery was developed, it gave increased production with less maintenance. One line began operating on 22 July 1948, but, since the production rate was not fast enough to meet the March 1949 date, a second line was installed. The estimated average production of one line was 175 clusters per 8-hour shift. A 6-day week was authorized on 7 September, and three shifts began operating on 18 September. The highest 1-shift production was 225, attained on 22 December 1948. About half of the 81,055 clusters were demilitarized by the end of December.

The Engineering Service Division also built a plant at Building 799 for the transfer of phosgene from shells to ton containers. Designed for summer work, the building contained a large insulated room and refrigeration equipment in addition to transfer equipment.

Meanwhile, the Corps of Engineers accelerated the leasing program and quite a bit of land was let for agricultural purposes. The District Engineer issued invitations to bid on all facilities except utilities and those in Area No. 1 being used by the Chemical Corps. Some buildings were rented.

Organizational Changes

From July-December 1948, Huntsville Arsenal made an all-out effort to complete shipment of Class "A" munitions and standby equipment to other installations. This was done. The Gulf Chemical Depot Activity was discontinued as of 31 August 1948, its mission accomplished. A new organization, the Demilitarization, Decontamination, and Destruction Activity, was formed the next day to demilitarize and destroy chemical and toxic agents, equipment, and materiel. This Activity could claim 11 per cent of the officers and 49 per cent of the civilians employed at the Arsenal by 31 December 1948. The Inspection Activity was discontinued on 10 October 1948. The Procurement and Planning Division had been renamed Engineering and Procurement Division on 14 July 1948.

Under Third Army

Beginning 1 October 1948, Huntsville Arsenal came under the command and control of the Commanding General, Third Army for participation in the Territorial Command Test (Operation TACT) for six months. After 31 March 1949, the Arsenal was to revert to the Chief, Chemical Corps. Operating policy and procedure remained the same except that the authority of the Commanding General, Third Army replaced that of the Chief, Chemical Corps except on purely technical matters.

Accomplishments, July-December 1948

At the beginning of FY 1949, the Fiscal Division's workload was still at a peak, principally because of the movement of Huntsville Arsenal stocks. After the deactivation of the Depot Activity, ceilings

and funds had to be adjusted between the depot and the demilitarization allotments. When the Arsenal went under the Third Army, the Fiscal Division had to set up new ledgers on all allotments that had previously been the responsibility of the Office of the Chief, Chemical Corps.

The value of property declared to the Technical Services from July-December 1948 was \$3,117,094; withdrawn from the War Assets Administration—\$132,863; donated to educational institutions—\$808,758; shipped on orders of the War Assets Administration—\$252,211; declared to the Reconstruction Finance Corporation—\$225,094; shipped as technical excess property—\$374,196. The Salvage Division shipped 7,091.5 tons from July-December 1948 and rewarehoused 800. Over 8,400 tons of scrap metal were generated during the same period.

Standby Status

On 9 November 1948, the Chief, Chemical Corps informed Huntsville Arsenal that it was being removed from the surplus category and placed on a standby basis. Plants Areas 2 and 3 would be deactivated for retention in an austerity standby status as of 1 July 1949 for a period not to exceed 10 years.

This change was brought about because the Department of the Air Force was negotiating with the Department of the Army for the use of Huntsville Arsenal. There was also a possibility that another Army agency might use it. The Chemical Corps' standby status budget for FY 1950 provided for 76 positions and \$257,630.

By the end of 1948, of the 1,083 buildings and structures on the Arsenal, 58 were leased, 50 were used by utilities, 419 had already been placed in standby, and 556 remained to be placed in standby.

Arsenal for Sale

It is desired that you take the necessary action to dispose of Huntsville Arsenal as an installation surplus to the needs of the Department of the Army. . . . The Assistant Secretary of the Air Force has released the Department of the Army from its commitment to retain the Huntsville Arsenal for further consideration by the Air Force. . . . Disposal action should be expedited.

Thus ran a memorandum for the Director of Logistics from the Office of the Assistant Secretary of the Army on 17 March 1949. And so Huntsville Arsenal was to be advertised for sale by 1 July 1949 with the opening of bids scheduled for 30 September 1949.

The Arsenal did not return to the Chemical Corps on 31 March as scheduled but stayed under the command of the Third Army for the brief remainder of its lifetime.

During the early part of 1949, the Arsenal continued to ship serviceable supplies and materiel to other installations; to demilitarize unserviceable chemical materiel; to dispose of surplus property and materiel through sale as salvage; to decontaminate plants and ground areas; and to place Plants Areas 1, 2, and 3 in standby.

The Surplus Property Division was abolished on 14 February, its duties being absorbed by the Property and Salvage Divisions. The Finance Division was discontinued on 15 February, a Class B Agent Finance Office replacing it.

After it became known that the Arsenal was definitely "for sale," it shipped all equipment being held for standby that the Department of the Army might need elsewhere. Most of the manufacturing facilities were left undisturbed because there was no Army demand for this equipment. Other facilities were left because of an anticipated

increase in the Arsenal's value if such property was allowed to remain intact. For instance, utilities, including steam, water, and sewage plants, were left in an operating condition with a reserve of 90 days' supply of operating spare parts.

The Station Hospital was discontinued and an Industrial Dispensary established on 31 March. The Engineering and Procurement Division was discontinued the same day, but a Procurement and Contracting Division took its place effective 1 April 1949.

Buildings occupied by the 4th Echelon Repair Shops were transferred to Redstone Arsenal on 31 March, after which time it had the responsibility for 4th echelon repair of Ordnance vehicles.

The Industrial Research Corporation of Detroit, Michigan, made a comprehensive industrial survey of buildings and grounds from May to July 1949. The Corps of Engineers planned to use their work in advertising the Arsenal for sale.

The transfer of phosgene from 4.2-inch chemical mortar shells was completed on 8 February 1949. The M17 bomb cluster demilitarization program ended on 14 March 1949. The material recovered exceeded the cost of the operation by \$60,750. The program of transferring mustard gas from unserviceable M70 bombs yielded 387 tons of mustard gas and 574 tons of scrap.

The Demilitarization, Decontamination, and Destruction Activity had the job of decontaminating toxic areas, delineating toxic areas which could not be decontaminated, and removing all surface duds and scrap metal from the 8,000 acres that were used as bomb and mortar ranges.

The Salvage Division shipped out 18,381 tons. Scrap metal generated equaled 9,607 tons. The value of contract sales was \$328,530.

In early 1949, Huntsville Arsenal had about 1,300 civilian employees, over 300 of whom were permanent. At that time, Redstone Arsenal, in standby, had 7 officers and 250 civilians. By 30 June, Huntsville Arsenal had pared its staff to about 450, who would be transferred to Redstone to assist in the latter's buildup.*

Thus, at the end of Fiscal Year 1949, Huntsville Arsenal closed not only its books but its doors. Acting in a caretaker capacity, Redstone Arsenal assumed such functions as were necessary to provide internal security and maintain essential utilities for lessees. Of the 450 former Chemical Corps personnel retained by Redstone Arsenal, about 100 formed the Chemical Division of Redstone Arsenal to complete the disposal of surplus and salvage property and to transfer installed property in Arsenal buildings to the District Engineer for disposal action.

Although Huntsville Arsenal ceased to exist as a separate installation at midnight 30 June 1949, it was not officially discontinued until April 1950, at which time the Chief, Chemical Corps relinquished jurisdiction over it to the Chief of Ordnance. Those portions retained by the Department of the Army were then consolidated with Redstone Arsenal.

* See pp. 132-134.

