THE WORLD WAR II ORDNANCE DEPARTMENT'S GOVERNMENT-OWNED CONTRACTOR-OPERATED (GOCO) INDUSTRIAL FACILITIES: LAKE CITY ARMY AMMUNITION PLANT HISTORIC INVESTIGATION

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U.S. ARMY MATERIEL COMMAND HISTORIC CONTEXT SERIES
REPORT OF INVESTIGATIONS
NUMBER 10A

GEO-MARINE, INC.

US Army Corps
of Engineers
Fort Worth District

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This report presents the results of an examination of historical records related to the construction and operations of the Lake City Army Ammunition Plant (LCAAP), Jackson County, Missouri. This project was undertaken as part of a larger Legacy Resource Program demonstration project to assist small installations and to aid in the completion of mitigation efforts set up in a 1993 Programmatic Agreement among the Army Materiel Command, the Advisory Council on Historic Preservation, and Multiple State Historic Preservation Officers concerning a program to cease maintenance, excess, and dispose of particular properties. As part of the larger project to develop the national historic context of seven sample installations on a state and local level, the major focus of the project at LCAAP was to document the impacts that the facility had on the state and local environments.

The project was conducted by Bear Creek Archeology, Inc., under subcontract to Geo-Marine, Inc., during February 1995. Duane Peter, Senior Archeologist at Geo-Marine, Inc., served as Principal Investigator. Scott C. Shaffer, Deborah L. Crown, and Wendy J. Eliason conducted the archival research and oral history interviews necessary for completion of this report.

As one of the Ordnance Department's Government-Owned Contractor-Operated industrial facilities, LCAAP was designed to provide munitions and materiel for European and American forces during World War II. In addition to the technical aspects of munitions production, this report discusses the direct and indirect effects construction and operations had on Kansas City, Jackson County, and the surrounding small communities.

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MANAGEMENT SUMMARY

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We also wish to express our appreciation to the current employees of the Lake City plant for their expertise and willingness to assist us in the research for this project. Ms. Blanca Roberts, our primary contact at the plant, was invaluable in assembling information and facilitating the interviews.

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CHAPTER 1
INTRODUCTION

This report is the result of historical research into the origins and development of Lake City Army Ammunition Plant (LCAAP), in Jackson County, Missouri. In September 1993, the U.S. Army Corps of Engineers (USACE), Fort Worth District, contracted with Geo-Marine, Inc. (GMI), to conduct research and documentation at a number of ammunition plants under the jurisdiction of the Army Materiel Command (AMC). This work was to mitigate the effects of "a program to cease maintenance . . . and dispose of certain . . . properties" owned by the government (Scope of Work [SOW] 1993:1). The investigation was extended to include LCAAP and research was initiated in 1995 with Duane E. Peter, Vice-President of GMI's cultural resources management division, serving as Principal Investigator. In August 1995, Scott C. Shaffer, Deborah L. Crown, and Wendy J. Eliason conducted the research. The work was performed under Contract No. DACA63-93-D-0014, Delivery Order No. 089.

This report presents the results of research into the historical record of the LCAAP. Chapter 2 of this report presents the objectives of the research and the methods by which the investigations were carried out. The historical context (Chapter 3) includes a discussion of the military and political setting and a detailed description of the construction and World War II-era operations of the facility. The second part of Chapter 3 discusses the social impact the construction and operation of the plant—initially known as Lake City Ordnance Plant—had on the surrounding communities. A discussion of the effects of the end of the war and the postwar activities follows. The final part of the chapter consists of a summary and conclusion, and a list of references cited concludes this report.

CHAPTER 2
OBJECTIVES AND METHODS

METHODOLOGICAL APPROACH

Historic contexts are a cornerstone of the historic preservation planning process in the United States. The Secretary of the Interior's Standards for Preservation Planning state:

> Decisions about the identification, evaluation, registration and treatment of historic properties are most reliably made when the relationship of individual properties to other similar properties is understood. Information about historic properties representing aspects of history, architecture, archeology, engineering and culture must be collected and organized to define these relationships. This organizational framework is called a "historic context." The historic context organizes information based on a cultural theme and its geographical and chronological limits. Contexts describe the significant broad patterns of development in an area that may be represented by historic properties [National Park Service (NPS) 1983:44717].

Historic context development results in a document that is designed to serve both the technical and informational needs of preservation planners. A single historic context describes one or more significant historical themes or patterns of historical development represented by individual historic properties. Historic contexts are developed at a variety of scales, delineating important themes relating to the heritage of a neighborhood, town, county, region, state, or the nation as a whole (NPS 1991:9-10). Thematic, geographical, and chronological boundaries between historic contexts often overlap. While the goal of historic context development is the creation of a complete, fully documented, comprehensive study of a particular set of cultural resources, it is assumed that historic contexts will need to be refined and modified as more data become available.

Historic context research and writing involve five basic steps: (1) identify conceptual, geographical, and temporal boundaries; (2) define research questions; (3) assemble and analyze existing data about the historic context; (4) synthesize the data in the form of a written narrative; and (5) identify information needs. These activities need to be carefully planned in order to produce a useful final product and must take into account the sponsoring agency's planning needs; its legal obligations under the National Historic Preservation Act (1992, as amended); Executive Order 11593, and other preservation regulations; time and funding limits; and the nature of the cultural resources under investigation.

Lake City Army Ammunition Plant (LCAAP) was originally referred to as the Lake City Ordnance Plant (LCOP). This designation continued through the World War II operation. After a tremendous contribution

to the United State's World War II war effort, LCOP's name designation was changed to the Lake City Arsenal (LCA). The facility was inactivated in 1945 and placed in standby status. For the next six years, only a handful of military and maintenance personnel were kept at the plant. In December 1950, the plant was reactivated to help meet the nation's military ammunition needs during the Korean War. The third and present name designation of LCAAP was assigned during the Vietnam War. The facility has always been referred to as just "Lake City" by operating personnel and local residents. Development of the historic context for the LCAAP involved archival research in both primary and secondary source materials. Primary sources of information concerning LCAAP included published and unpublished documents and graphic material generated by various agencies of the U.S. government and its contractors, state and local governments, and individuals connected with LCAAP. Of particular interest were the textual and graphic records of the property's physical development and operation. Much of this material has been deposited in the National Archives or is on file in the LCAAP archives vault located at the plant. Additional data are archived at the USACE, Rock Island and Fort Worth district offices.

Secondary sources consisted of books, monographs and pamphlets; articles in scholarly and professional journals and magazines; articles in newspapers and popular periodicals; maps, atlases and plans; and unpublished research papers and reports. A limited number of general works on U.S. military history, wartime arms production and industrial architecture were also consulted. Bibliographic control for research in secondary source materials was provided by a number of standard reference works, the most useful of which were those compiled by Higham (1975) and Higham and Mrozek (1993). A substantial amount of archival material from the National Archives was photocopied, and additional archival research was carried out at LCAAP.

Five oral history interviews were conducted in June 1995 in order to provide some insight into the plant workers' perspectives of not only LCAAP, but of World War II and the changes that the Kansas City area experienced during the plant's early years. Oral history interviews were conducted, according to guidelines, with three women and two men, all of whom were employed at LCAAP during World War II. The interviews were recorded for approximately 60 minutes each, using a high quality Marantz PMB 430 portable cassette recorder. The questions asked during the interviews were prepared prior to conducting the interviews. Informants were asked about working at the plant and about general conditions of the local area during the war. The tapes were indexed, but not transcribed. Data obtained from the oral histories are incorporated into the "Social History" section of this document.

The first interview was conducted in Independence, Missouri, with Ms. Rosalind Priest at her home. During World War II, Ms. Priest worked in production on final trim and head turn. She is a life-long resident of the area and was living in her present house when she went to work at LCAAP. After World War II, Ms. Priest worked at Barbie Frocks (a garment manufacturer) and later at a local hospital.

Ms. Frances "Frankie" Brasington, long-time resident of the Kansas City area, was interviewed at her home in Independence, Missouri. During World War II, Ms. Brasington worked in inspection and, on occasion, in packing. She quit her job before the end of World War II and moved to California to be with her husband, who was in the military.

The third interview was conducted with Alice McEldery at her home in Independence. Ms. McEldery, a life-long resident of the area, was living in her present home and working in the home when World War II began. While her husband awaited his call into the military, Ms. McEldery worked at LCAAP in the box factory (stenciling and painting boxes in which the ammunition was to be shipped) and in soldering. She quit her job before the end of World War II in order to be home with her family.

Mr. Dale Pollard was interviewed at LCAAP in Lake City. Mr. Pollard began work on construction of the plant in 1941. He later worked for the chief factory clerk doing inventories of ammunition and tracking employee time cards and absenteeism. Mr. Pollard left the plant briefly during World War II to join the

military. He returned to the plant in 1945 and assisted in putting the plant in layaway. He worked at the plant again beginning in 1950 during reactivation for the Korean operation. After attending several government schools, Mr. Pollard became the Contract Operations Officer in 1978, and was the highest-ranking civilian at LCAAP. He was a supervisor at the plant for over 40 years until his retirement in the fall of 1995.

The fifth and final interview was conducted with Mr. Cornelius Lundy at his home in Kansas City. Mr. Lundy, an African American, worked on construction of the plant laying railroad ties. Mr. Lundy worked as a janitor during World War II, but was eventually promoted during the Korean operation to tool setter for final inspection. He continued to work at the plant until his retirement in the late 1960s.

Both the historical documents and oral histories should be viewed as important tools for understanding the past, and the present study is not an argument for the superiority of one over the other. Middle range theory suggests that the disparity between certain data sets, in this case documentary and oral tradition evidence, be considered as "ambiguity" (Leone and Potter 1988). This ambiguity can only be clarified through a critical use of all available resources. The middle range theoretical approach has been criticized as reductionism (Beaudry 1990:116; Hodder 1986:4); however, interpretation, like any form of human perception, is reductionist. This reduction is lessened by acknowledging the diversity of biases inherent in both documentary records and oral history tradition, as well as the multiplicity of possible and potential interpretations. The present study intends to use documentary records and oral history tradition in a complimentary fashion, in order to create a richer interpretation of the socio-cultural history of the people who were involved with LCAAP during World War II.

CHAPTER 3
HISTORIC CONTEXT FOR LAKE CITY ARMY AMMUNITION PLANT, A WORLD WAR II ORDNANCE DEPARTMENT GOCO INDUSTRIAL FACILITY, 1940 - 1995

AN INTRODUCTION TO THE LAKE CITY ARMY AMMUNITION PLANT

LCAAP is a complex of industrial buildings, structures, sites, and landscapes that has historical significance in its World War II-era production history as well as its subsequent and present-day missions. It is located in Townships 49 and 50 north and Ranges 30 and 31 west, Jackson County, Missouri, in a rural setting (Figure 1). This location is approximately 17 miles east of downtown Kansas City, Missouri, seven miles east of Independence, Missouri, and six miles north of Blue Springs, Missouri. The facility is situated between the east-west running U.S. Highway 24 to the north and Interstate 70 to the south. State Highway 7 runs along western border of the plant. The physical geography of LCAAP is characterized by flat lowlands and steep-sided ridges. The lowlands, at an approximate elevation of 740 feet above mean sea level, are part of the broad valley bottom of the Little Blue River and West Fire Prairie Creek. An unnamed lake, which inspired the name Lake City, once existed within the present site boundaries. The lake was drained in the 1880s (Brown et al. 1979), leaving lowland swamps until more recent drainage improvements and ground leveling.

The original property boundaries encompassed 3,908.22 acres, which included 236 buildings exclusive of 104 minor structures such as water tanks, pump houses, control towers, sentry boxes and gate houses (Figure 2; Table 1). Original production and support buildings covered 1,507,000 square feet of manufacturing area. As of 1995 LCAAP federal land totals 3,935 acres and includes over 400 buildings and structures, 34 acres of parking areas, 11 miles of paved six-foot-wide walkway, 51 miles of paved roads, and two million square feet of space devoted to production facilities. The installation is owned by the federal government and is presently part of the U.S. Army Industrial Operations Command (IOC; Figure 3).

Contextually, LCAAP is a product of the government-owned contractor-operated (GOCO) war materiels production program established by the War Department just prior to World War II. As the LCOP, the facility was the first of the new GOCO small arms facilities to be established under the War Department's program to expand small arms ammunition production in the United States. The facility was originally under the War Department's Ordnance Ammunition Command and was not made a permanent Department of the Army installation until July 1, 1954. Acquisition of the original 3,908.22 acres of land from 24 different landowners cost approximately $680,000, with the original 219 buildings and support facilities costing an additional $51,000,000. LCOP was a permanent Class II industrial installation originally designed and

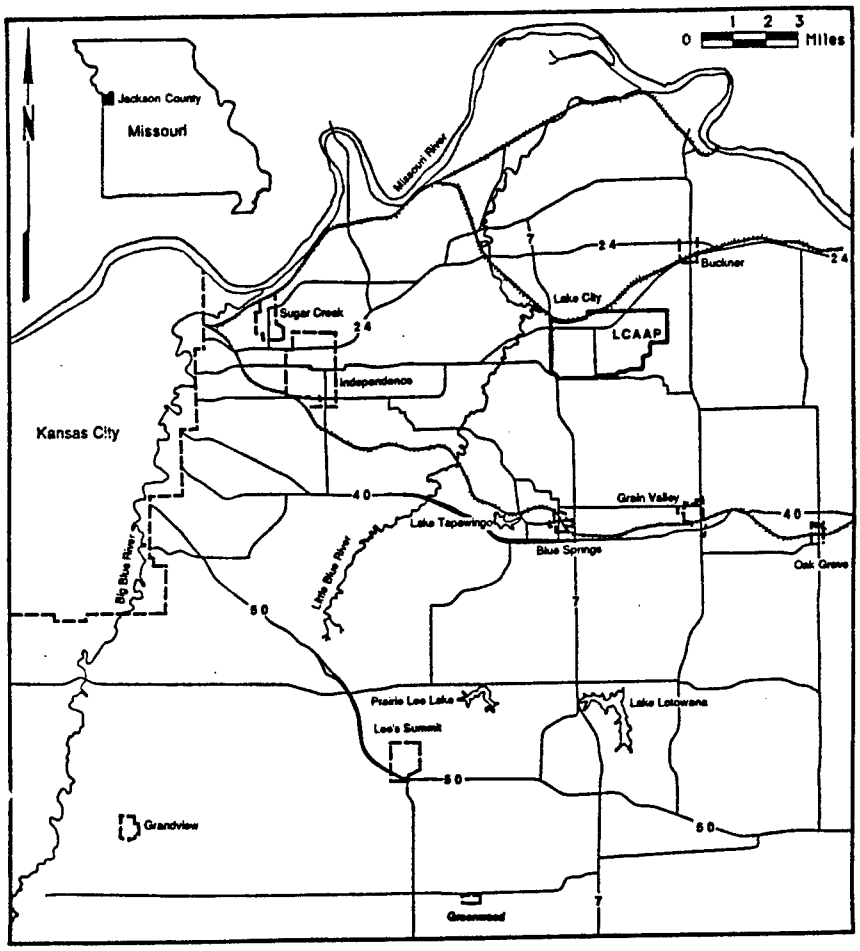


Figure 1. Scale map showing location of LCOP within Jackson County, Missouri.