PART TWO

ORDNANCE ACTIVITIES

IX. ORIGIN OF THE REDSTONE ORDNANCE PLANT

Location Chosen

Shortly after the President issued the Emergency Proclamation in September 1939, the Ordnance Department began to plan for the expansion of its facilities to meet the growing needs of national security. Among its anticipated projects was a chemical shell assembly plant and its related facilities. The site for such a plant had not been chosen, however, when the Chemical Warfare Service decided to erect Huntsville Arsenal. Realizing the tremendous economy that could be achieved if a shell-loading plant could be located close to such an arsenal, the Chief of Ordnance, Maj. Gen. Charles M. Wesson, directed Maj. Myron Leedy of his office to conduct a survey of available sites in the vicinity. Acting upon the major's recommendation, the Ordnance Department decided to build a shell-loading plant on property adjacent to Huntsville Arsenal.

In September 1941, the Plant Engineering and Maintenance Section of the Ammunition Division prepared a general plot plan. Appropriations for construction of the plant were approved, and on 25 September, Maj. Carroll D. Hudson, Ordnance Department, was named Commanding Officer.

Facilities Required

On 6 October 1941, Major Hudson arrived in Huntsville and immediately established a temporary office at Huntsville Arsenal. On 7 October, he called a meeting of the Area Engineer and representatives

of the architects, Whitman, Requardt and Smith, and of the contractors, Kershaw, Butler, Engineers, Ltd., who were building Huntsville Arsenal, to discuss plans for the construction of what was to be known as the Redstone Ordnance Plant—named because of the preponderance of red soil. The requirements for the plant, as established by the Office of the Chief of Ordnance, called for the loading and assembly of 75-mm chemical shells, plus the loading and assembly of burster charges for this ammunition. Accordingly, the layout of original plans called for the construction of: two burster-loading and assembly lines; two shell-loading and assembly lines; 24 inert storage warehouses; 30 igloos; 35 finished ammunition magazines; administrative and utility buildings; and all utilities.

The Plant's tract of land consisted of approximately 4,000 acres, designated on the surveyor's map of Madison County as a portion of the Siebert Arsenal Project.* Located ten miles south of the City of Huntsville, it was a rolling, rural terrain, entirely agricultural in nature, that had been used exclusively in the past for the production of cotton, peanuts, livestock, and the like. There were no roads outside of those "corduroy" trails that served the farmers. The nearest paved highway was more than two miles from the eastern extremity of the reservation. The closest power facilities were located at the Huntsville Arsenal, as was the water supply. Rail transportation was furnished by the Nashville, Chattanooga and St. Louis Railroad, but its terminus was, at that time, 1½ miles from the reservation, at Farley, Alabama.

* See p. 58.

Construction Begun

A combined quarters for staff members and a temporary administration building was the first necessity. For this purpose, a two-story barracks-type structure was designed, consisting of a small kitchen, small dining-room, and other small rooms of identical design which could either be used as offices or living quarters. The building later was to provide living accommodations for bachelor officers and key civilian personnel who were in residence.

No difficulty was encountered in the construction of this building, which was ready for occupancy on 11 November 1941. It served as Redstone headquarters for Major Hudson, his staff, and the representatives of the Area Engineer, the architects, the contractors, and whatever guard force was on hand at that time.

Organization and Staffing

Before leaving Washington, Major Hudson had been asked to estimate the number of officers and civilian personnel needed to activate Redstone Ordnance Plant. He requested the immediate assignment of three officers whom he planned to supplement with about seven key civilian assistants at the start. He needed primarily a military assistant to handle administrative organization and details, thus leaving himself free to devote as much time as possible to the planning of construction, the transmitting of Ordnance requirements to the Area Engineer architects, and the approving of all plans. In addition, he requested an officer who could assist in the solution of ordnance engineering problems, and also one who could serve as an executive officer. Because of the acute

shortage of officers, the Ordnance Department found it impossible to comply with Major Hudson's original request.

On 30 October 1941, however, Lt. William H. Stevens, Ordnance Department, reported to Major Hudson and was assigned the primary duty of Adjutant, with secondary duties as Property Officer. He was also charged with the responsibility of building an administrative organization. The military organization was to consist of an Executive Officer, the Chiefs of the Administrative, Production, Engineering, and Plant Security Groups,* and the military officers.

The Administrative Group contained the following Divisions: Mail and Record, Personnel, Fiscal, Property, and Procurement. The Production Group was composed of the Storage Division, under which were the Igloo, the Magazine, and Inert Warehouse Sections; the Operating Division, including the Burster Production Section and the Finished Ammunition Production Section; the Transportation Division, with Rail and Motor Sections under its jurisdiction; and the Production Control Division.

Under the Engineering Group were the Drawings, Specifications and Reproduction Division; the Design Division; and the Utilities and Maintenance Division.

The Inspection Group incorporated the Operations Inspection Division, composed of the Burster and Finished Ammunition Sections; the Storage Inspection Division, under which were the Igloo, Magazine and the Inert Warehouse Sections; the Gage Division; the Final Acceptance Division; and the Materials, Supplies and Equipment Division.

*The name "Group" was changed to "Division" in May 1942.

The Plant Security Group was divided into the following departments: Fire, Police, Medical, and Safety Inspection.

The Military Group encompassed the Adjutant, Intelligence, Plans and Training, Property, Transportation, Utilities, Survey, Salvage, Finance, Quartermaster, Construction Quartermaster, Signal, Medical, Provost Marshal and Public Relations.

Major Hudson had been promised a complement of 14 officers, but in the meantime he and the Adjutant went ahead solving construction and organizational problems. The balance of the officers reported singly over a period of several months, and it was not until the summer of 1942 that the entire quota was filled.

The first problem facing the Adjutant in his newly assigned duties was that of obtaining personnel, so that when production was ready an organization also would be ready to function. Inasmuch as most of north Alabama had heretofore been devoted to agriculture, instead of industrial pursuits, the trained labor situation was indeed serious. More than that, artisans for miles around were in the employ of the contractors, and it was unlikely that many of these could be counted on as potential Redstone employees when the Plant actually got into production.

A two-sided personnel problem instantly presented itself. In the first place, manpower had to be recruited. Second, once recruited, this manpower had to be trained, the training being of utmost importance because of the very nature of the Plant's contemplated production operations.

Because many plants of a similar nature were being constructed at this time, there naturally existed a great deal of competition for the

services of experienced and high-type persons. However, through personal contacts and the cooperation of the Civil Service Commission in Atlanta, Redstone was able to staff its more important positions with capable civilians within the course of several weeks. A profitable source for recruiting key civilians was the School for Senior Clerks at Rock Island Arsenal. From this school, Redstone obtained four people who had been especially trained to take over duties in administrative work. As manpower grew more scarce, Redstone turned to womanpower, an innovative step at that time. So successful were the "female trainees" that, by December 1942, approximately 40 per cent of Redstone employees on the production lines were women.*

Another problem was that of obtaining such operating equipment as the Area Engineer did not furnish. Because of material shortages, the Plant was on its own to do the best it could. Luckily, by the time the Plant was ready to go into production, every bit of equipment needed for administrative purposes was on hand and ready. Although several machine tools were needed for production, at no time was the Plant severely handicapped for lack of office equipment, except for a shortage of typewriters.

In the first stages of the Plant's operation, there was no organized training program. It is true that several of the key civilians had been sent to Picatinny Arsenal and Charleston Ordnance Depot

* Women employees soon adopted a distinctive garb indicative of their participation in war work. The uniform they selected was a two-piece suit of regulation "Army Pink" material. The jacket, skirt, visor cap, and leather belt were considered "regulation," with the overseas cap and matching belt optional. Costing about \$22 each, the first uniforms arrived in December 1942.

for intensive operational instruction, but as far as line workers and the like were concerned, it was up to Redstone to assume the training responsibility. The Plant therefore arranged with the Alabama State Department of Vocational Training for the full-time assignment of a qualified supervisory instructor.

Construction Completed

Meanwhile, construction encountered several setbacks. Because the original estimates and appropriations for the construction of the Plant had been made prior to the selection of its site, all figures were based on the supposition that the terrain was level ground. This was not the case. Much of the area was rolling, and a high percentage of it proved entirely unsuitable for the laying of roads. Much earth had to be excavated and removed, then replaced with proper soil, before construction could proceed. Thus it became apparent that original cost figures had been underestimated considerably. While the building of the various structures varied little from their estimates, the additional cost of construction increased almost \$2 million over the original estimate of approximately \$6 million because of the nature of the terrain.

Cold weather at times also slowed progress. For example, rain and low temperatures delayed the pouring of concrete for a week. Gravel was difficult to obtain in large quantities, and until roads were graveled, prior to paving, a severe rain would stop all traffic and therefore all construction work on the project.

Burster Line No. 1 was scheduled for completion first, as it was to go into production as soon as possible manufacturing M5 bursters.

It consisted of 15 buildings, somewhat octagonal in arrangement, situated on an area of approximately 25 acres. A priority list made up at the start designated affiliated buildings which would have to be completed simultaneously with the burster line. Accordingly, a certain number of igloos, magazines, storage warehouses and other related essential facilities for operating the burster line were given high priority.

Meanwhile, during the latter part of December 1941, Picatinny Arsenal developed the cast method of loading bursters, a radical departure from the pelleting and reconsolidating procedure. Ordnance's adoption of this new method necessitated revisions in the burster line—no major changes, but a number of minor ones, thus causing delay. The construction of the modified line was completed in March 1942. Burster Line No. 2, which had been under construction simultaneously, was installed with the new changes at a somewhat lesser cost.

After the declaration of war, the work was placed on a 24-hour basis instead of the usual 1-shift operation. Simultaneously, with the building of the production lines, every effort was made to rush to completion such structures as storage warehouses, igloos, magazines, shops, and the fire and police building. Construction of Lines No. 3 and No. 4 began in February. Completed in April, Line 3 started operating on 28 April. Line 4 opened in August.*

Since the Huntsville Arsenal had designed a loop system for its water, and the loop passed right by the extremity of the Redstone reservation, the Ordnance Plant decided to use the supply developed by the Arsenal, rather than attempt to develop its own water system from wells

* See also pp. 106-107.

in the area. Consequently, a 200,000-gallon storage tank was erected in the center of the reservation, which was kept at the same level as the storage tanks at the Arsenal. This assisted in maintaining constant pressure throughout the entire system. The system worked satisfactorily with one or two possible exceptions. Without a return line to the Huntsville Arsenal supply, thus forming a loop within the Redstone area, however, Redstone ran the risk of having only the water in the tank if a main from the Arsenal to the Redstone area broke. The Plant recommended installation of the return loop, but in view of the shortage of critical materials and the added cost involved, higher authority decided that it was not essential.

To avoid duplicating the facilities of Huntsville Arsenal, Redstone Ordnance Plant decided to get electric power from the same source, namely, the Tennessee Valley Authority. Consequently, Redstone hooked onto the Arsenal power line with two connections, one at the north side of the Arsenal and the other on another branch of the line. By this system, should power be cut off in one portion of the Arsenal, Redstone could still be served from the other side of the loop. The capacity was 1000 kw.

The original construction project for the Plant was essentially completed in the summer of 1942, but already it was evident that working facilities would have to be expanded. Accordingly, a fifth line (Line 5) was designed to handle 155-mm shells and chemical bombs. Work on supplementary structures, such as fuze magazines, a utility building, laundry, and added trackage, including an extension of the railroad into Lines No. 1 and 2, progressed very rapidly, so that the facilities were

ready by 1943. Because of this expansion, a standby Diesel generating electric unit was added in order to provide minimum power necessary to continue the Plant in operation should a power failure from the TVA occur. There were several instances when the power supply from the Arsenal had failed, causing the Plant to shut down operations for short periods. Also, lightning occasionally struck the transformers, putting the Redstone power supply out of commission.

Thus, with the completion of the standby power plant, the Redstone Ordnance Plant was self-sufficient except for its water supply.

Channels of Command

Since Redstone was an exempted station of the Ordnance Department, its Commanding Officer was under the direct control of the Chief of Ordnance. Administratively, the Plant was under the jurisdiction of the Executive Branch, Industrial Division, Office of the Chief of Ordnance. Its manufacturing or production activities were directed by the Ammunition Branch, Industrial Division, through the Field Director of Ammunition Plants.

Finance

Redstone operated under one procurement authority. The Plant had only one fund and, as a result, its financial system was similar to those in use at average commercial establishments. The Plant operated for one year on the first fund. This was allocated in September 1941 and was supplemented at various times thereafter. The original appropriation was \$4,500,000.

Personnel Strength

In addition to its complement of 14 Ordnance officers, the Plant had four others on detached duty from their respective branches in the early war years. These included one Signal Officer, one Intelligence Officer, one Post Surgeon, and one Assistant Post Surgeon. As part of the Post Signal Officer's staff, four enlisted men were placed on detached duty at the station, taking up permanent residence on the reservation.

Strength Figures, 1942-1945

<u>Date</u>	<u>Civilian</u>	<u>Military</u>	<u>Total</u>
January 1942	24		
July 1942	1,183		
January 1943	1,906		
July 1943	3,523		
January 1944	3,426	20	3,446
July 1944	3,607	22	3,629
January 1945	4,252	26	4,278
July 1945	3,048	30	3,078

X. INITIAL OPERATIONS

Early Production Problems

The prime obligation of the Redstone Ordnance Plant was to manufacture and/or assemble certain ammunition items designated by the Office of the Chief of Ordnance. Precisely, the mission was the assembly of chemical ammunition, from 75-mm up to and including 155-mm, and the manufacture of all bursters for chemical shells and bombs. The Plant also assembled 30-pound and 100-pound chemical bombs.

Lines No. 1 and 2 performed similar operations, namely, the loading of burster tubes. The tube itself was obtained by Ordnance Districts from private manufacturers and shipped to Redstone as a free issue. Ordnance works manufactured the explosive ingredients, consisting of tetryl and TNT, which were also shipped to Redstone as a free issue. The Plant directly procured incidental items of assembly, such as packing boxes, stenciling machines, onion skin, and strapping machines.

Lines No. 3 and 4 loaded and assembled chemical ammunition. In general, all major components, such as cartridge cases and empty shells, came from manufacturers throughout the country via Ordnance Districts. Components such as fuzes, boosters, propellant charges, and primers were produced at other Ordnance works or plants and shipped to Redstone as free issue. Redstone itself procured items of a miscellaneous nature, such as adhesive tape and packing equipment.

After inspecting and testing the items, Redstone sent the empty shell and burster casing to the Huntsville Arsenal, which filled the shell with the proper chemical and then sealed it by pressing the burster casing into its seat. The ammunition was then returned to Redstone to become one of the components to be assembled into complete rounds. Redstone inspectors located at the CWS filling lines inspected munitions and accepted or rejected them before their return to the Plant.

It has already been explained how lines had to be redesigned when the cast method of loading bursters was adopted.* Despite the fact that Redstone Ordnance Plant had production orders to deliver 10,000 M5 bursters in January 1942 and a like amount during February, it was impossible to fill such orders because of the changeover. With an order of 50,000 facing the Plant for March, it was not until 28 March that Line No. 1 began operating, but in the remaining three days, it produced 55,202.

It is noteworthy that the line went into operation with substitute equipment. When the changeover order came through, several key civilian employees went to Charleston Ordnance Depot to study the cast method at first hand. They returned with lists of essential equipment which, because of the shortage of critical materials, was nearly impossible to obtain. In desperation, those in charge, Lt. Leon P. Woodall, Chief of the Production Division, and his assistant, Lt. Perry J. Keith, set about to scour the vicinity for substitutes. In a haphazard fashion, they were successful, with operations dependent on many purchases from five-and-ten-cent stores to tide them over until standard equipment could be obtained.

* See p. 98.

Even teaspoons, paring knives which were spark-proof, pyrex dishes, and the like, were used in the original casting operations.