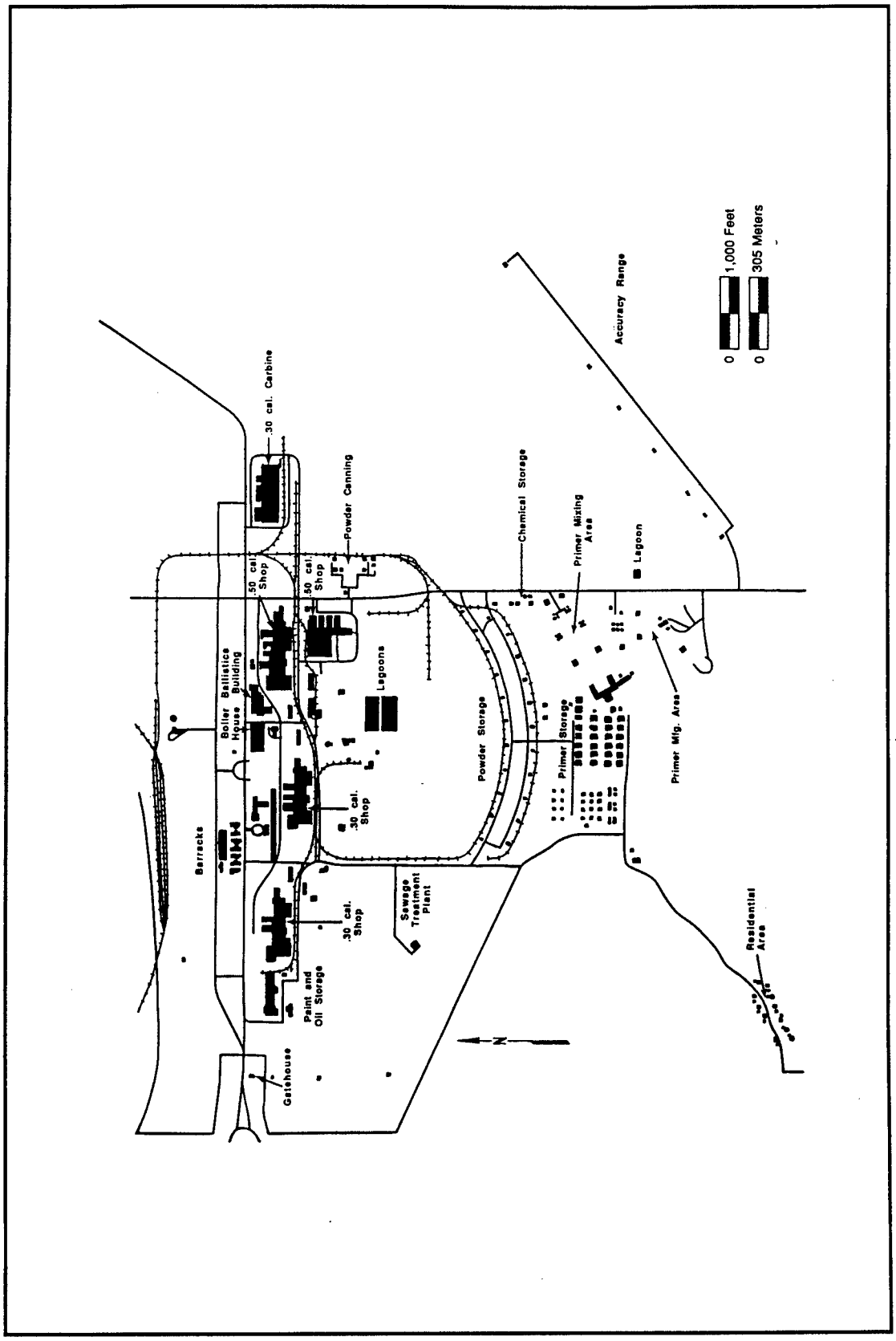


Figure 2. Scale map showing LCOP layout during World War II.

Table 1
List of Major Buildings and Structures*

Building Number	Description
1	.30-caliber Manufacturing
2	.30-caliber Manufacturing
3	.50-caliber Manufacturing
3A	.50-caliber Manufacturing
4	.30-caliber Carbine
5	Administration
6	Guard & Gate House
7	Obsolete Records
8	Ballistics
9A-C	Water Towers
10	Tool & Gage Shop
11	Lead Shop
12A & B	Miscellaneous Storage
13	Salvage
14	Garage & Shed
15	Boiler House
16	Water Treatment Plant
17A-K	Well Houses
18	Sewage Treatment Plant
19A-U	Powder Storage Buildings
20A & B	Empty Powder Case Storage
21	Sampling Magazine
22A-C	Service Magazine
23A-C	Canned Powder Magazine
24A-D	Canned Powder Magazine
25	Magnesium Storage Building
26	Nitrate, Chlorate & Peroxide Storage
27	Chemical Storage
28A-C	Tracer Chemical Distributing Houses
29A-B	Primer Chemical Distributing Houses
30	T.N.T. & P.E.T.N. Storage Magazine
31	P.E.T.N. Dry Houses
32A-C	Primer Pre-dry Houses
33A-F	Primer Mixing Buildings
34A-F	Primer Mix Control Buildings
35	Primer Manufacturing Building
36A-C	Tracer Distribution Houses
37A-B	Ballistics Storage Magazines
38A-C	Tracer Composition Manufacturing
39A-D	Tracer Composition Storehouses
40A-C	Primer Pre-dry Houses
41A-C	Primer Dry Houses
42A & B	Primer Composition Storehouses
43	Composition Storehouse

Table 1 (cont'd)

Building Number	Description
44A-H	Igniter Composition Storehouses
45	Proof House
47	Target House
48A & B	Target Houses
49A-X	Primer Storehouses
50	Water Reservoir
51	Forge Shop
52A-D	Vacuum Pump Houses
53	Powder Area Locker Room
54A & B	Attendants Stations
56A-D	Observation Buildings
57	Fire House
58	Gas Meter House
59	Condensate Pump House
60	Control Towers
61 & 62	Sentry Boxes
71A & B	Primer Canning
72	Office & Locker Room
73A-T	R-6 Composition Storehouses
74	R-6 Ingredients Storehouse
75	Explosive Laboratory & Office
77	Oil & Acid Storehouse
78	Oil Unloading Pump House
80A & B	R-6 Storage Buildings
81 & 85	Precipitator & Disposal Houses
82 & 83	Nitrator & Disposal Houses
84	Olnol Storage House
86	Polnol Storage House
87	Sensol Storage Igloo
88	Polnol Active Storehouse
89	Sensol Active Storehouse
90A & B	Neutralizing & Disposal Tanks
91A-F	Air Compressor Houses
92	Primer Storage Building
93A-C	Industrial Waste Treatment Plant
94	Acid Distribution
95A-H	Ignitor Storehouses
96	Scrap Blasting Pit
97	Explosive Scrap Burner
98	P.E.T.N. Dry Storage Magazine
99	Sand Dry House
100	Polnol Storage Unit
101	Short Flight Observation
114A-K	Staff Residences
T-200 - T-204, T-217, T-218, T-225	Barracks

* Data taken from USACE 1943

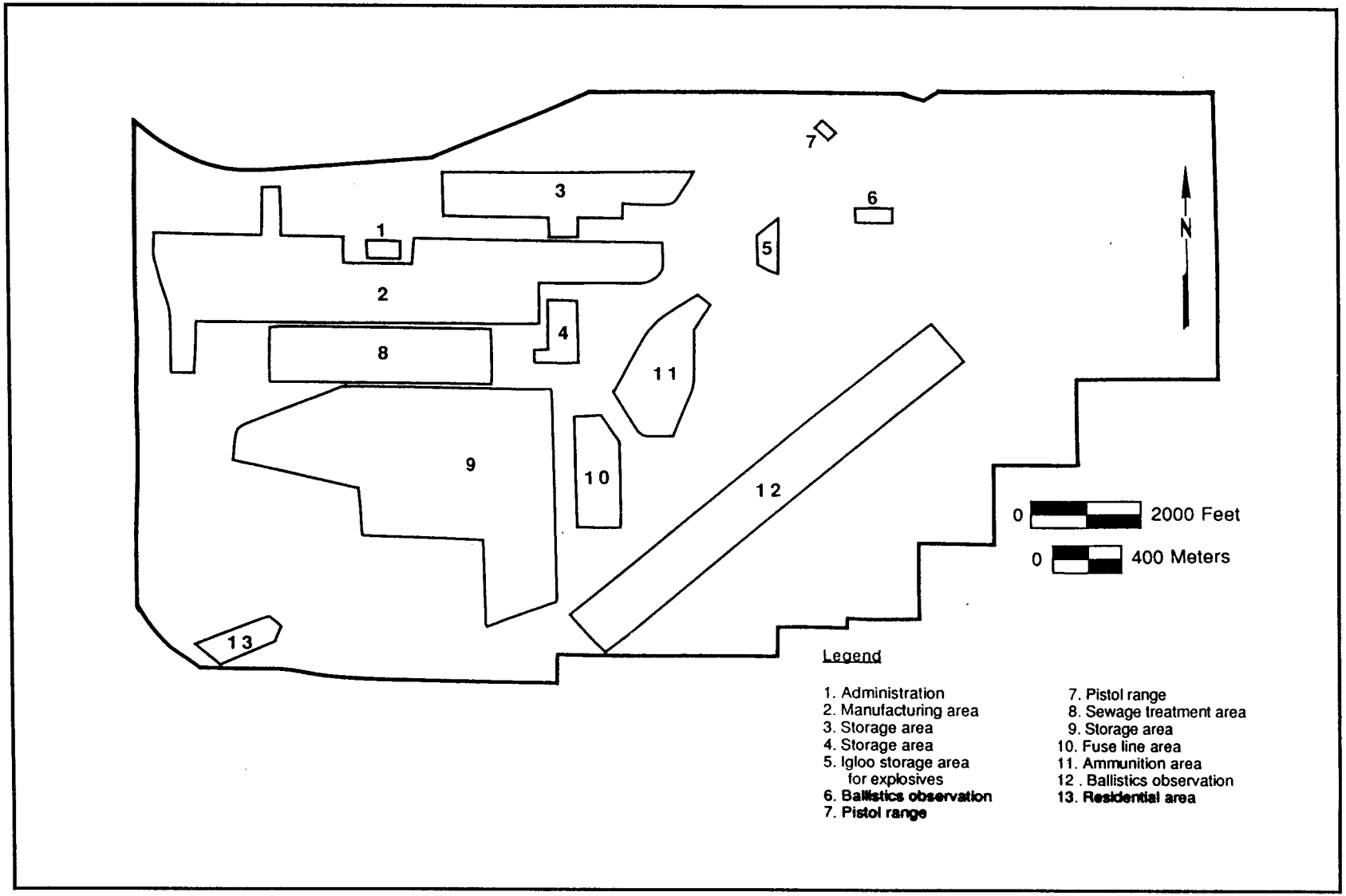


Figure 3. Scale map designating present facilities at LCAAP.

constructed, immediately prior to and during World War II, to produce .30-caliber cartridges, .30-caliber carbine, and .50-caliber ammunition. Additionally, primer manufacturing and mixing as well as tracer, igniter, and special composition manufacturing also took place at LCOP during World War II.

The history of LCOP is of special interest. Much that was accomplished on this initial undertaking proved to be the foundation for more extensive achievements later. This is true not only on the part of the LCOP contractor-operator, but of other companies as well. At LCOP, the original contractor-operator for the War Department was the Remington Arms Company (Remington) of Bridgeport, Connecticut. On September 3, 1940, Remington was first informed that the government desired its services in connection with the construction, equipment, and operation of a facility having a daily capacity of 1,000,000 .30-caliber and 600,000 .50-caliber cartridges. A letter of intent, dated September 10, authorized Remington to proceed with the project. This letter was superseded by the formal contract, W-ORD-484, on November 25, 1940. This contract doubled the previously specified .30-caliber capacity, calling for daily production per 24 hours of 2,000,000 .30-caliber and 600,000 .50-caliber cartridges (LCOP 1943a:5-6).

The construction of the facility demanded a close working relationship between the Ordnance Department, the Quartermaster Corps of the War Department, Remington, the Architect-Engineer, and the construction contractor. The Ordnance Department was the owner of the facility. The Quartermaster Corps (later the Corps of Engineers) was the Ordnance Department's representative with respect to construction. Remington was responsible for adequacy of construction for the manufacture of ammunition as specified in its contract. The Architect-Engineer (Smith, Hinchman and Grylls of Detroit, Michigan) provided plans and specifications. Two construction contractors were selected by the government with Remington's approval: both Foley Brothers of St. Paul, Minnesota, and Walbridge-Aldinger Company of Detroit, Michigan, engaged for the construction work under separate contracts.