In the changeover from the pelleting method, it was found that no provision had been made in the basic designs for the storing of TNT near the lines. The Plant therefore had to construct a building, set apart from the lines of operations, to store adequate quantities of the explosive.

During this period of initial production, one difficulty immediately appeared which tended to slow down output. This was the reclaiming of the explosive mixture which had solidified on the sides of the containers used for pouring. The problem was solved by a suggestion from a production superintendent, who pointed out that the mixture of tetryl and TNT could be reclaimed by washing off the mixture with TNT. This method proved so successful that it was adopted at Redstone.

As production was stepped up, it was found that air compressors used to furnish power for air-driven motors, tools, and pumps, and installed according to the original Picatinny specifications, were inadequate for the cast method. Inasmuch as delivery of larger compressors could not be guaranteed, it was found necessary to improvise again. As an interim measure, the Area Engineer agreed to furnish Redstone with portable compressors (300 cu. ft.). By parking these in adjacent roads and feeding air to the buildings, operations progressed in a satisfactory, if unorthodox, manner.

The next production order called for 190,000 bursters. The quota was made, despite difficulty with the air-driven agitators, two of which were worn out. Their replacements were acquired on the open market.

As time went on, it was noticed that slight but consistent delays were being caused by broken steam piping and condensate return lines. The breaks themselves were inconsequential, but time was lost when it became necessary to tear up floorings over pipe trenches on several occasions in order to repair the pipes. The installation of expansion joints remedied this. Also, all later pipe installations were exposed wherever possible.

Efficiency, to a certain degree, was retarded because buildings were not provided with celloglass, thus exposing employees to the weather. When celloglass was installed, an ameliorative effect was immediately noticeable.

All of the above problems arose during the early experimental operations on Line No. 1. Profiting by the mistakes, the Plant incorporated revisions and modifications into Line No. 2 so that the latter line started off with greater efficiency. By October 1942, the permanent equipment had been installed on Line No. 2, which was then ready for operation. With all the deficiencies encountered on Line No. 1 corrected, only the problem of temporary air compressors remained to be solved. The operation of the line was found to be so much more convenient and efficient that greater production was possible with a decrease in personnel. By reclaiming the explosive material as already described, the scrap waste of TNT and tetryl was reduced from 10 to 15 per cent to 3 per cent.

Original plans at Redstone called for two assembly lines, known as Lines 3 and 4. Both were constructed from plans suggested by Picatinny Arsenal but redesigned by Major Hudson to meet local problems and conditions. The modifications were such that both lines might be

identified as being peculiar to the Redstone Plant. Included in the specifications for both lines were Picatinny's recommendations for equipment and material which could not be obtained in time to meet the original production orders that called for the assembling of 50,000 105-mm mustard gas shells. Here again improvising was necessary. Presses and assembling machines were, in many instances, borrowed. Some temporary equipment was designed at the reservation. But the most important step taken at this time was the adoption of an entirely new system of assembly which simplified all other procedures.

This was the use of Redstone-designed racks into which shells were inserted. Then, workers using portable tools assembled fuze well cups, boosters, etc., while the shells remained stationary in the racks. The racks, mounted on trucks, moved from one operations room to the next. This eliminated the handling of the projectiles by employees except in the initial step of putting shells in the rack-holes. The method proved very satisfactory.

The lack of empty shells soon caused a serious reduction in schedules. This was not the fault of Redstone; it was rather a matter of having production schedules set higher than the availability of empty shells. Such a shortage in April 1942 stopped the assembly of mustard gas rounds, but the shift to the manufacture of white phosphorus shells ran smoothly.

When Line No. 4 went into operation on 3 August 1942, Lieutenant Colonel* Hudson decided that this would function along the original

*As of February 1942.

recommendations made by Picatinny Arsenal, while Line No. 3, called the "Redstone line" because of the many modifications, would operate independently in an effort to determine relative efficiency. This experiment lasted for one week. The results: With the same number of employees, approximately 25 per cent more production was consistently obtained by the Redstone process of assembly. Consequently, the equipment recommended by Picatinny was replaced by Redstone-designed equipment on Line No. 4.

As part of the expansion program embarked upon by Redstone on 4 August 1942, Line No. 5, designed primarily to handle the assembly of 155-mm shells, was approved and, after necessary appropriations were obtained, constructed accordingly. This line was completed about the first of the year.

Inspection Procedures

The method of handling the first 100-pound chemical bombs and burster casings on the schedule was to subject them to an air pressure test of 100 pounds to find any leakers. They were then shipped to Huntsville Arsenal for chemical-filling. Returned to Redstone, they were assembled complete with fuzes and fillers, boxed, strapped, stenciled, and otherwise made ready for shipment.

It was discovered very early in the operation that the 100-pound air test did not eliminate all leakers; that the method of closure of the burster casing in the bomb after filling was not satisfactory, and as a result, a considerable number of leakers were found in the processing operations. The Office of the Chief of Ordnance, being quite concerned, directed that, in addition to the air test, a 400-pound oil test

be made by filling the bombs with SAE-10 oil and subjecting them to a pressure of 400 pounds. As some of the bombs burst under this pressure, a thorough investigation of the matter revealed that the oil test in many cases stressed the metal in the bomb body beyond its elastic limit, making some bombs burst and weakening many which did not burst. A change in specifications called for an internal air pressure test of 350 pounds.

Another reason for using oil was that mustard gas was dissolving the asphalt paint covering inside the bomb body and exposing flaws in the metal, thus causing leakage not indicated in the 100-pound air test. The gas also dissolved the white lead luting compound on the threads of the burster casing where they screwed onto the bomb body. As a result, use of this compound was discontinued and litharge and glycerine substituted. As a further safety measure, decontaminating crews, furnished by the Chemical Warfare Service, accompanied each shipment of the completed bombs to forestall trouble.

When the lines actually got into production, incoming components, usually a lot or 100 units from each lot, were inspected on receipt for fidelity to drawings and other specifications. If two units, or two per cent or more, failed to meet requirements, the lot was rejected.

Another phase of inspection was the inspection for acceptance of chemically filled components received from the neighboring Huntsville Arsenal. For this purpose, a staff of eight, all on the Redstone payroll, were Ordnance inspectors at Huntsville Arsenal. On 18 November 1942, an inspector was placed permanently at the CWS's Pine Bluff Arsenal, maintaining constant inspection of all orders filled for the Redstone Plant.

On the ammunition assembly lines, process inspection concerned the inspection of incoming chemically filled shells from the Chemical Warfare Service. Such shells were inspected for leakers, high burster casings, damaged rotating bands, proper painting and stenciling, and zone markings. "At first," according to the earliest Ordnance Plant history, "it was difficult to impress upon the Chemical Warfare Service at the Huntsville Arsenal the exactness of Ordnance Department requirements but this situation had been greatly remedied by the close of 1942."

Final inspection checked the assembled projectile and assembled cartridge cases, the packing of the assembled round into the fiber container, and the assembly of the containers into clover leaves with their proper shipping and identification plates. Another aspect of final inspection was to approve or disapprove loading and dunnaging of all outgoing shipments from the assembly line.

In June 1942, Redstone was notified that, in an effort to conserve manpower, the general policy of the Ordnance Department was to reduce the number of inspectors in all ammunition plants. Because of this, a general change in procedure gave individual operators in production added duties in process inspection, under the supervision of the Inspection Division, with the latter ultimately responsible for both process and final acceptance inspection.

During November 1942, the method of proof-firing ballistic samples was changed; that is, different test phases were conducted on component lots previously tested. Under the new criteria, many lots failed to meet requirements because of the variance of propelling charge pressure in the velocity test phase.

At the beginning of operations, Redstone submitted ballistic samples, provisionally accepted, to the proving ground for final acceptance. However, the Redstone Commanding Officer had authority to approve final acceptance of certain types of ammunition prior to proof firing. In these cases, ammunition was shipped direct from the assembly lines to its destination.