While the technical planning of the facility began in October 1940, actual construction commenced on December 16, 1940. This earliest construction included temporary buildings only. The groundbreaking ceremony took place on December 26, and excavation started for the plant proper on December 30, 1940. Approximately eight and one-half months later, on September 12, 1941, the first loaded .30-caliber cartridges were produced. These were followed, on November 27, 1941, by the first .50-caliber cartridges. Interestingly, two days before the Japanese launched their air attack on the United State's Pacific fleet at Pearl Harbor, the Ordnance Department announced their Third Wave expansion of the small arms ammunition program (LCOP 1943b:6); this included increasing the capacity at LCOP. While construction was completed on August 31, 1943, sporadic additions and improvement construction continued until V-J-Day.

Complete termination of Remington's prime contract took place on August 28, 1945. On December 1, 1945, the function of the LCOP changed from active production to standby storage of machinery, equipment, and buildings. During this period the facility was under government supervision, with only a commanding officer and civil service employees. In the interim period, from August 28 to December 1, the plant was contractor-operated, but no production activity was carried on (LCOP 1945a:314). By the end of World War II, LCOP had delivered to the government over five and one-half billion rounds of small arms ammunition, including 2,700,000,000 of .30-caliber, 1,500,000,000 of .30-caliber carbine and 1,300,000,000 of .50-caliber. In addition to the number and types of rounds stated above, LCOP World War II production included 61,522,365 rounds of .30-caliber ball frangible, 8,334,533 rounds of .30-caliber rifle grenade, 24,482,052 rounds of training and gun functioning ammunition and the facility loaded 24,960,256 20-mm incendiary shells (LCOP 1943a:Appendix I:3).

In August 1950, personnel from the Office of the Chief of Ordnance advised Remington that a partial reactivation of LCA was anticipated (LCA 1951:1). This originally involved 25,000,000 .50-caliber ball and 75,000,000 .30-caliber armor-piercing rounds. Production schedules, which included the manufacture of ordnance never before produced, were soon increased. New ordnance production included manufacture and

assembly of 30-mm rounds and M505 fuse load and assembly (LCA 1956:7). By June 1952, all manufacturing buildings were running three shifts, six days a week, and 5,621 people were employed in the production section (Remington Arms Company 1967:22). After the Korean War armistice in July 1953 schedules were reduced, and by 1960, only 383 were employed in the production section (Remington Arms Company 1967:22).

Due to an escalation of the conflict in Southeast Asia, production schedules were once again increased in 1966. All manufacturing buildings were put in operation, and many former employees and new employees were hired. During the Vietnam War, production employment peaked at 5,047 (Remington Arms Company 1967:22). Today, due to the reactivation of other army ammunition plants and the lack of participation in a major conflict on the part of the United States, the demands on LCAAP have eased, and production requirements are presently below peak levels.

Since 1951, LCAAP's production capacity has been increased by the construction of several new buildings housing various 20-mm units. A total of 114 types of ammunition or components thereof, totaling more than 11 billion rounds, has been produced at LCAAP since 1951. In addition to the regularly scheduled production, LCAAP has produced 260 special or miscellaneous lots of ammunition or components totaling over 5 million rounds since 1951 (Remington Arms Company 1967:22). Interesting miscellaneous munitions include the 20-mm spotting M101 round fabricated from depleted uranium and the .30-caliber and 7.62-mm National Match rounds. These are described in detail later in this report.

The LCAAP is historically significant because of its historical, physical, and social association with U.S. industrial mobilization during World War II and the development of the military industrial complex during the postwar and Cold War periods. This is especially true for its contribution to innovations in small arms manufacturing. Many of these innovations were in manufacturing process engineering, ballistics engineering, and control and inspection. Additionally, World War II industrial mobilization and its long-term effects on American culture and society represent a significant broad pattern of events, and the LCAAP reflects the importance of the war on the home front. The effect of this facility's impact on both a quiet, rural farm district and the nearby urban Kansas City area is further evidenced in the oral histories conducted during the course of this investigation.

Several significant aspects of LCAAP's World War II and Cold War production have been presented above. These will be discussed in greater detail below. Also of interest are the construction process, employment trends, technological history, and the social history associated with the facility, all of which will be discussed below. In her contextual overview for the Ordnance Department's World War II GOCO industrial facilities, Kane (1995) has outlined several potential research subjects which may be associated with the LCAAP. These include: the production of ball frangible, .30-caliber carbine, armor-piercing incendiary, and carbine grenade rounds; the change from copper to steel bullet jackets and cartridge cases; innovations in packing for shipment; innovations in inspection; the use of plastic cartridge components; and the use of high-speed, computer-monitored machinery. Kane (1995) also defines criteria that should determine if equipment at LCAAP is significant under National Register Criteria. These research topics will be addressed below.

Architecturally, portions of the property are significant as products of mid-twentieth-century industrial and military design, and many areas of the plant retain much of their 1940s character. Being a First Wave facility, LCOP was designed and built as a permanent Class II industrial installation. The major production and support buildings constructed during World War II were two-story, brick-faced, permanent structures, with reinforced concrete and structural steel framework. Many exhibit architectural distinction, and collectively they represent a specific historical environment. While some of the production machinery has been slightly modified, much hardware is of World War II vintage and may be important to engineering history because of LCOP's role in the development and implementation of production technologies.

MILITARY AND POLITICAL CONTEXT

The American War Machine

The first global war of 1914-1918 mobilized entire societies in the pursuit of victory, with the military application of industrial technology producing revolutionary effects both on the battlefield and the home front. The U.S. entry into the war in 1917 forced the military to launch a crash program for arming the nation. Eventually, an army of nearly five million was raised, one million of whom were sent "over there." In its effort to arm, clothe, feed, and transport the military, the federal government created a giant new bureaucracy to run a managed national economy. Under the energetic leadership of Bernard Baruch, the War Industries Board (WIB) allocated strategic resources, set factory production schedules, and established a comprehensive government purchasing policy. Millions went to work in factories, where government contracts guaranteed high wages, an eight-hour work day, and equal pay for comparable work. The demands of war production brought unprecedented numbers of women, African Americans, Mexican Americans, and other nontraditional industrial workers into the job market. To forestall worker discontent, the Wilson administration created the National War Labor Board (NWLB), appointing Samuel Gompers of the American Federation of Labor (AFL) to one of the seats on the Board. The NWLB guaranteed the rights of unions to organize and bargain collectively on behalf of war industry workers. The logistical achievements of the U.S. in World War I were impressive, with more than eight million tons of military supplies delivered to Europe in less than 19 months (Baruch 1941).

With the signing of the armistice on November 11, 1918, most Americans genuinely believed that the Great War had been the "war to end all wars," and the national military establishment was promptly dismantled, along with much of the centralized economic and industrial planning bureaucracy. U.S. industries quickly invested their wartime profits into the production of consumer goods, and the small military establishment was content to make do with surplus equipment and stores. With the national debt running at $20 billion in 1920, roughly 10 times its prewar level, Congress was little inclined to invest more in defense planning or preparation (Fussel 1975).

The National Defense Act of June 4, 1920, literally turned back the clock for the U.S. military by reverting control of logistical functions to the individual service supply departments. Procurement was taken out of the hands of the services and placed under civilian control, and the Office of the Assistant Secretary of War (OASW) was made responsible for planning (Risch 1989:562-585). Fourteen ordnance districts were created and charged with undertaking industrial surveys and mobilization plans (Cambell 1946:23). Missouri was included in the St. Louis District (Thomson and Mayo 1960:14). From 1920 until 1942 there was no centralized command over the supply bureaus and virtually no coordination of the national defense logistics system below the level of the secretary of war (Green et al. 1955).

"In the early 1920s, America's industrial mobilization plan and records consisted of a few notecards in an old shoebox" (Murphey 1993:2). The Army-Navy Munitions Board, the brainchild of Assistant Secretary of War Dwight F. Davis, was created in June 1922 in an attempt to facilitate interservice planning, but was underfunded and lacked the necessary political support to be effective. The Munitions Board sponsored a series of Industrial Mobilization Plans (IMPs) and championed the concept of a centralized command authority for economic and industrial mobilization, but otherwise accomplished very little that would serve the nation's interests in the next war. It was not until the 1930s that the War Department began to undertake realistic planning for another global war. Even then, however, the General Staff was preoccupied with manpower issues and neglected problems of industrial mobilization and supply (Smith 1991:39-45).

During the two decades between the world wars, the U.S. was a minor producer and supplier of military hardware. Armaments production between 1920 and 1940 was concentrated in six "old line" arsenals with production facilities dating back to the early nineteenth century. Before Lend-Lease, arms exports were

negligible, and U.S. army units relied upon World War I stockpiles of weapons and ammunition. Several factors contributed to this situation. First and foremost, the traditional American ambivalence toward involvement in foreign affairs fostered isolationist policies that caused the U.S. to adopt a posture of military neglect. At the same time, successive Congresses showed little inclination toward funding anything more than the most rudimentary national defense establishment, particularly land-based forces. This reflected a basic conviction, held by the majority of Americans during the interwar period, that a large peacetime military establishment was antithetical to traditional American notions of what constituted the national defense. Another reason for military neglect was the cost of the armaments themselves. Consequently, the low priority the national leadership assigned to military affairs served to dampen the Army's own institutional desire to modernize and prepare.

A renewal of the arms race among the great powers occurred in the 1930s, with the U.S. the most reluctant participant. From 1931 onward, the Japanese aggressively expanded their empire at the expense of the Chinese, while in Europe the rise of Italian and German fascism made a general war inevitable by the time Hitler's forces occupied the Rhineland in 1936. Encouraged by the British and French governments' policy of appeasement, the Nazi dictator marched his troops into Austria in 1938 and Czechoslovakia in 1939. On September 1, 1939, the Germans invaded Poland, and on September 3 Great Britain and France declared war on Germany. Within a year, German forces had overrun Denmark, Norway, and the Low Countries, and had forced the capitulation of France; only the British Isles remained unconquered. In June 1941 Hitler turned against the Soviet Union, bringing the British some reprieve from a situation that had appeared hopeless. Japan secured control of French Indo-China after the fall of France, and when the U.S. and Great Britain responded with economic sanctions, including an oil embargo, Japanese leaders set in motion plans that would culminate in the December 1941 strikes against Hawaii, the Philippines, Malaysia, and the Dutch East Indies.

Frustrated by neutrality legislation and opposed by isolationist political forces, President Franklin D. Roosevelt formed the War Resources Board (WRB) in August 1939, but its recommendations were largely ignored, and it disbanded after a few months. The German invasion of Poland provided Roosevelt with his first opportunity to ask Congress to authorize additional funds for national defense. Roosevelt also sent his Secretary of War, Henry L. Stimson, to ask Congress to amend the National Defense Act to give the Secretary complete authority over military procurement. This was accomplished, and on May 25, 1940, the Roosevelt administration created the Office for Emergency Management. Four days later Congress established the Advisory Commission of National Defense, in effect the first war mobilization superagency, whose functions were shortly thereafter absorbed by the Office of Production Management (OPM), which was itself replaced by the Supply Priorities and Allocations Board (SPAB) in August 1941. The Military Supply Act passed by Congress on June 13, 1940, contained a $1.8 billion appropriation for defense projects and put the U.S. on the path to becoming the world's foremost producer of armaments (Green et al. 1955; Thomson and Mayo 1960).

On December 29, 1940, in a famous year-end "fireside chat," Roosevelt proclaimed that the U.S. must be the "arsenal of democracy" for Great Britain. Five months later, the president declared an unlimited state of national emergency shortly after signing the Lend-Lease Act into law. Based upon a 1940 agreement between the Roosevelt administration and the government of Prime Minister Winston Churchill, under the Lend-Lease Act the U.S. "loaned" Great Britain 50 obsolete destroyers in exchange for base rights in the British Commonwealth and committed the industrial power of the U.S. to the defeat of Nazi Germany and Fascist Italy. Although the U.S. was still technically neutral, Lend-Lease "jump started" the U.S. war machine (Murphey 1993:5) and initiated direct American involvement in World War II (Catton 1969; Drummond 1955; Green et al. 1955:65-82).

By late 1941 it was obvious that the existing War Department logistical organization was not up to the demands being placed upon it, but when the Japanese raided Pearl Harbor on December 7, 1941, the Army-Navy Munitions Board was still the only functioning industrial mobilization organization in place. The

structure of the logistics system soon changed, however. The War Production Board (WPB) was created in January 1942 and quickly emerged as the chief coordinating agency for national defense. The WPB controlled war plant construction and supervised contracting, and its Controlled Materials Plan (CMP) became the centerpiece of the federal government's control of the wartime economy. The old Army-Navy Munitions Board, meanwhile, was reorganized in February 1942 and became somewhat of a liaison office between the War Department staff and civilian mobilization agencies.

Far more important than the administrative shuffle involving the Munitions Board and the WPB was the so-called Marshall reorganization of the U.S. Army. By presidential executive order issued on March 9, 1942, the army was divided into three major commands: the Army Air Forces (AAF), the Army Ground Forces (AGF), and the Services of Supply. The latter, in part because of its unfortunate acronym (SOS), was soon rechristened the Army Service Forces (ASF). The War Plans Division (renamed Operations Division or OPD) became the central War Department planning entity, with the Logistics Group in the OPD responsible for implementing procurement and distribution policies. Under the command of Lt. Gen. Brehon B. Somervell, ASF was assigned responsibility for administering the supply and service operations of six technical services, eight administrative services, nine corps areas (i.e., service commands), six ports of embarkation, and nine general depots. Creation of the ASF represented a major step toward centralized planning and is widely regarded as a major victory in the fight against the Axis (Smith 1991:48-72).