The Inspection Division had the authority to halt assembly at any time if it detected a condition that would prevent ammunition from meeting specifications. For example, in December 1942, Line No. 4 was shut down for one week when shells were returned to Huntsville Arsenal because of improper paint and rust on the shells. A change in paint specifications corrected the condition.

Safety and Security

The Redstone Ordnance Plant tried to instill safety consciousness into all its employees. Although men trained in safety work were hard to come by, the Plant nevertheless chalked up a good safety record by indoctrinating individual employees.

When the Ordnance Plant opened, guards were on duty 24 hours a day, operating on a 3-shift basis. As no patrol cars were available, they had to use their own automobiles to get to their posts. Moreover, they had to furnish their own firearms. A requisition for arms yielded .45-caliber revolvers for each shift and, shortly thereafter, rifles to be stored for use in case of emergency. The Fourth Service Command then recalled all rifles and revolvers, which were to be replaced by 12-gauge shotguns. The shotguns did not arrive until October 1942 and then proved

unsatisfactory. First, they were hard to keep in good condition and were unwieldy when the men got in and out of patrol cars. They were also awkward for the mounted patrol. Pending the issue of .38-caliber revolvers and night sticks, which the Plant planned to make standard equipment for the police force, the guards were once more furnishing their own arms as of December 1942.

Since the extremities of the reservation were not completely fenced in, large portions of the unrestricted areas were exposed. To cope with this situation, mounted guards patrolled these open areas, using horses loaned by the Corps of Engineers. As the Plant was able to retain only four of these 18 horses, it obtained 33 riding horses and four draft horses from Fort Royal, Virginia. These arrived in the spring of 1943. The problem of feed for the horses led to the planting of corn on abandoned farm lands adjacent to the stables. Huntsville Arsenal donated many acres of hay which Redstone cut and baled.

XI. THE WAR YEARS

1943

New Name and Organizational Changes

At the beginning of 1943, Redstone Ordnance Plant had six divisions. Under the Commanding Officer and his Executive Officer, these were Administration, Production, Inspection, Engineering, Service, and Safety and Security. After the Plant's name was changed to Redstone Arsenal on 26 February 1943, the Arsenal revised its organizational structure somewhat. It kept the latter five divisions but substituted staff branches for the Administration Division. An Executive Assistant was added to the Commanding Officer's staff to assume some of the workload. Effective 21 June 1943, the 10 new branches were: Military Personnel, Civilian Personnel, Chief Clerk, Fiscal, Procurement, Property, Industrial Relations, Legal and Military Intelligence, Special Service, and Mail and Record. Six months later, on 13 December 1943, another branch—Control—was activated. The Chief Clerk Branch was discontinued, its functions assumed by the Control Branch. The Fiscal and Procurement Branches were combined into one branch with the joint title. The Civilian Personnel Branch absorbed the Industrial Relations Branch, while the Property Branch became a section under the Service Division.

Contractor to Operate

A major reorganization appeared to be in the offing on 7 August 1943

when the OCO informed Redstone Arsenal that the latter would be turned over to a subsidiary of the Continental Can Co. A 30 August letter from the Field Director of Ammunition Plants to the Concan Ordnance Co. authorized the company to operate the Arsenal.

The public announcement of the contemplated change on 3 September assured employees that, although the contractor would take them over intact, they would nevertheless carry with them the full rights and privileges they enjoyed under the civil service system. As the company was to begin managing the Arsenal as soon as contractual details could be worked out, the Arsenal immediately began to prepare for the change-over.

Property accounting procedures, for example, were revised to conform to the property accounting manual for Ordnance industrial establishments. This necessitated classifying all property on the reservation into "A," "B," and "C" rather than "expendable" and "nonexpendable" categories. Under the property setup tentatively established with the Concan Co., Property Branch duties were expanded to include planning for storage space and the location of all incoming material. As it required additional personnel to handle these responsibilities, the Property Branch moved out of the Administration Building into Warehouse No. 442, as did the Engineering and Service Divisions. Although the Engineering Division later returned, the Property Branch and the Service Division remained permanently in the warehouse because operating in close proximity with the field entailed several advantages, among which was reduced paperwork.

In the inspection area too, much preliminary planning was done. After agreeing on what the Ordnance contractor functions would be and which personnel would be released to the contractor, representatives of the Concan Ordnance Co. and the Ordnance Department thoroughly reviewed inspection procedures and decided what changes would have to be made under the new setup. Inspection procedures on all lines and incoming materials, and at Pine Bluff and Huntsville Arsenals, were discussed in detail.

New Commanding Officer

Shortly after the changeover was announced, Colonel Hudson received orders to report for duty at the Office of the Field Director of Ammunition Plants in St. Louis. It was specified, however, that Colonel Hudson would be present to represent FDAP when the Arsenal was turned over to the contractor. On 1 October Maj. Leslie S. Solar, leaving the Cornhusker Ordnance Plant in Grand Island, Nebraska, assumed command of Redstone.

Ordnance to Keep

Preparations thus continued apace until 15 November when a telephone call from FDAP revealed that negotiations had been broken off and that the Ordnance Department would retain management of operations. A letter of 17 November gave formal notice of the termination of the 30 August letter of intent because of "changed conditions." Soon after, the Arsenal reverted to a more or less "as you were" status. On 29 November Major Solar announced that he was being transferred to a special assignment. The skeleton crew of Concan officials and employees who had already moved

onto the Arsenal had all left by 1 December. On 7 December, Colonel Hudson returned as Commanding Officer.

Production

Production continued to run rather smoothly at Redstone Arsenal during 1943. Schedules were usually met on time and labor shortages caused no delays, although there were some component shortages and technical problems. In January the 48-hour week went into effect with overtime for all work over 40 hours. On 14 August 1943, an explosion on Line No. 1 killed one person and injured seven others.

Production proceeded on the 105-mm M60 white phosphorus (WP) or mustard gas (HS) shells, the 155-mm WP or HS-filled shell, M5 and M6 burster charges, the 100-pound A1 WP bomb, and the 100-pound A47A2 HS bomb. Among the new orders received in 1943 were those for M8 burster charges (by the casting method); M4 and M10 burster charges; 115-pound M70 HS bombs; 75-mm WP M64 shells; and 105-mm M84 HC base ejection shells.

The equipment on Line No. 3 had to be altered slightly to manufacture the M64 shell. Although few problems were encountered in making or assembling the shell, proof-firing indicated that it was improperly designed or needed different components. The trouble was traced to the M8 burster, which was not powerful enough to detonate the shell properly. Since a reconsolidating pure tetryl burster was deemed more effective, the Chief of Ordnance decided in May 1943 that cast bursters would no longer be used and that Redstone would go into production of the new

bursting immediately at the rate of 250,000 a month. Six reconsolidating machines were put into operation but never worked properly. Three could have done the job if they had been perfected. Production schedules were met, but only because twice the number of people ordinarily used were assigned to the work.

Production of the M84 shells, scheduled for January, did not begin until May because of a shortage of components. Production of the M4 burster charge, also set for January, was postponed until May. The manufacture of this item would have required considerable training of employees. Meanwhile, an order for 25,000 M10 bursters, received in February, provided the practical experience necessary. The M4 and the M10 bursters were identical except for a 2-inch difference in length. When the 25,000 bursters were completed, proof-firing showed them to be of excellent quality.

The manufacture of the M70 mustard gas bomb began in June 1943. After the CWS had filled, painted, and stenciled the bomb, there was little for Redstone Arsenal to do except ship it to its destination. Received from Huntsville and Pine Bluff arsenals, the bombs were stored temporarily. The unusually high percentage of leakers among them created a great hazard, and many employees of the Service Division received mustard burns. Five magazines were also contaminated. Closer inspection of incoming items was therefore exercised and, later, direct shipping was instituted.