Massed fire power on the scale employed during World War II was beyond the capability of the U.S. Army in the summer of 1940, or even as late as the summer of 1941 (Thomson and Mayo 1960:104). Of the large reserve of ammunition held by the U.S. in 1919, a small portion was used for training purposes on a yearly basis, and the remaining rounds gradually deteriorated. Reserves of .30-caliber, which far exceeded all others in volume, dropped from approximately one billion rounds in 1919 to a little over one-half billion in early 1940 (Thomson and Mayo 1960:190). Reserves were further depleted in the summer of 1940 by shipment of 138,000,000 rounds to the British government. Even without aid to the British, which included another shipment of 50,000,000 rounds, there would have been a shortage of rifle ammunition in the winter of 1940-1941 (Thomson and Mayo 1960:190).

Frankford Arsenal was the only facility in the U.S. producing military small arms ammunition in the 1930s. While several commercial firms produced sporting ammunition, the differences between this and military munitions was drastic. Incendiary, tracer, and armor-piercing rounds, for example, presented production problems that had no counterpart in peacetime manufacture of cartridges which would be used by farmers, hunters, and policemen (Thomson and Mayo 1960:191). Additionally, private companies received no contracts for military ammunition production during the 1930s. This was because the Army was forbidden by law to purchase from commercial suppliers unless the price was less then that of Frankford Arsenal. This was something that private industry could not do. In 1936 and 1937, Ordnance officials met frequently with Remington officials concerning expansion of Remington's small arms production capacity in times of emergency. Also, Remington's operation of a new government-owned small arms plant was discussed. Plans were drawn up for speeding production in the event of war. These included model plant layouts, descriptions of manufacturing, estimates of personnel needs, lists of tools and machinery, and data on commercial sources of raw materials (Thomson and Mayo 1960:192). Under the Educational Orders Act of 1940-1941, the government placed 12 orders for small arms ammunition; 10 of these went to Remington. While the primary purpose of the orders was education for industry rather than production, the transfer of over one-fourth of the U.S. stockpile to Britain in the summer of 1940 caused production to become more important.

To meet the situation at hand in the summer of 1940, the Ordnance Department took steps to create something new in American economic life: a vast interlocking network of ammunition plants owned by the government and operated by private industry (Thomson and Mayo 1960:105). The decision was made to construct this national system of armament manufacturing plants in 1940, and the first GOCO plant contract was awarded in July 1940 to Du Pont to construct the Indiana Ordnance Works smokeless powder factory.

By December 1940, 22 GOCO plants were under construction by the War Department (Thomson and Mayo 1960:32, 200-203), and by the end of 1941, 17 of these installations were in operation (Murphey 1993:3-4).

The GOCO Industrial Facilities Program was administered by the Ordnance Department of the U.S. Army Quartermaster Corps, one of the U.S. Army's seven technical services. The Ordnance Department was a venerable institution that traced its lineage to the Continental Army of the American Revolution (Green et al. 1955:14-64). In the twentieth century, the Ordnance Corps was concerned with supplying the Army with arms, ammunition, vehicles, and fire control instruments. Another major function of the Ordnance Department during World War II was the repair and maintenance of the Army's munitions. On the eve of World War II, the Office of the Chief of Ordnance was organized into four groups: the General Office, the Technical Staff, the Industrial Service (formerly the Manufacturing Service), and the Field Service. The Industrial Service staff had broad responsibility for production and procurement, as well as for research and development of new weapons technologies, and it was assigned the mission of building and operating the new system of arms manufacturing plants.

From a procurement point of view, the manufacture of small arms ammunition was simpler and easier than the manufacture of large projectile bombs and military vehicles. It did not involve the production of fuses, and the component parts were relatively few. Nevertheless, the mass production of small arms was an exacting process which incorporated some manufacture of and the loading of high explosives. Each round had to meet rigid specifications, particularly if it were to be used in aircraft guns. "The Ordnance objective was to produce ammunition that could be fired round after round for billions of rounds, whether in tropic heat or arctic cold, in the desert sand or steaming jungle, without malfunctions and without significant deviations in performance" (Thomson and Mayo 1960:190).

The Biggest Thing in the Industrial History of Jackson County

The first two waves of GOCO defense plant construction were launched by the Ordnance Department in 1940-1941. Of the 77 GOCO industrial facilities, LCOP was the first of the small arms ammunition plants to have a signed contract and to have construction begin. The contract for LCAAP was signed on November 20, 1940. This contract was the fifteenth signed out of the 77 GOCO facilities (Voight 1945).

The Office of Production Management (OPM) established a Plant Site Board to select locations for the new facilities in 1941 (Fairchild and Grossman 1959:102-103): location criteria had been given consideration for some time. Site selection criteria included a variety of factors. The policy of avoiding coastal areas in favor of the less vulnerable interior regions set certain limits, as did the policy of avoiding, on the grounds of safety, large centers of population (Thomson and Mayo 1960:108). The availability of raw materials such as water and natural gas; the availability of electric power; proximity to railroad and highway transportation routes; and a reliable pool of skilled and unskilled labor—for construction and facility operation—were also major concerns (Thomson and Mayo 1960:108). Recommendations made by the War Department Site Committee generally concurred with the above considerations, with the suggestion that facilities be located west of the Appalachians, east of the Rockies, and 200 miles from the Canadian and Mexican borders as to reduce the risk of attack (Fine and Remington 1972:134-135). Ordnance plants producing explosives, entirely or as only a portion of their wartime mission, also required large tracts of land. This was a requirement not because the production buildings were large, but because safety considerations called for the production lines to be isolated and for wide, open areas between the storage facilities (Thomson and Mayo 1960:108). Whenever possible, facilities were also constructed on land that was not well-suited for agricultural use and that could be purchased at reasonable cost. As the War Department's choice of sites meant financial prosperity to communities and individuals, the transfer of large tracts of private land to public ownership and the establishment of new installations and facilities had a wide-ranging significance (Fine and Remington 1972:131). Also, due mainly to the monetary factors involved, there were strong political

pressures at work, and friends who had friends in high places sometimes influenced the decisions being made on where to locate GOCO facilities (Shaffer and Crown 1995:17).

The location of the LCOP was ideal when considering several of the government's criteria, and for the communities of Jackson County, Missouri, the government's choice was "the biggest thing in the industrial history of Jackson County" (*Independence Examiner* 31 October 1940). Both Remington and the city of Independence Mayor Roger T. Sermon played significant roles in the selection of the Lake City valley site. At its first meeting with government representatives, Remington was requested to recommend localities for the proposed new ammunition plant and agreed to do so. Remington was assisted by the Engineering Department of the Du Pont Company, Remington's parent company, as this department was experienced in handling plant location problems and real estate procurement (LCOP 1943a:12). Remington originally chose to look at locations in four regions: the Illinois-Indiana area, Ohio, the Missouri-Kentucky area, and the Tennessee-Alabama area. More detailed studies of 13 cities followed. From careful study of maps, files located at the Du Pont Real Estate Division, previous reports, and other data, it appeared that the Kansas City area offered the most desirable features (LCOP 1943a:13). On September 10, 1940, representatives of Remington departed to visit a number of localities, including Kansas City and Denver. These visits were undertaken in order to inspect labor supply, housing conditions, and other pertinent factors. Ten days later, the Ordnance Department advised that it was filing a preliminary request for approval of a site in the Kansas City area (LCOP 1943a:13). The locality studies undertaken by Remington in connection with LCOP and the Denver Ordnance Plant provided valuable background information in locating nearly all other GOCO small arms plants which were to be established by both Remington and other companies.

Preliminary inspection of possible sites around Kansas City began on September 30, 1940 (LCOP 1943a:13); this included all areas having suitable topography within a 30-mile radius of Kansas City. Preferred areas included Lake City; areas within the Little Blue, Missouri River, and Kaw River bottoms; Olathe and Kenneth, Kansas; Warrensburg and Liberty, Missouri; and the site of a former race track south of Kansas City. The choice was narrowed to three locations, known as Lake City, Little Blue, and 39th Street. The Lake City and Little Blue sites were near Independence, from which it was expected that a large number of employees would be drawn. It was also determined that rail and bus service from Kansas City to these sites would be available as needed. Remington compared the three sites on the basis of 16 important considerations. While a complete list of these considerations is unavailable, it is known that the 39th Street site was not large enough to accommodate the entire proposed facility and, being within city limits, presented an undesirable explosive hazard (LCOP 1943a:14). It is also known that when considering flood hazard, the Little Blue site rated only fair (LCOP 1943a:14). After reviewing all considerations, Remington reported that "[b]ased on our engineering studies, it is our recommendation that the Lake City site be approved" (LCOP 1943a:14). Remington was, however, willing to proceed with the construction of the plant at any of the three locations if specifically desired by the War Department. The War Department decided to take options on all three sites. Remington undertook this work for the War Department with the understanding that the options would be turned over to the government for purchase.

Because a number of landowners were involved and there was some fear that premature publicity would result in higher land valuations, the process of taking options required delicacy and tact. A separate private real estate firm was hired for each of the three locations, with the firm of Chaplin, Hood and Henry handling the Lake City options (LCOP 1943a:15). While the real estate firms were provided no compensation beyond the reimbursement for cost of the option, the firm handling the property for the final plant location was authorized to charge the sellers a commission of two percent for its services. This understanding was reached to relieve both the government and Remington of liability.

Optioning for the Lake City property began on October 10, 1940, and by October 23, 1,474 acres were covered at $145 an acre. On October 30, Remington was informed that the Lake City location was approved and that the Quartermaster Corps was to proceed with the purchase of the land. The final price paid for the entire plot was between $160 and $165 an acre, the average having been increased by a higher price paid for

a few key parcels (LCOP 1943a:15). A Quartermaster Corps' estimate for the total amount paid for the Lake City site, dated January 9, 1941, listed $552,220 for the land (LCOP 1943a:15). The government later purchased an additional 740 acres; on the basis of the $160 to $165 an acre, it would appear that the entire site cost approximately $670,000 (LCOP 1943a:15).

ARCHITECTURAL AND ENGINEERING CONTEXT

Architect-Engineer Firm

Under its contract with the government, Remington was responsible for the acceptability of capacity, design, and engineering for the LCOP. For the first time in the history of the United States, a complete small arms ammunition plant was to be planned and built from the ground up. This was a major undertaking, and Remington's work involved collaboration with an Architect-Engineering firm in several areas (LCOP 1943a:17). The first area of collaboration was in the preparation of complete factory layouts, including the arrangements of all facilities to provide an uninterrupted flow through the operation sequences, and the location of auxiliary and storage facilities, offices, sanitation facilities, change houses, cafeterias, and other supporting structures. The second area where an Architect-Engineer was required was the dimensioning of floor layouts and the development of such special features of building design as storage of explosives and other chemicals and mixing houses for primer and tracer mixtures. Finally, Remington required assistance in the preparation of a plot plan for providing for the arrangement of numerous major buildings to assure efficient management and supervision, as well as adequate defense of the facility. Also, the layout of roads, railroads, parking lots, and outdoor testing ranges had to be facilitated.

Early in September 1940, Remington submitted to the Ordnance Department a list of firms regarded as capable of handling the engineering work for LCOP. On September 23, Remington was informed that Smith, Hinchman and Grylls, Inc., of Detroit, Michigan, had been selected (LCOP 1943a:17). This firm had been founded in 1853 and had an established track record of designing large industrial plants (Holleman and Gallagher 1978). As the Architect-Engineer for the LCOP project, Smith, Hinchman and Grylls was to perform two distinct functions: (1) prepare the layout and design, and (2) prepare specifications for building construction and the installation of equipment. As it was felt that special assistance would be needed to handle the engineering for the complete plant layouts, Smith, Hinchman and Grylls subcontracted with the firm of A.J. Brandt, Inc., for assistance.

Design for the Plant

To give the reader a better understanding of the difficulties under which the Architect-Engineer worked, Table 2 presents the five "waves" of the government's GOCO small arms program. For many weeks, Remington worked closely with the Architect-Engineer and A.J. Brandt to develop information relative to the design of the required buildings. This work was conducted at Remington's Bridgeport, Connecticut, office, and specialists at both Du Pont and the Frankford Arsenal were consulted freely. Particular attention was paid to the layout and design of hazardous areas and features affecting safety, fire protection, and employee morale (LCOP 1943a:18).

At first a "court" arrangement was contemplated for the main manufacturing units, with each building being highly specialized for a certain type of product. At the outset, however, the War Department determined to abandon this design in favor of rectangular buildings, which would be more flexible and better adapted to meeting changing requirements in the Army supply program.

Table 2
Summary of GOCO Small Arms Manufacturing Production Waves*

First Wave (Autumn 1940)		
New Plants:	**Lake City (Remington)**	
	Denver (Remington)	
	St. Louis (Western Cartridge)	
Second Wave (Spring 1941)		
New Plants:	Utah (Remington Arms)	
	Des Moines (U.S. Rubber)	
	Twin Cities (Federal Cartridge)	
Expansion:	St. Louis (Western Cartridge)	
Third Wave (Winter 1941-1942)		
New Plants	Kings Mills (Remington)	
	Evansville (Chrysler)	
Expansion	**Lake City (Remington):**	**Increased daily capacity by:**
		500,000 rounds cal. .30
		200,000 rounds cal. .50 incendiary
		2,000,000 rounds cal. .30 carbine
	Denver (Remington)	
	Utah (Remington Arms)	
	Des Moines (U.S. Rubber)	
	St. Louis (Western Cartridge)	
	Twin Cities (Federal Cartridge)	
Fourth Wave (Spring 1942)		
New Plants	Lowell (Remington)	
	Allegheny (Kelly-Springfield)	
	Eau Claire (U.S. Rubber)	
	Milwaukee (U.S. Rubber)	
	Kenosha (canceled on Fifth Wave)	
Expansion	**Lake City (Remington):**	**Increased daily capacity by:**
		400,000 rounds cal. .30 carbine
	Denver (Remington)	
	Des Moines (U.S. Rubber)	
	Evansville (Chrysler)	
Conversion	Kings Mills (Remington)	
Fifth Wave (Spring-Summer 1942)		
Expansion	**Lake City (Remington):**	**Increased daily capacity by:**
		600,000 rounds cal. .50
	Des Moines (U.S. Rubber)	
	Twin Cities (Federal Cartridge)	
Conversion	Lowell (Remington)	
	Allegheny (Kelly-Springfield)	
	Eau Claire (U.S. Rubber)	
	Milwaukee (U.S. Rubber)	

* Data taken from LCOP1943a:Appendix VII

Note: To expand military ammunition production, the government set up three new small arms ammunition plants in the autumn of 1940. As military needs grew, more new plants were built and existing facilities were expanded. These enlargements were commonly referred to as "waves."

During a visit to Bridgeport in November 1940, Major Clark of the Quartermaster Corps stressed the importance of complete flexibility, even with the increased construction costs (LCOP 1943a:18-19).

A 1920 amendment to the National Defense Act of 1916 established both a Planning Board, to make studies and plans for the war-time mobilization of industry, and the Army-Navy Munitions Board, to coordinate the needs of the services. The newly established Boards worked closely with manufacturers to determine logical sources of supply and formulate production plans. Remington participated actively in this program from the start, and it was no surprise when they were asked by the government to participate in the GOCO program in 1940. The so-called Unit Plan of 1938 was the result of more than a year's worth of study. The Unit Plan provided for six small arms ammunition plants, each to consist of two units and each unit to produce either 1,000,000 .30-caliber or 600,000 .50-caliber cartridges a day. Construction, equipment, raw materials, and personnel requirements were all taken into consideration. Approximate cost estimates and construction-time schedules were also included. It was expected that the first unit would come into production 11 months after initiation of its construction (LCOP 1943a:4).

The Unit Plan was the starting point for the vast small arms ammunition program later carried out and served as a guide at the outset. It did not, however, anticipate the tremendous size of the ultimate program or specify sites for the proposed plants. World War II brought about significant military changes, including the development of modern aerial warfare and the greater use of mechanized weapons calling for small arms ammunition in far greater quantities and of more types. These changes magnified the problems of obtaining adequate quantities of perishable tools and the training of sufficient numbers of skilled workers. To add to the confusion of designing the first of the GOCO small arms manufacturing plants, the Ordnance Department was considering the possibility of closing down the Frankford Arsenal after the war and moving all government small arms ammunition operations to the proposed Kansas City plant (LCOP 1943a:2).

During the planning of the main manufacturing units for LCOP, the process was laid out in such a manner that basic raw materials would enter at one end and the finished product would be stored and shipped at the other end. Each unit was to be a self-contained factory including machine and maintenance shops, a cafeteria, changing areas, first aid stations, and other supporting facilities. Before detailing of the buildings could proceed and before any work was authorized on the ground, all preliminary drawings were presented for approval to Remington, the Ordnance Department, and the Construction Quartermaster. The scope of the design project was immense: the LCOP was over 3,900 acres in extent, on which 236 buildings and over 100 minor structures were located. Many alternatives to the plot plans were developed and studied before adoption of the final plan. However, by December 9, 1940, preliminary drawings covering floor layout and elevations of the first .30-caliber manufacturing unit were submitted to the Contracting Officer (LCOP 1943a:19).

Based on Unit Plan of 1938, the LCOP was designed as a permanent facility. Originally, all GOCO plants were to be permanent facilities which would last approximately 20 years (Fine and Remington 1972:165). By early 1941, however, the Ordnance Department had accumulated $100 million of cost overruns (Kane 1995:84). Economy, already an important factor in the GOCO program, became even more critical. Government correspondence associated with LCOP and dating to the first several months of 1941 are filled with references to reducing the costs of the plant (LCOP 1943a:7-9). At this time, government officials reported that many GOCO projects were exceeding construction estimates and that it might be necessary to reduce these costs. Cost reduction was essential, even though this action would mean a variation from the policy of building permanent facilities. In February at a Quartermaster Corps district meeting in Houston, Texas, Smith, Hinchman and Grylls personnel were informed that all building construction and utilities were to be based on a life of five years (LCOP 1943a:22). However, features of building construction that had an important bearing on quality of production or reasonable comfort in operation were not to be eliminated. As there was some confusion as to where cost reduction should take place, agreement was reached covering some 20 items, representing potential savings of approximately $5,500,000 at LCOP. The principal areas where savings were to take place included: the Range Area, $1,545,000; contingencies, $1,400,000;

Buildings 4, 5, and 6 combined, $840,000; machinery installation, $787,500; and utilities, $600,000 (LCOP 1943a:23). Government correspondence over the several months following March 1941 reflects a growing concern with machinery procurement and getting the plant operational; apparently, the need to begin ammunition production was more important than further cost reduction (LCOP 1943a:9-11). Advancement of the LCOP completion date to September 30, 1941, added considerably to the final First Wave construction cost. Including machinery installation, this was approximately $20,700,000 or about one million dollars more than the estimate of January 1941.

While layout of the LCOP was influenced by the Unit Plan of 1938, particular factors, such as the topography of the Lake City area, were taken into consideration. The 236 main structures were organized into several different areas (Figures 4 and 5). These included: the manufacturing area, incorporating five main manufacturing buildings, tool and gauge buildings, a forge shop, storage buildings, ballistics buildings, a lead shop, salvage buildings, service and maintenance buildings, and additional support structures; the hazardous area, incorporating chemical storehouses, a primer manufacturing building, a primer mixing building, primer storehouses, tracer and igniter composition manufacturing buildings and storehouses, a powder canning building, and powder magazines; the accuracy range, including proof houses, target houses, and observation houses; the temporary barracks area; the staff residential housing area; a separate steam-heat generating plant, and water, sewage, and industrial waste treatment facilities (LCOP 1943a:1-2).

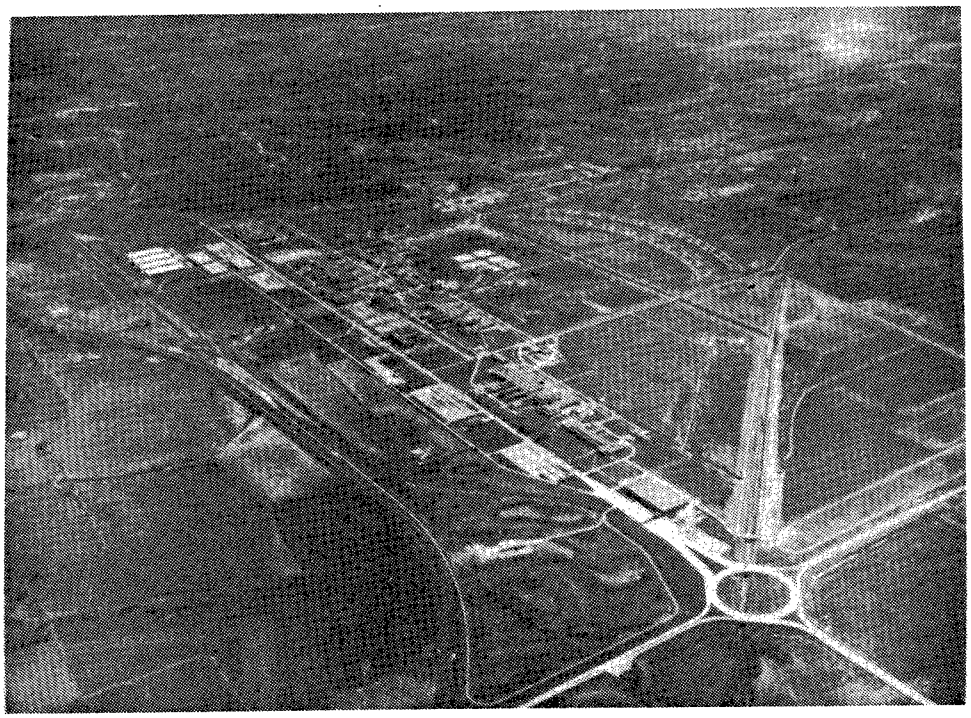


Figure 4. Aerial view of LCOP, ca. 1941, view SE (original photograph on file, LCAAP).

Figure 5. Aerial view of LCOP, ca. 1941, view SSE (original photograph on file, LCAAP).

The typical manufacturing building was a two-story permanent structure with reinforced concrete and structural steel framework (Figures 6 and 7). Foundations were concrete, and in most instances, reinforcement was present. Walls were brick and/or concrete block, and roofs were one-inch thick tar and gravel over steel. First-story floors were constructed with maple blocks over concrete. Most manufacturing buildings had mezzanine floors of iron grating and concrete Several manufacturing structures varied somewhat from these designs. Building 3, for the manufacture of .50-caliber ammunition, was two stories with a third-story monitor; building 3 also included a built-up roof over a steel deck and precast concrete. Building 4, for the manufacture of .30-caliber carbine rounds, was a one-story building except for the rest rooms and locker facilities, which were located in second floor areas. Building 3-A, for the production of .50-caliber rounds, was a one-story structure with a mezzanine over the loading wing. This structure had a concrete foundation and a concrete slab floor. Interior walls were clay tile, with the exception of brick fire walls. Other interior features included wood sash and wood columns. The exterior walls were tile of a semi-permanent nature, and the roof was of temporary construction. Building 3-A's construction was the last of the large manufacturing structures to have been started (USACE 1943:248): the entire structure was classified as semi-permanent. While initial construction of Building 3-A began only 12 and 20 days after initial construction of the .30-caliber units, this was at the time when the War Department was most concerned about cost overruns.

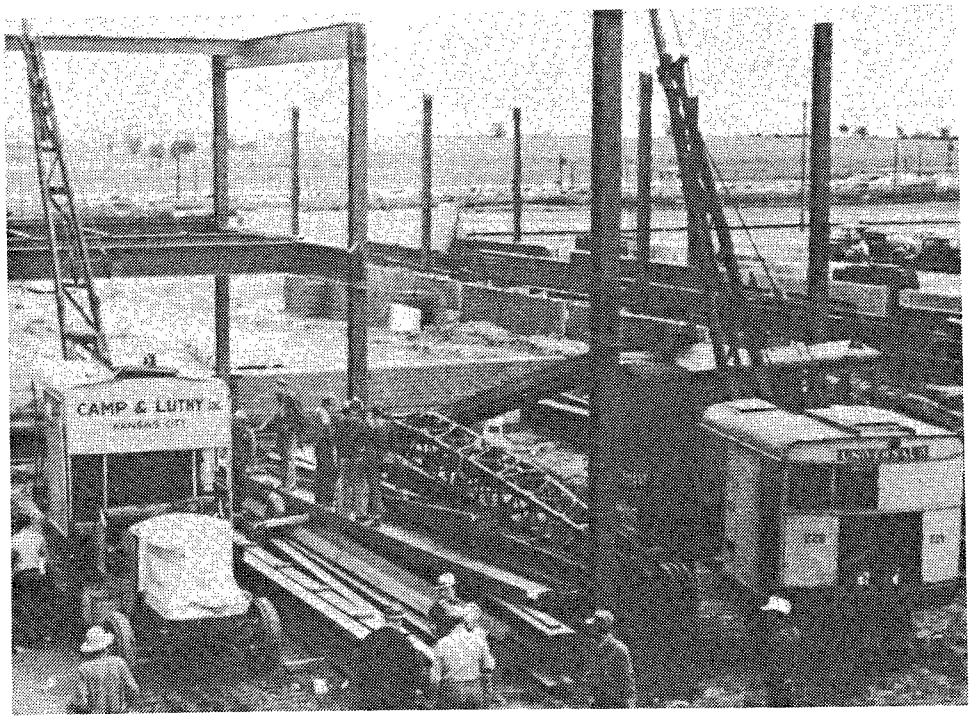


Figure 6. Overview of LCOP construction, unknown structure, ca. 1941 (original photograph on file, LCAAP).

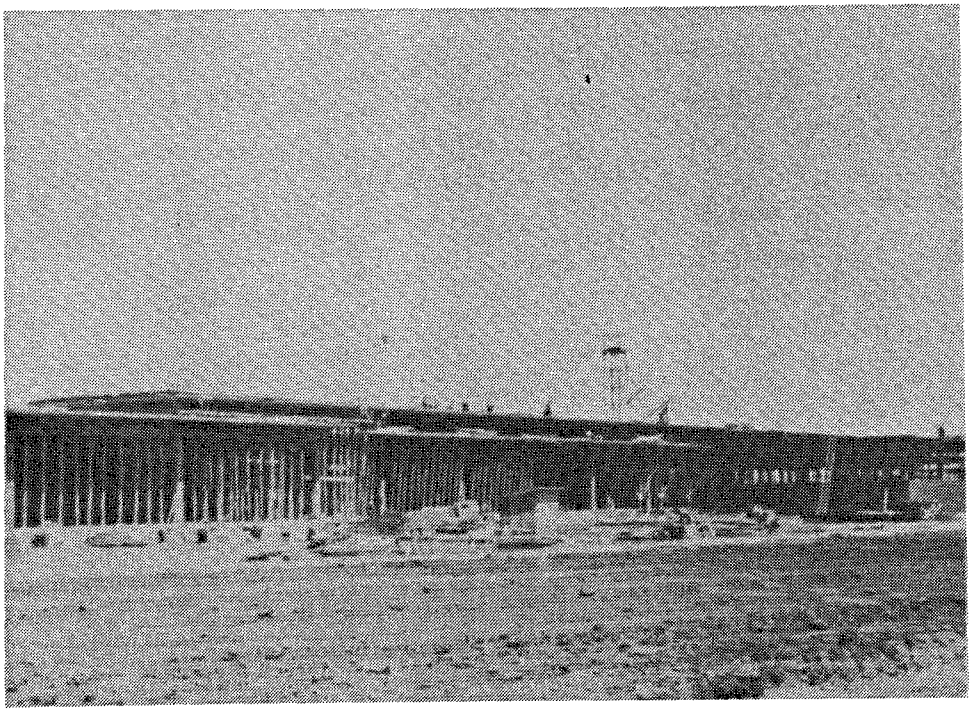


Figure 7. Overview of LCOP Tool and Gauge Shop construction, 1941 (original photograph on file, LCAAP).

While it has not been definitely documented, the construction of Building 3-A as a semipermanent structure may have been a response to the War Department's economic concerns.