Component shortages delayed production of the T-6EI HC smoke rifle grenade, the M116 155-mm HC smoke projectile, and the M115 shell for the 155-mm howitzer. The M1 burster was produced in November and

December. When production started on M2 demolition blocks in October, the item was cast into bakelite molds. Redstone soon developed a process of pouring directly into the paper covering. Approved by the Chief of Ordnance, this improvement saved labor and time.

Storage and Property

In the storage area, a March directive from OCO stipulated that no more ammunition was to be shipped until all containers were stained. At that time, Redstone had on hand about 300,000 100-pound bombs in boxes awaiting shipment, and unstained boxes were constantly arriving from manufacturers. Obviously a quick method for staining was needed. A roller conveyor and hand-operated guns were not fast enough to overcome the backlog. A hooded mechanical operator placed on a conveyor line partially solved the problem, but, in addition, Huntsville Arsenal had to install a supplementary dipping vat. The combination of these measures proved efficacious, but meanwhile the storage problem had become acute. At one point 80,000 bombs were stored outside of magazines.

In the administrative area, a great deal of confusion developed over property accounting. A War Department circular attempted to simplify the adjustment of discrepancies in shipping by placing the responsibility on the receiving officer, but this conflicted with an Army Regulation that allowed the shipping officer to approve or disapprove the damage report. Because of the wide variations in interpretation of the circular, a controversy arose between Redstone Arsenal and the Birmingham Ordnance District in regard to the proper procedure to be followed in cases of shortages in shipments. When the case was submitted to the Fourth Service

Command, that Command stated that the provisions of the circular were very plain. Redstone then took the case to the Chief of Ordnance who upheld the procedure in effect at Redstone. Soon another War Department circular rescinded the one causing the contention.

1944

Resources and Workload

Redstone acquired new rank when its Commanding Officer was promoted to full colonel on 26 February 1944. As the war entered its third year, Redstone Arsenal experienced great difficulty in obtaining adequate labor, both skilled and unskilled, although the State Selective Service Headquarters, local boards, and the Regional Deferment Committee were very cooperative in deferring essential workers. In every instance where it was practicable, women replaced men. The first WAC to be assigned to the Arsenal, 2nd Lt. Eleanor B. Wilson, arrived on 29 March 1944 on temporary assignment from the Fourth Service Command to assist in the work of the Signal Corps. There was only slight fluctuation in employment despite a considerable turnover, ranging from 4.4 to 11.9 per cent a month. The employment problem continued to be aggravated by the lack of low cost housing and scarcity of transportation. Absenteeism ran high, sometimes as much as 10 per cent.

New production in early 1944 included the 75-mm M89 base ejection shell; the M104 and M110 155-mm shells, both having either white phosphorus or mustard gas filling; the 81-mm M57 white phosphorus mortar shells; and the M13 burster. Increased demands for M1 demolition blocks

necessitated a redesign and relocation of equipment and fixtures on Line 2 in order to produce 1.5 million pounds of such blocks a month. There were also four colors of smoke rifle grenades and special orders for M84 105-mm and M116 155-mm propaganda shells, in addition to the 1,000-pound M79 phosgene bomb. Schedules changed up or down, or were canceled on short notice, as the Ordnance Department tried to meet the demands of field forces.

During the second quarter of 1944, Redstone Arsenal was designated the official center for the screening and renovation of chemical ammunition returned from overseas and from depots in the United States. An agreement between Redstone and Camp Sibert permitted the training of CWS depot units in methods of loading, unloading, dunnaging, and renovating various chemical ammunitions. The first unit from Sibert arrived on 5 June 1944.

Improvements in Procedures

The packing of the 105-mm shell was changed from a short box and the M129, M130, and M133 containers to the long ammunition box and M105 fiber container. This, coupled with the elimination of the third wire on packing boxes, effected a considerable saving in manpower and costs and used the stocks of long boxes already on hand.

New specifications issued in the spring of 1944 stipulated that not only must ammunition boxes be stained but that a wood preservative and a fixing agent must be used to prevent the fading of the stain when exposed to sunlight for long periods. Redstone thus began to treat the 400,000 boxes on hand to comply with the specifications.

Other instructions directed that all rifle grenades be "jungle-packed." This procedure entailed more work and required a larger packing box because the grenade containers had to be packed first in a cardboard box wrapped in moisture-proof material and then dipped in a moisture-proofing wax before being put in the shipping box.

A number of product improvements were made. For instance, the Arsenal learned that pouring temperature and agitation of the mix had an effect on the quality of M5 burster charges. Through control of the pouring temperature, a more uniform product was achieved.

Also, the M104 auxiliary booster was first given to Redstone Arsenal as an experimental order with instructions to develop a manufacturing procedure for loading it with tetrytol. (The booster had heretofore been loaded with tetryl pellets.) The tests that Redstone conducted showed that tetrytol-loaded M104 auxiliary boosters had a greater brisance than the tetryl-loaded ones but that a heavier booster charge was required for detonation. Since such a booster charge was already available, the tetrytol-loaded auxiliary booster was considered more satisfactory than the tetryl-loaded one.

In September 1944, the Field Director of Ammunition Plants canceled the requirement for staining boxes except those for small arms ammunition. This would save 3-5¢ a box. It also freed about 20 Redstone employees for other work, as the Arsenal had built and was operating a staining plant.

The Arsenal found a more efficient way of tying retainers to the base powder charge. By using two pins instead of one to thread the retainer, operators increased their output per hour from 100 to 170 units.

Also, conversion of the preassembly of the M1 demolition block mold to a belt-conveyor operation increased production by about 20 per cent.

Changes in the loading and assembly of the 155-mm M116 shells saved 16 handlers a day while still producing 4,000 rounds in eight hours. This was accomplished by doing all operations in one building instead of transferring the painted shells to another building for assembly. Another change that saved 16 handlers a day was the moving of the shell painting equipment from Building 441 to Building 601 in Line 5.

The Field Director of Ammunition Plants authorized the use of Bates wire tie in place of the standard lead car seal as a method for sealing boxes, grommets on 155-mm shells, and lids on metal containers. This saved about 2,000 manhours a month.

Redstone began stenciling metal containers as they were unloaded from box cars to avoid unnecessary handling and problems that arose when the containers became wet and then frosted during the winter months. In the past, it had been necessary to pre-heat and thoroughly dry all surfaces of the containers before stenciling. The new procedure saved about 1,000 manhours a month.

The rifle grenade assembly line was redesigned to eliminate unnecessary handling. This released four operators per 8-hour shift for a production of 7,500 grenades.

When the Field Director of Ammunition Plants allowed 155-mm shells to be painted without removing the grommets, both the Ordnance Department and the Chemical Warfare Service benefited from lower costs. Redstone and Huntsville Arsenals saved 26 and 6 to 8 operators, respectively, per shift.

Manpower and Mechanization

An extensive recruiting program in the fall was successful in meeting most of the Arsenal's hiring needs. But more employees aggravated the transportation problem and necessitated additional bus service for new workers. The Arsenal leased Government buses to commercial carriers and induced several private operators to furnish transportation for Arsenal workers.

Nevertheless, there was an acute shortage of personnel on Lines 1 and 2 during the last quarter of 1944. Consequently, schedules were not met for M1 bursters, M1 demolition blocks, and M84 smoke shells for several months. The colored smoke rifle grenades and other smoke munitions were delayed by lack of components at Huntsville Arsenal. In December extremely cold weather, accompanied by snow and ice, caused slowdowns and shutdowns because of such diverse conditions as impassable roads and wet boxes.