Buildings located in the hazardous area were of permanent, semipermanent, and temporary construction. All incorporated nonsparking floors such as compolite, asphalt, granolithic, and maple block over concrete. Permanent construction was all of a one-story type with details comparable to the permanent structures in the manufacturing area. Typical semipermanent structures had concrete foundations and floors, asbestos shingle over wood walls, and asphalt and asphalt felt over wood or one-inch tar and gravel over wood roofs. Additionally, many were separated by earthen barricades. Typical temporary structures included no foundations and were of frame construction with composition roofs.

The staff residential unit consisted of 11 houses. All were constructed as two-story semipermanent structures of the Dutch Colonial design (Figures 8 and 9). They had concrete footings and concrete block walls in the basements. They were fully insulated and had wood frame walls with wood siding and asbestos-shingle roofs. Three smaller houses included three bedrooms, a full basement, and a one-car detached garage. Three intermediate-sized houses included three bedrooms, a maid's room on the first floor, baths on the first and second floor, a full basement, and a detached two-car garage. Five larger houses included four bedrooms and two complete baths upstairs, a maid's room and bath in the full basement, and a detached two-car garage. Additionally, all residences included an oil-burning forced warm air furnace, attic fan ventilation, electric hot water heater, and electric stove and ice box. All residences were originally used to house families, with the large and intermediate houses reserved for field grade officers and the small houses reserved for company grade officers. Today they are all occupied by military personnel; however, some residents are not affiliated with the LCAAP (William Melton, personal communication 1995). A twelfth residence was maintained at the LCOP during World War II. This structure was originally a farmhouse located on the land purchased for the plant. It was a one-story frame building with wood walls and a wood shingle roof. During the World War II operation it was used as a bachelor officer's quarters. After the war it was maintained as a family unit.

All other World War II-era structures located at the LCOP were constructed in ways similar to the manufacturing and hazardous area buildings described above. Interesting structures not noted above included production support and storage facilities. The Sensol Storage Igloos included an igloo-type, elliptical-shaped concrete roof, while the TNT and PETN Storage Igloos incorporated parabolic concrete roofs. The Ballistics Building (No. 8, Figure 10) included velocity and pressure ranges with lengths from 50 to 200 yards; function and casualty ranges which included one angle fire and three hang fire ranges; two 100-yard perforation test ranges; one 100-yard carbine accuracy range; a grenade velocity test range; and 200-yard, double-type, underground incendiary performance ranges. The underground ranges were complimented with complete photograph and dark room equipment. Also present at LCOP were horse stables, a blacksmith shop, and subways to provide safe crossing from parking areas to the manufacturing buildings. The horses were provided for guard duty in the less-accessible portions of the plant and for patrolling the perimeter fence.

At the LCOP, as with all GOCO facilities, the architectural form reflected the industrial function in the design of the individual buildings and in the overall layout of the plant. As with other GOCO small arms ammunition plants, production lines were laid out first, and then the buildings were designed to house them (MacDonald and Mack 1984:20). Under normal conditions, construction work comparable to that needed for LCOP would not have been started until detailed plans were complete, requiring many months of preparation. However, the necessity for getting the plant into operation precluded normal practices. Construction excavation began before the month of December, 1940, was over.

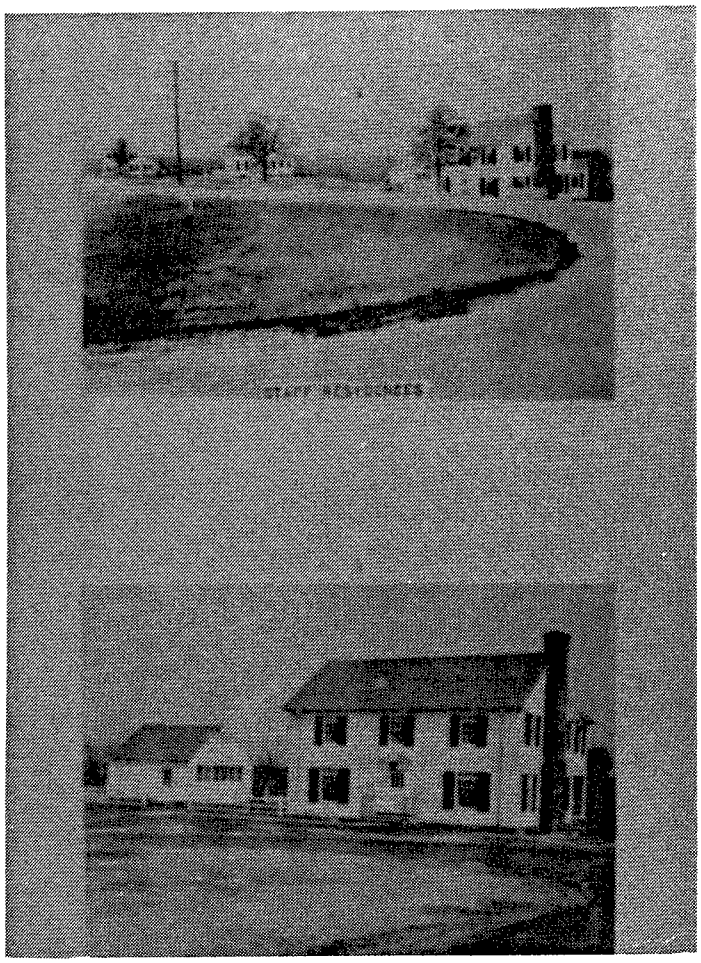


Figure 8. Overview of LCOP Staff Residence, ca. 1941 (original photograph on file, LCAAP).

Constructing and Equipping the LCOP

Construction

By the time the government signed its original contract with Remington, several preliminary steps toward construction had already been taken. The plant site had been selected, the government had selected an Architect-Engineer, and considerable progress had been made on the preliminary drawings and on the large task of preparing equipment specifications. The government had engaged two construction contractors under a collateral contract with the Architect-Engineer; these were the firms of Foley Brothers, Inc., of St. Paul, Minnesota, and Walbridge-Aldinger Company of Detroit, Michigan. The story of construction at the LCOP cannot be told without including details of equipment procurement. Indeed, within the individual production units, machines and their layout, as the foundation of industrial production, came first. Buildings and structures, which existed to house the machines, their operators, and their products, came second (Kane 1995:84).

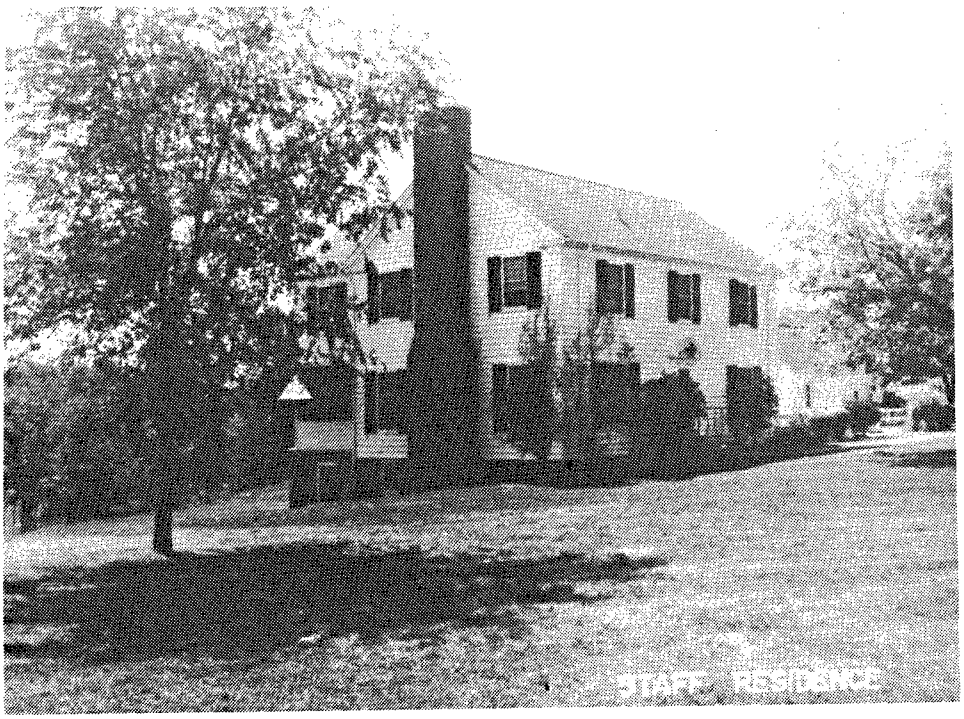


Figure 9. Overview of LCOP Staff Residence, ca. 1941 (original photograph on file, LCAAP).

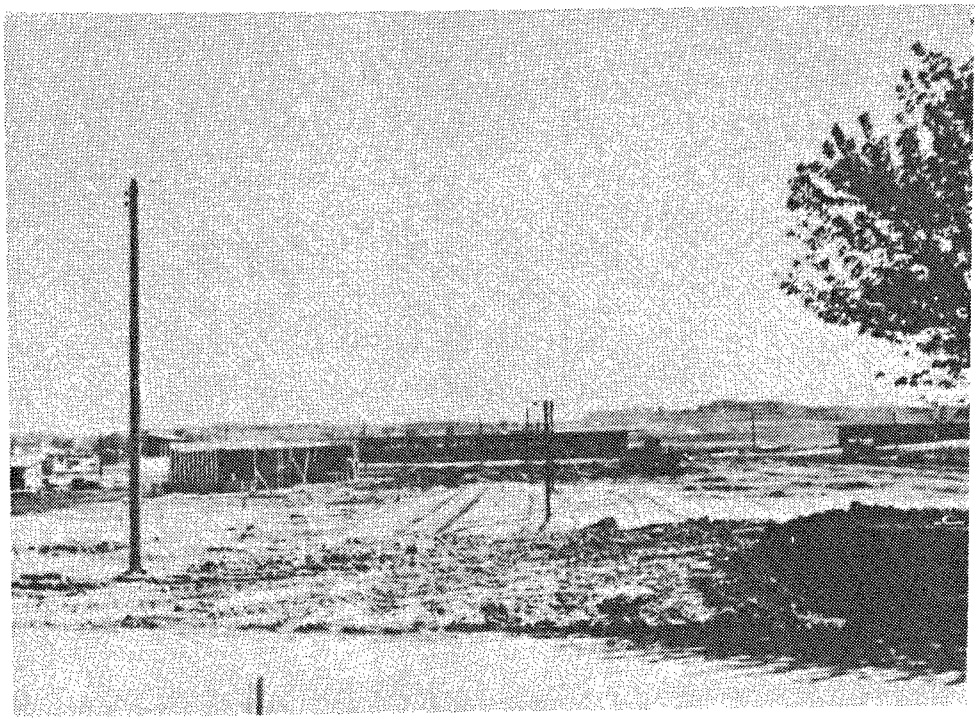


Figure 10. Overview of LCOP Ballistics building construction, 1941 (original photograph on file, LCAAP).

Early in December 1940, while design work was progressing as rapidly as possible, supplies and equipment started arriving at the site. Construction was begun on temporary buildings on December 16, 1940, and the official groundbreaking took place on December 26. This ceremony was attended by Senator Harry S. Truman of Missouri, Remington personnel, and government authorities (Figure 11). The original contract estimated that the work of constructing and equipping the plant would take 15 months. In late April 1941, due to the urgent need for small arms ammunition, the desired completion date was pushed ahead to September 30, 1941. In early January 1941, Lieutenant J. T. Waugh of the Quartermaster Corps submitted a cost estimate to the Quartermaster General covering the entire Lake City project. This included an "Original Estimate Unit Plan" and a "Revised Remington Arms Estimate" (LCOP 1943a:20). The original estimate totaled $18,981,110, of which $8,108,600 was for machinery and equipment and $350,000 for land. This indicated a total construction cost of $10,522,510. The revised estimate amounted to $32,311,450, with $12,000,000 for machinery and equipment and $552,220 for land, leaving $19,759,475 for construction. Remington had no knowledge of the estimate or any part in its calculation. For business reasons, Remington officials were very concerned about the title "Revised Remington Arms Estimate." Official Remington correspondence states "that this refers to the project as a whole as a Remington Arms project and that there is no intention of placing the responsibility of the estimate upon our company" (LCOP 1943a:21).

Figure 11. Ground breaking ceremony for LCOP; note Senator Harry S. Truman in hole at left (original photograph on file, LCAAP).

In addition to the actual building construction, the LCOP project included work such as the removal of farm buildings, extensive drainage operations, road building, grading, fencing, and relocation of the Blue Springs Municipal Well. As of February 15, 1941, the construction had already consumed 14,000 tons of crushed rock and 50 carloads of lumber (LCOP 1943a:26). By early March, 1,500 construction workers were employed (Figure 12). This number gradually rose and reached a peak of 6,277 in July (LCOP 1943a:26). In the early phase of the construction, representatives from Western Cartridge Company, contractor-operator for the St. Louis Ordnance Plant's GOCO facility, arrived at the LCOP site. This visit, with a subsequent exchange of information, was requested by the Ordnance Department because the entire LCOP project was progressing more rapidly than the St. Louis project. The first production machinery arrived on May 5 while construction was taking place, and by July the first complete line of operating equipment had been installed (Figure 13). The first cartridge cases were produced in August, and by September 30, the desired opening date, the plant was in operation and 54,800 rounds of-caliber .30 ammunition had been loaded for presentation to the government (LCOP 1943a:27). The plant was dedicated on October 11 at ceremonies attended by Undersecretary of War Patterson, Governor Donnell of Missouri, General Somervell, and General Harris. Remington officials were also present. A total of 219 buildings, large and small, stood virtually complete. Final completion of the LCOP First Wave construction took place on January 31, 1943.