One thing that was expected to ease the personnel problem was the half-million-dollar mechanization program approved by the Secretary of War in late 1944. Involving reconstruction, alteration, and additional equipment for all production lines and the ARFO (Ammunition Returned From Overseas) renovation line, it was expected to reduce manpower requirements by approximately 900 people so that increased production schedules could be met without hiring more personnel. Operations would be mechanized with conveyor belts, automatic loading machines, mechanical lifting and handling machines, and special handling equipment. The increased productivity of operations, it was calculated, would cause the project to amortize itself within a few months after completion. Maurice H. Connell

and Associates were the Architect-Engineers, and the C. G. Kershaw Contracting Company was in charge of construction.

1945

Expansion Begun

On 16 January 1945, the Arsenal announced a new expansion program costing \$5.5 million. Included in the program was a new production line, Line 6, additional transportation and storage facilities, and utilities. The C. G. Kershaw Contracting Company of Birmingham, Alabama, was in charge of construction. Maurice Connell and Associates of Miami, Florida, were Architect-Engineers. As already stated, Huntsville Arsenal ceded the land for the project.

Production Progress

The belt line for the loading and assembly of 105-mm ammunition continued to pay dividends. Besides yielding a higher quality product, the new method maintained a cleaner line and reduced the need for janitor and clean-up services by 25 per cent. Accidents on the line also decreased by 90 per cent. About 90 per cent of the previous intermediate storing and handling was eliminated. There was a reduction of over 50 per cent in manhours per 1,000 units.

Activated in early 1945, the Ammunition Renovation Section had reclaimed 28,000 81-mm mortar shells, 19,000 75-mm shells, and 18,000 105-mm shells, all white phosphorus-filled, by the end of March and reissued them to Field Service.

Component shortages, particularly canisters, delayed quite a few schedules as metal became more scarce.

By the time the Arsenal reached its third production anniversary on 27 March 1945, it had produced over 11 million high explosive burster tubes. In 1942 it shipped an average of two carloads of munitions a day. In 1945 it was shipping 20 carloads a day. In less than three years, it had won five Army-Navy "E" Awards for its production prowess. The Undersecretary of War bestowed the first "E" (standing for Excellence) on 28 November 1942. Stars appeared on the "E" flag* each time the Arsenal again earned the award, on 17 July 1943, 15 January 1944, 4 November 1944, and 23 June 1945.

New Processes

The loading and assembly of the M1 demolition block was changed by using a 3-story melt-pour building as well as conveyor belts throughout the line. The final assembly and packing were also performed on a belt conveyor. After being packed and strapped, the demolition blocks were loaded for shipment in foreign cars located at the line. By the use of foreign cars and the conveyor line principle, a 20 per cent saving in manhours resulted. Other advantages were high quality production and more effective supervision.

* Another flag the Arsenal was privileged to fly was the Minuteman "T" banner conferred by the Treasury Department on those installations having over 90% of their employees investing 10% of their earnings in War Savings Bonds. Redstone was the first activity in the Fourth Service Command to achieve this, on 5 May 1943, with 93.84% and 10.56%, respectively. Huntsville Arsenal followed on 30 September with 93.87% and 12% participation, getting its flag on 17 November 1943.

Renovation Practices and Techniques

If ammunition was obsolete or in such bad condition that it did not warrant renovating, the ammunition was disassembled and the components either reused, scrapped, or destroyed. Of the two principal ways of detecting faults and failures in ammunition, the first and most important was by testing random samples taken from each lot. The proof firing indicated failures in functioning that were typical of the entire lot. The other method was visual inspection, supplemented by the use of gages. The ammunition to be renovated fell into two broad categories: ammunition returned from overseas and ammunition rejected immediately after production. In the case of ARFO, defects resulted from severe handling and storage conditions.

Renovation of complete rounds involved five principal steps: unpacking and inspection; disassembly of complete rounds and removal of defective components; repair or replacement of defective components; reassembly of the rounds; and repacking. The renovation of each item varied with almost every lot of ammunition. Some items required repair or replacement of components; others required nothing but inspection and the replacement of packing materials.

Line operations in renovation were the same as in the production of new ammunition except for the unpacking, disassembly, and repair phases. Unpacking was done with hand tools. Special tools were needed for many operations. For example, when fiber containers were badly weathered, only non-sparking knives were safe to cut them away from the round. The disassembly of projectiles was done with hand wrenches and other hand tools. Special air-driven machines were used for pulling apart fixed

rounds and for removing primers from cartridge cases. After removing rust and corrosion from projectiles with hand devices or with sand blast equipment, Arsenal workers repainted and restenciled the projectiles. Wooden mandrils and non-sparking mallets were used to repair dented cartridge cases. Explosive components were replaced if they were faulty.

Expansion Completed

The mechanization and expansion programs begun in 1944 were essentially complete by V-J Day. They included the following. Line 1 gained four buildings and the necessary facilities and utilities; namely, one melt-pour building, two screening and storage buildings, and one change house, to produce 200,000 pounds of tetrytol bursters per month. Additions to Line 2 included three buildings, plus facilities and utilities, to increase the capacity of this line to 3,000,000 pounds of tetrytol demolition blocks per month. One of the two new buildings constructed in Line 3 was for processing ammunition returned from overseas. The other was a paint storage building. These, plus extensive renovation of existing buildings to adapt the line to mechanized assembly of 105-mm chemical shells, would enable the line to produce 625,000, instead of 235,000, rounds per month. Likewise, a new paint storage building and additions to existing buildings at Line 4 would permit production of 650,000 rounds of 81-mm chemical mortar shells per month. Changes to Line 5 and the addition of a storage building more than tripled the production capacity for 155-mm chemical shells—from 58,000 to 190,000 projectiles per month.

The completely new line, Line 6, was to handle both 81-mm chemical mortar and 105-mm chemical shells. It consisted of four manufacturing buildings, one change house, and one high-pressure boiler plant, along with all the necessary access roads, railroads, and utilities. The production equipment was never installed, however. Open field storage areas were set up near Line 6 to store ammunition returned from overseas. An elevated water storage tank, with a capacity of 200,000 gallons, was also installed near Line 6.

Additional trackage was laid in the classification yard to handle the increased traffic brought about by the overall expansion of the Arsenal. Five masonry warehouses augmented the inert warehouse area for the storage of components. Four igloos were expanded to twice their original size to accommodate the contemplated added volume of tetryl and TNT explosives.

An addition to the boiler house serving Lines 3 and 4 provided for another boiler and a central air compressor station. Permanent concrete interconnecting ramps and car unloading pads were constructed in the magazine area to expedite the handling of finished ammunition by electric lift trucks to and from the magazines, railroad cars, and trucks.

A combination change house, office, and receiving building was erected near the inert warehouse area to house the personnel controlling the flow of all materials in and out of the Arsenal. A reinforced concrete laboratory building was constructed to house precision equipment and all types of analytical works.

A 10-inch steel water main supply line was installed to give added protection and capacity to the water distribution system. An electric

utility building, constructed of masonry, was built next to the generating facilities for servicing and maintaining the electric fork-lift trucks and batteries used throughout the reservation.

Five 5-room frame staff houses were added. A 2-story, 46-room frame men's dormitory was built to house more employees. The southwest wing of the Administration Building was extended, and the kitchen was expanded. A second sewage plant doubled the capacity of the existing sewage disposal system. The building previously used as a stable was converted into a general utility building for the men's dormitory.

Personnel Picture

Both skilled and unskilled laborers were difficult to obtain in early 1945. Competition was keen. Workers returning to farms siphoned off a sizeable portion of the labor force, and the construction contractors further cut into the dwindling manpower market. Despite intensive recruiting, the Arsenal's needs were not met. Turnover again rose above 10 per cent.

A \$6,228 Federal Works Agency program was approved to provide child care facilities at Redstone Park to take care of employees' children. Long sought after by the Arsenal, this nursery was expected to reduce absenteeism and turnover considerably and release some mothers for employment. Also, the Office of Price Administration established a Tire and Gas Rationing Panel at the Arsenal so that employees could attend to rationing matters in less time.

Occupational deferments became increasingly harder to get in the lower age groups. Of the 61 first-quarter requests for deferment in the 26-29 bracket, only one was approved. In the 30-33 group, however,

all but three were approved.

In March 1945 the Civil Service Commission announced that Redstone Arsenal was leading all other War or Navy Department installations in Alabama in the use of physically handicapped persons. The percentage was 18.1. Another interesting statistic was that, from November 1944-April 1945, 1,960 individuals were treated in the dispensary for compensable injuries and illnesses.

The personnel dearth ended with V-E Day; in fact, a reduction in force was effected in June. The absentee rate declined when a number of chronic absentees were removed from the rolls. Many programs were discontinued altogether and others drastically reduced. Component shortages still hampered some schedules.

After V-J Day

All schedules were canceled on V-J Day. Production ceased on 17 August, although some lines operated part of the day to complete items in process. During the last quarter of 1945, there were no items manufactured or assembled at Redstone Arsenal. Nevertheless, Redstone expected to continue as a permanent manufacturing arsenal under the Ordnance Department, although with its activities greatly curtailed. The renovation and salvage of ammunition returned from overseas was an on-going program, for one thing.

Pending the announcement of its future work, the Arsenal put all unneeded civilians on annual leave. Only those employees required to decontaminate buildings and equipment remained. By the end of September, Lines 3, 4, and 5 had been cleaned and put in standby condition. The

decontamination of Lines 1 and 2 was completed by 31 October 1945, when these lines followed the others into standby status.

Contracts totaling \$4,782,005.63 were canceled between V-J Day and 31 December. During October, November, and December, settlements were reached on a no-cost basis on \$1,241,464.25 of the above amount. Negotiated settlements of claims were made on \$3,422,823.38 at a cost to the Government of \$146,583.02.

By the end of the year, Redstone Arsenal had declared \$600,000 worth of public property surplus. The Reconstruction Finance Corporation made sales totaling \$42,442 from property stored on the reservation. Sales of salvage and scrap items at the Arsenal grossed \$43,198 from V-J Day until 31 December 1945, exclusive of surplus property disposed of by other federal agencies. The largest amount of one item sold was 165,000 pounds of scrap brass. A large part of the scrap metal sold was a by-product of the ammunition renovation and destruction program. More than 300 different items were sold to residents of the Huntsville Area, including such articles as used small tools (hammers, pliers, files, wrenches), fencing and posts, and used pipes and fittings.

The demobilization and readjustment activities at Redstone followed plans carefully worked out in advance, obviating any major problems. A planning board established on 6 September 1944 assisted the Special Planning Officer in making tentative demobilization plans. The board consisted of the chiefs of the major operating divisions, the Personnel Officer, the Fiscal Officer, and the Special Planning Officer. The board reviewed the general plans developed by the Special Planning Unit before submitting them to the Commanding Officer for approval. Under the

general policies and directives of higher echelons, the plan of action for each organizational segment of the Arsenal was set in motion immediately following V-J Day. As the demobilization and readjustment program progressed, the Commanding Officer held staff meetings to adjust original plans to meet changing conditions. By the end of November 1945, the major reduction in force and primary readjustment of Arsenal activities to a peacetime basis had been accomplished. Military personnel no longer essential had been declared surplus or were scheduled for separation from the service as they became eligible. Civilian personnel no longer required had departed. Employees numbered 605 by the end of 1945. As personnel stood at 3,048 in July 1945, this represented an 80 per cent reduction.* Also, with operations cut back, many civilian positions were reclassified to a lower grade.

* Needless to say, the Nursery School never materialized. After V-J Day, there were not enough mothers employed at the Arsenal to justify the operation of the school.

XII. RETRENCHMENT AND RESURGENCE

For the next three and a half years, Redstone Arsenal was dormant. Renovating and salvaging of materiel continued until February 1947 when the Arsenal went on a standby status. Its standard force was about 225 people. Col. Carroll D. Hudson departed on 15 March 1946. His temporary replacement as Commanding Officer was Maj. Edwin J. Grayson, who served until Col. Duncan G. McGregor took over on 23 April 1946. After he left on 28 July 1947, his interim successor, for a week, was Capt. Louie Miller, Jr. Lt. Col. James O. Branch, who assumed command on 4 August 1947, stayed until 11 September 1948. Capt. Vernon W. Morgan was then in charge until 30 November 1948, when Colonel Hudson returned to guide the Arsenal through its reactivation period. He remained until the Arsenal was well into the missile era (7 May 1952).

During 1948 the Office, Chief of Ordnance decided to designate an arsenal to do research and development in the field of rocketry. On 1 June 1949 the Ordnance Department reactivated Redstone Arsenal to carry out this mission. As already noted, on 1 July the latter also became caretaker of all the land the buildings that had formerly comprised Huntsville Arsenal. The combined area was thus about 40,000 acres.* Early in 1949 tentative planning contemplated moving the Guided Missile Research and Development Center from Fort Bliss, Texas, to Redstone.

*The 9-17 June 1953 Mobile District Engineer's Real Estate Utilization Inspection Report listed Redstone Arsenal as having 31,998 acres of fee-owned land and 6,990 acres of land under a use agreement from TVA, the whole tract measuring about 6 by 10 miles.

In July 1949 it became officially known that the Fort Bliss research and development activity would transfer to Redstone.

For the next six months, the Arsenal made preparations for the move. In August 1949, a group of Army officers and former German scientists, who had been engaged in rocket research at Fort Bliss since World War II, visited the Arsenal to assess its facilities and were highly impressed with its possibilities. They suggested alterations in various facilities to adapt them to the new mission. Also in 1949 the Government contracted with the Rohm and Haas Company and the Thiokol Corporation to do research on rocket propellants. Both these companies moved onto the Arsenal.

About 450 people transferred from Huntsville Arsenal to Redstone Arsenal to give the installation a total strength of 720 (709 civilians, 2 officers, and 9 enlisted men) as of 1 July 1949.* The Arsenal's strength held fairly stable throughout the rest of the year, standing at 711 on 1 December. By January 1950, with the arrival of more military personnel, it had passed the 1,000 mark and by the end of the year had almost tripled (2,960).

From 1 June—31 October 1949, the Third Army completely funded Redstone Arsenal on an experimental basis under the Territorial Command Test. Upon discontinuance of this exercise, the Chief of Ordnance again started financing for those activities that were an Ordnance responsibility

*The Payroll Section reported in the Redstone Arsenal Historical Summary, V-J Day to 31 December 1950, that "As of 1 June 1949, there were approximately 650 employees in total and during the month approximately 450 additional were transferred from Huntsville Arsenal, due to the deactivation of that installation." This statement appears to be in error, however, for the personnel strength chart in the same volume giving monthly figures from 1 July 1949—31 December 1950 does not bear this out. Nor does the Huntsville Arsenal History, January—June 1949.

and the Third Army funded only activities of a housekeeping nature. In December 1949, OCO authorized the use of a standard stock fund to defray overhead costs.

Before 1 July 1949, the Post Finance Office operated as a Class "B" Agent to the Atlanta Finance Office of the U. S. Army. Located at Huntsville Arsenal, it serviced both that Arsenal and Redstone Arsenal. Beginning on 1 July 1949, this office was closed at Huntsville Arsenal and reactivated at Redstone Arsenal, operating on a staff level. Indicative of the limited scope of the activity is the fact that, until mid-1950, cash held on hand to accomplish the mission did not exceed \$3,000, the amount authorized by the Chief of Finance.

When, in 1950, Congress appropriated funds for additional construction at Redstone, it appeared that the Arsenal had attained a viable existence. As of 1 April 1950, Huntsville Arsenal was completely deactivated. Its facilities were consolidated with those of Redstone Arsenal and from the combination emerged the new Redstone Arsenal, Guided Missile and Rocket Research Center. With the arrival of a complement of officers and 120 former German scientists from Fort Bliss in April 1950, the Arsenal entered the missile era.

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