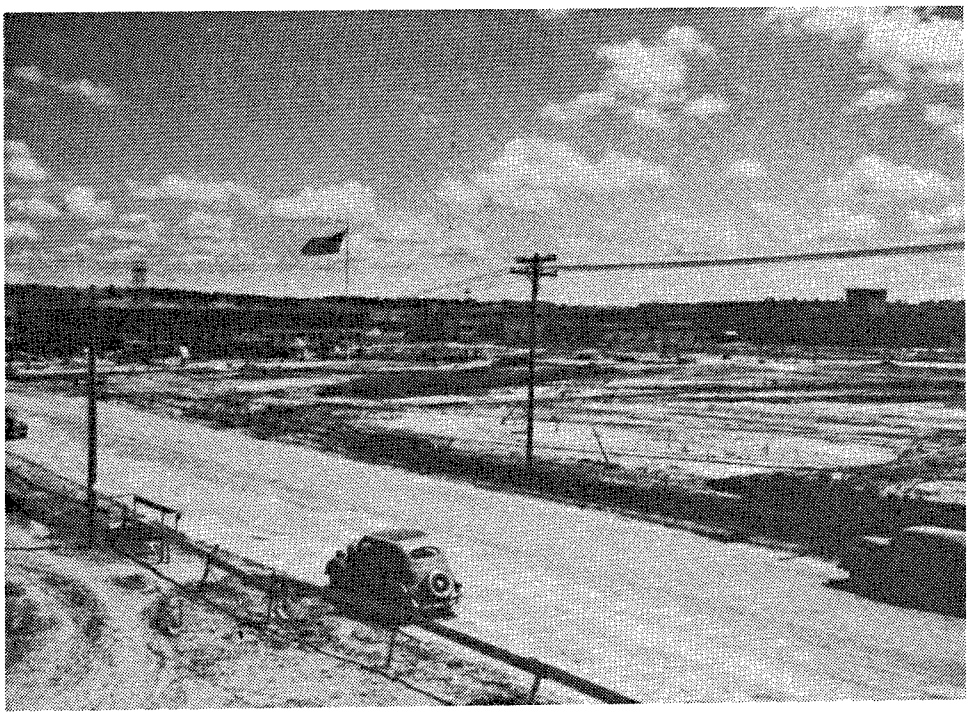


Figure 12. Overview of LCOP Administration building construction, 1941, view SW (original photograph on file, LCAAP).

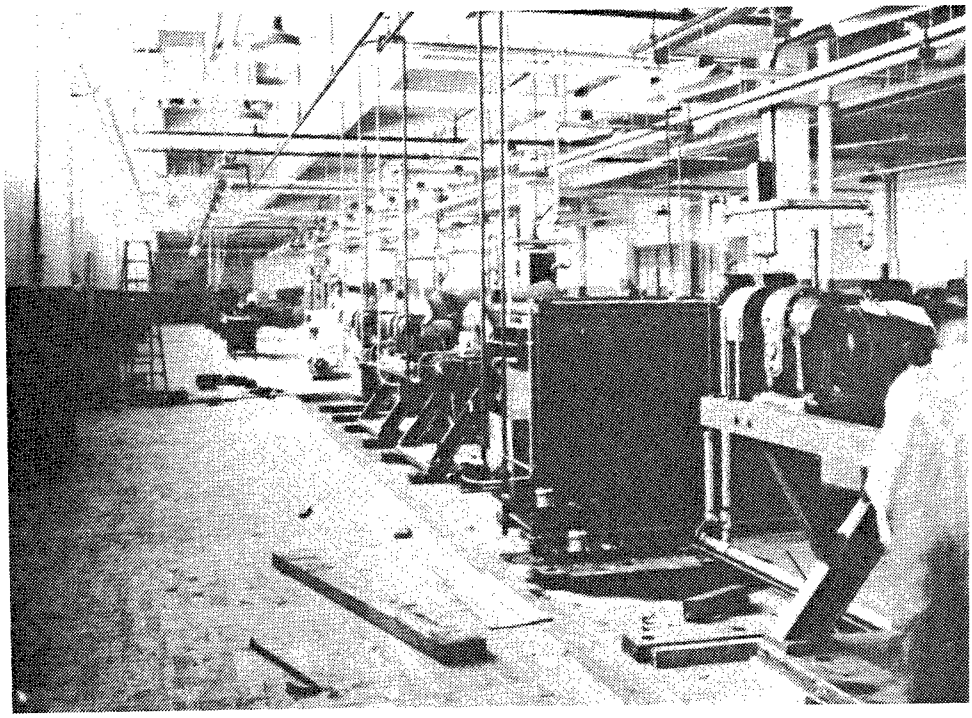


Figure 13. Overview of LCOP Primer Manufacturing area interior during construction, ca. 1941 (original photograph on file, LCAAP).

The First Wave construction at LCOP was carried out under a number of unusual conditions (LCOP 1943a:27; USACE 1943:229-230). The tremendous pressure to work quickly marked the undertaking from the first day. As discussed earlier in this report, this pressure was intensified when the completion date was advanced from December to September 1941. The need for speed made it necessary to use extra shifts and to increase the amount of worker time-and a-half and double-time pay. The long work hours reduced the worker efficiency, especially in the construction of the staff residences. Also contributing to the difficulty of construction was the need for coordination between the many different government and private agencies concerned with the project. This included the Army-Navy Munitions Board, to become the War Production Board in 1942, which created regulations covering priorities and the use of prohibited and critical materials. These regulations affected the materials and equipment market in the areas of cost and availability. Construction at the low building site became more difficult as the wet, cold, winter weather came on in late 1941. With the wet weather, it became difficult to move heavy equipment, and the amount of crushed rock needed for temporary roads was increased. In a number of instances, small lakes and ponds had to be drained before buildings could be staked out. Finally, recurrent labor shortages required the training of unskilled labor and added to the cost of construction.

Equipment

The Lake City contract placed the obligation of procuring all equipment on Remington. Plans for this work started immediately after Remington's acceptance of the government's contractor-operator offer in September 1940. The plans had not advanced far when the Denver Ordnance Plant was assigned to Remington. As a result, procurement for both plants was undertaken together. It was estimated that $12,000,000 worth of equipment would be needed, with the major portion being for production machinery (LCOP 1943a:28).

Since there were only a few manufacturers of ammunition machinery in the United States and three huge First Wave plants to be equipped, the War Department recognized the need for a unified purchasing plan. Also, it was highly desirable that machines and parts be interchangeable between all new plants. In later years this variable would prove to be very important in LCAAP's monopoly on small arms manufacture.

Once again Remington was asked by the War Department to cooperate with Western Cartridge, this time to coordinate equipment purchasing so that "all three plants come to initial and full production at the earliest possible time" (LCOP 1943a:29). The next step in outfitting the First Wave GOCO small arms plants was preparing specifications so that orders could be placed. This included a meeting between Office of Production Management personnel and representatives from equipment manufacturers. At this meeting, the manufacturers indicated their ability to participate in the program and specified the type of work for which their shop was best fitted. Table 3 lists the manufacturers for the LCOP who furnished guarantees covering materials, equipment, and services. The guarantees were of a blanket nature and covered a period of one year from the date of acceptance against defective materials and workmanship (USACE 1943:222).

Together, Remington and Western Cartridge opened a joint office at the Frankford Arsenal. This was the only location where large-scale manufacture of military ammunition had been maintained, and this facility had carried on considerable experimental work. Remington and Western Cartridge agreed that the Frankford manufacturing process would be utilized at the new plants with such modifications as each company deemed desirable based on commercial experience. Changes to the Frankford Arsenal design would include motorization of production equipment and the adaptation of machinery to a conveyor system, which would be used in the new plants (LCOP 1943a:30). The result of intensive work by Remington and Western Cartridge, with Frankford Arsenal's cooperation, was a series of what came to be termed the RW specifications. These were the basis of the First Wave machinery procurement program. The RW series included a first group of 80 specifications jointly developed at Frankford and another group of about 60 completed by Remington engineers at Bridgeport (LCOP 1943a:32). Subsequently, Remington prepared the R series, approximately 80 additional .30- and .50-caliber specifications (LCOP 1943a:32). Both the RW and R series specifications were made available to all companies entering the small arms ammunition program and were ultimately used in purchasing production equipment valued at more than $150,000,000.

Operating equipment needed for LCOP totaled 1,320 machines. The first orders, covering 28 items, went out on December 27, 1940 (LCOP 1943a:31). As purchasing agreements had to be worked out between Remington and the government for every lot of ordered machinery, Remington requested and was granted authority to advise vendors verbally to proceed with manufacture, pending the placement of firm orders at a later date. This enhanced the speed of procurement by eliminating numerous small delays. By the end of March almost all equipment was on order, and the first machine was delivered at the plant on May 5, 1941. Problems were anticipated when the First Wave completion date was advanced to September 30. The problem of scheduling was especially complicated, for it was necessary to coordinate the arrival of machinery at the plant with the progress of construction and requirements for the hiring and training of personnel. Remington immediately expanded its original staff of 25 to include approximately 215. This larger staff expedited equipment procurement by handling the scheduling, inspection, and additional problems brought on by the necessity to begin production. The newly formed staff was successful, and on September 30, 98 percent of the production equipment for LCOP had been delivered or was en route to the plant (LCOP 1943a:32). After Remington's performance in dealing with the procurement problems, the War Department requested that they assume the responsibility for the scheduling, expediting, and inspection of all production equipment for all new small arms ammunition plants and for certain equipment being purchased for shipment to Russia under the Lend-Lease program (LCOP 1943a:32).

Table 3
Manufacturers Who Guaranteed Materials, Equipment, and Supplies During LCOP Construction*

A. Y. McDonald Mfg. Co.
Allen Corporation
Allis Chalmers Mfg. Co.
American Air Filter Co., Inc.
American Blower Corp.
American District Steam Co.
American Machine & Metals Inc.
American Well Works
Anemostat Corp. of America
B. F. Sturtevant Co.
Babcock and Wilcox
Bailey Meter Co.
Black Sivalls & Bryson, Inc.
Buffalo Forge Co.
Builders Providence Inc.
Burke Engineering Co.
Butters Pump & Equip. Co. Inc.
Certaineed Products Corp.
Chicago Pump Company
Columbian Steel Tank Co.
Cramer Safe & Office Equip. Co.
Crane Company
Dempster Mill Mfg. Co.
The Dorr Company
Electric Storage Btry. Co.
Elgin Softener Corporation
The Engineer Company
English Bros. Machine Co.
Fairbank Morse Company
Forslund Pump & Machine Co.
Geo. D. Roper Corp.
Glasco Electric Company
Graybar Electric Co.
H. H. Wright Company
Harzard Insulated Wire Wks.
Heaven Engineering Co.
Ingersoll Rand Company
Johnson Service Company
K. C. Structural Steel Co.
Kansas City Insulation Co.
Kieley & Mueller, Inc.
Kimball Bros.
Kompolite Kompany
Kornbrodt Kornice Ko.
Kuhlman Electric Co.
Leeds and Northrup Co.
Liquidometer Corporation
Maloney Electric Co.
Marley Company, Inc.
Minneapolis-Honeywell Regulator Co.
Messplay Machine Co.
Midwest Precote Co.
Moorland Company
Municipal Service Co.
Omega Machine Co.
Pittsburgh Equip. Meter Co.
Potter Auto. Sprinkler Co.
Powers Regulator Co.
Richards Wilcox Mfg. Co.
Rivard Sales Co.
Rowe Mfg. Co.
Sellers & Marquis
Smith-White Company
Spencer Turbine Co.
Surface Combustion Co.
Trane Company
Tri-State Equipment Co.
U. S. Supply Company
Uhrich Supply Co.
V. L. Phillips Company
Viking Refrigerators, Inc.
Vilter Mfg. Co.
W. B. Young Supply Co.
Warren Webster
Whitcomb Bauer Flooring Co.
Worthington Pump Company
Wyatt and Reed
York Midwest Company

* Data taken from USACE 1943:222

In addition to production machinery (Figures 14 and 15), Remington made other purchases for LCOP, including tool room and miscellaneous equipment. These items included equipment such as pots, pans, and paper towels for the cafeterias, automatic revolvers and search lights for the guard force, fire hoses and rubber boots for the firefighters, and vitamin pills and pillow cases for the hospital. Approximately 600 different types of perishable tools and 500 types of gauges were required for .30- and .50-caliber ammunition manufacture. Additionally, tolerances had to be as fine as 1/10,000 of an inch in certain instances. While large quantities of tools were necessary, no ammunition tool industry existed in the U.S. to serve as a source of supply. To meet this problem, Remington had to search out scores of possible vendors in all areas of the U.S. This proved to be a large and time-consuming task, and in the case of many small shops, Remington had to teach the vendors the fine art of making ammunition tools (LCOP 1943a:34).

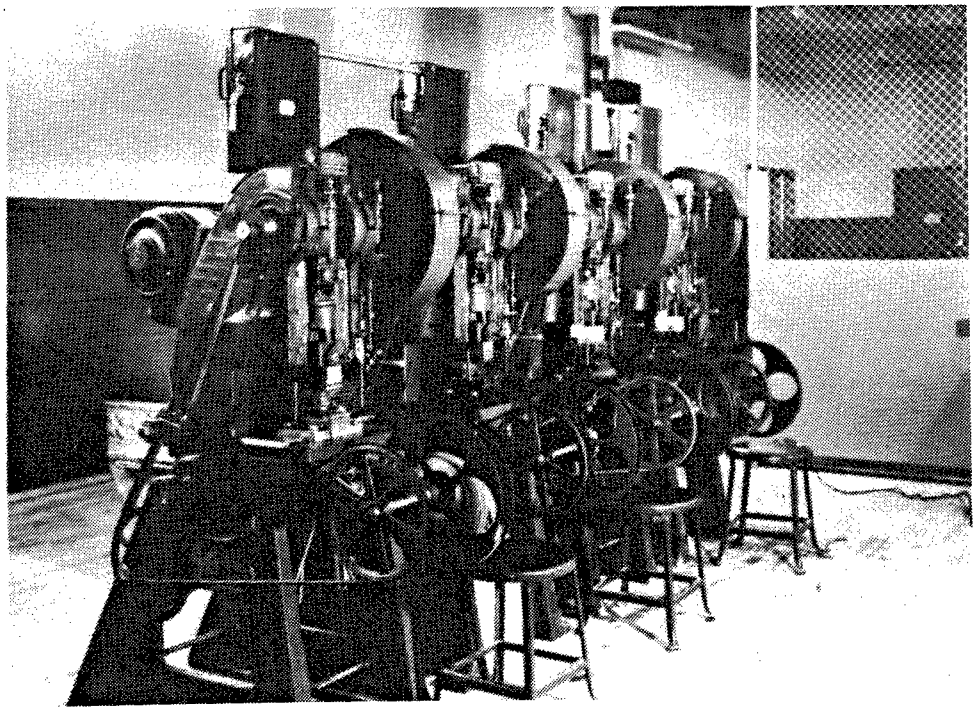


Figure 14. Primer Manufacturing equipment, 1941 (original photograph on file, LCAAP).

Expansion and Additional Procurement

Approximately two months after dedication of the LCOP, the Third Wave of the GOCO small arm ammunition program was announced. At LCOP, this expansion would greatly increase the number of operating personnel and increase the original daily production capacity from 2,600,000 rounds to 8,900,000 rounds (LCOP 1943a:40). This increase at LCOP was followed within the next few months by further augmentation under the Fourth and Fifth Waves (see Table 2).

Under the Third Wave program, LCOP was originally to have been allocated a large .30-caliber expansion and the Denver plant facilities for the manufacture of carbine ammunition. Specifications for the carbine cartridge called for a noncorrosive primer formula which, as pointed out by Remington, could be handled

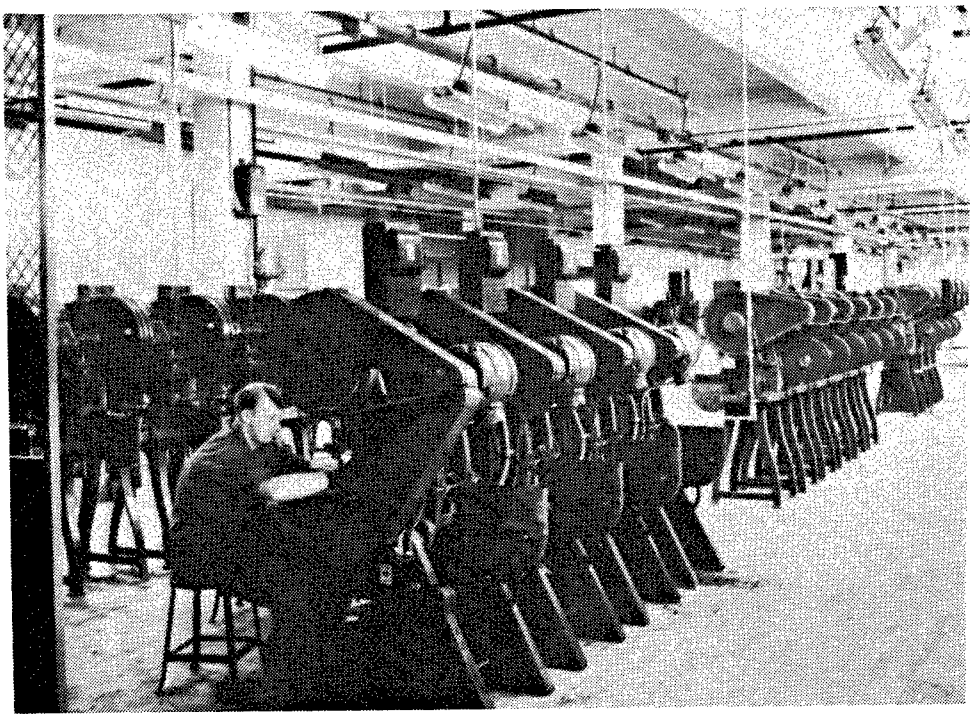


Figure 15. Primer Manufacturing equipment, 1941 (original photograph on file, LCAAP).

with less hazard in the lower, moister atmosphere at LCOP. The original plans were changed, and LCOP received a carbine manufacturing facility with a daily capacity of 2,000,000 rounds. The Fourth Wave called for further increases in LCOP's capacity to produce. Third and Fourth Wave expansion required additional construction and extensive alterations. New production of .50-caliber incendiary ammunition called for an addition to Building 3, alteration to the tracer composition manufacturing building, enlargement of the boiler house, additional ranges and storage houses, and alterations and minor construction for additional machinery (LCOP 1943a:44). The carbine program required construction of a main building, Polnol and Sensol (Remington trade names for lead styphnate and tetrazene) manufacturing facilities, and a carbine primer charging wing. Additional construction included primer mixing, drying and storage facilities; expansion of the lead shop and powder canning facilities; extension of utilities; and the expansion of roads and walkways in the hazardous area (LCOP 1943a:44).

Actual construction began in February 1942, and by the end of 1942, Third and Fourth Wave construction was complete. A delay in the delivery of production machinery and components prevented production until November. The cost of the Third and Fourth Wave program at LCOP was $6,500,000 (LCOP 1943a:44).

In early May 1942, Remington was advised that another expansion at LCOP was desired to provide for an increase in .50-caliber production. This required a new .50-caliber manufacturing building and expansion of the existing .50-caliber facility. It was also necessary to expand the ballistics building, salvage facilities, and primer mixing, manufacturing, and storage facilities. Construction began in July 1942 and was completed in March 1943.

In late 1942, a meeting discussing the termination of the collateral contracts with the Architect-Engineer and construction contractors was held. In early 1943 it was decided that certain tasks which needed to be finished would be undertaken by the Contractor-Operator, and certain tasks would be the responsibility of the area

engineer. The government terminated the collateral contracts with the Architect-Engineer and construction contractors on January 31, 1943 (LCOP 1943a:47).

Third, Fourth and Fifth Wave expansion called for additional equipment procurement. These expansions virtually equaled the original procurement by calling for 1,317 production machines (LCOP 1943a:48). Machines needed for the .30- and .50-caliber expansion totaled 664, while 653 were needed for the new carbine facilities. The manufacture of carbine machinery was new and unfamiliar to suppliers. Certain equipment could not be ordered until certain requirements had been determined; for example, this included packing equipment. Various minor adjustments were made, including transfer of equipment from other government facilities, as the new procurement program progressed. Cost of the additional machinery amounted to $14,374,070 (LCOP 1943a:49), and necessary tools and miscellaneous equipment for the expansions totaled over $9,000,000 (LCOP 1943a:49).

As Remington's Architect-Engineer, Smith, Hinchman and Grylls operated in an efficient manner and used good initiative and resourcefulness (USACE 1943:233). As construction contractors, both Foley Brothers, Inc., and Walbridge-Aldinger Company were efficient and economical in the conduct of their work. Both used very good judgment in employment, payment of salaries, and the purchase of materials. In all phases of conducting their work, their initiative and resourcefulness were excellent (USACE 1943:233). All three companies executed their contracts to the best interest of the government.

CONTRACTOR OPERATIONS

As stated earlier, Remington Arms Company of Bridgeport, Connecticut, was chosen as the Contractor-Operator at LCOP. The formal contract, W-ORD-484, was signed on November 25, 1940. Remington was chosen for its experience in small arms manufacturing. The company was established by Eliphalet Remington in 1816 as a manufacturer of rifle barrels and flintlock sporting guns. Since the Civil War, Remington has been a principal supplier of sporting and military arms and ammunition. During its involvement in the World War II GOCO program, Remington was a subsidiary of the Du Pont Corporation, and remains so today. In more recent years, particularly after World War II, Remington has become one of the most progressive of the old-line arms manufacturers (Nonte 1973:210-211). From an early date Remington had cooperated with the Planning Board to make studies and plans for the war-time mobilization of industry. It was no surprise when Remington was asked to participate in the GOCO program in 1940.

As work on various LCOP buildings reached completion, they were inspected and accepted. On January 31, the government terminated its contracts with the Architect-Engineer and the construction contractors. At this time, Remington took full control of the installation.

The Contract

The contract negotiated between Remington and the government called for Remington to provide the following services:

1. Furnish management services covering (a) optioning of the site, and (b) consultation with and advisement to the Architect-Engineer with respect to adequacy of design, engineering and construction of the plant.
2. Procure all equipment, including supervision of design and plans for installation, except utilities.
3. Make all necessary preparation for operation of the plant.
4. Operate the plant when constructed.

Under Remington's contract, the management services called for by Title I were to be furnished on a fixed-price (lump sum) basis, and the procurement of equipment and operation of the plant, under Titles II and III, on a cost-plus-fixed-fee basis. Remington was to receive:

1. The lump sum of $600,000 and a fee of $1 to cover management services, engineering, consultation and procurement under Titles I and II. The company estimated direct charges against performance of this work at $300,000 and distributive charges at $200,000, leaving $100,001 as fees.
2. A payment of $1,000,000 as complete reimbursement for the cost of training personnel outside the Lake City plant, not including charges by government arsenals incident to such training or the cost of transferring personnel from Remington plants or government arsenals to LCOP. This payment was provided for in view of the practicability of determining the cost of training as it was incurred.
3. A monthly payment of $45,000 as reimbursement to cover general administrative and other general expenses of the company incidental to operation of the plant during the period required for production of the ammunition ordered in Title III, but not exceeding 20 months (Supplement 4 removed the 20-month limitation, and Supplement 8 terminated the monthly general administration expense payments as of June 30, 1943).
4. Manufacturing fees per thousand rounds as follows:

.30-caliber ball M2	$2.00
.30-caliber A.P. M2	$3.60
.30-caliber tracer M1	$3.00
.50-caliber A.P. M2	$11.00
.50-caliber tracer M1	$10.00

(For subsequent revisions of fees, see Table 4)

The operating contract was a cost-plus-fixed-fee (CPFF) or "fixed fee" contract. This was one of six emergency contract forms developed by the War Department in 1940 as a means of "reforming" military procurement practices (Smith 1991:48-72). The CPFF contract allowed greater flexibility in pricing, as compared with the standard fixed-price supply contract. Because many wartime contractors had little or no experience in defense contracting and were engaged in manufacturing material that had never before been produced on the scale required by the government, they were reluctant to pursue fixed-price contracts. CPFF allowed the government and contractors to bypass competitive bidding and made pricing "flexible." The official history of Ordnance Department procurement and supply in World War II describes the CPFF as in Table 4.

Each company was reimbursed at regular intervals for approved expenses in operating the plant, and in addition was paid a fee based on the number of rounds of ammunition or pounds of explosive produced. Under this arrangement the contractors ran no risk of failing to make a profit. To protect the government's interest, teams of auditors at each plant checked the company's accounts and approved or disallowed every item of expense in accordance with policies established in Washington (Thomson and Mayo 1960:113).

While the liberal provisions of CPFF contracts greatly expedited the construction of new Ordnance Department facilities at a time when the fate of the entire Allied cause hung in the balance (Cambell 1946:108), they came under criticism and were the subject of a series of Congressional inquiries known as the Truman Committee hearings (Fine and Remington 1972:562-585; Smith 1991:280-283; Thomson and Mayo 1960:113, 130). CPFF contracts provided incentives for quality control but not for cost-efficiency. Whether operating under a CPFF contract or under a loosely negotiated fixed-price contract, war suppliers behaved in much the same manner. The wartime tax structure, with marginal excess profits tax rates of 90 percent, removed much of the power of the profit motive to reduce costs. Lavish expenditures by many fixed-price contractors cost them only ten cents on the dollar and for all practical purposes placed them in a cost-plus status (Smith 1991:276).

Table 4
Summary of Revisions of Fees Per 1,000 Rounds*

Original Contract		
(see this document)		
Supplement 3		
approved February 25, 1942	.50-cal. incendiary	$15.00
	.30-cal. carbine	$1.00
Supplement 4		
as of May 1, 1942	.30-cal. ball	$1.50
	.30-cal. armor piercing	$2.50
	.30-cal. tracer	$2.00
	.30-cal. carbine	$0.75
	.50-cal. armor piercing	$8.00
	.50-cal. tracer	$7.00
	.50-cal. incendiary	$9.00
Supplement 8		
effective as of July 1, 1943	.30-cal. ball	$1.25
	.30-cal. armor piercing	$1.75
	.30-cal. tracer	$2.00
	.30-cal. carbine	$1.00
	.30 carbine grenade	$0.75
	.50-cal. armor piercing	$5.00
	.50-cal. tracer	$5.50
	.50-cal. incendiary	$6.00
effective January 10, 1944	.50-cal. armor piercing I.	$6.00
Supplement 15		
effective April 1, 1944	.30-cal. ball	$1.05
	.30-cal. armor piercing	$1.50
	.30-cal. tracer	$1.70
	.30-cal. carbine	$1.00
	.30 carbine grenade	$0.75
	.50-cal. armor piercing	$3.75
	.50-cal. tracer	$4.50
	.50-cal. incendiary	$4.50
	.50-cal. armor piercing I.[1]	$5.50
effective August 2, 1944	.50-cal. ball	$4.30
Supplement 31		
effective March 1,1944	.50-cal. unpack and repack	$0.70
	.50-cal. unpack, inspect, repack	$1.00
effective August 1, 1944	.50-cal. blank	$1.50
effective October 1, 1944	.30-cal. ball	$1.05
	.30-cal. armor piercing	$1.75
	.30-cal. tracer	$2.00
	.30-cal. rifle grenade	$1.15
	.30-cal. ball frangible	$3.00
	.30-cal. carbine	$1.00
	.30 carbine grenade	$0.75
	.30-cal. carbine tracer	$1.30

Table 4 (cont'd)

	.50-cal. ball	$4.30
	.50-cal. armor piercing	$3.75
	.50-cal. tracer	$4.85
	.50-cal. incendiary M1	$4.50
	.50-cal. incendiary T-48	$5.20
	.50-cal. armor piercing I.	$4.85
	.50-cal. armor piercing I. T.[2]	$5.20
	20-mm loaded	$4.50
Change Order 32		
effective April 1, 1945	.30-cal. ball	$1.05
	.30-cal. armor piercing	$1.75
	.30-cal. tracer	$2.00
	.30-cal. rifle grenade	$0.90
	.30-cal. ball frangible	$3.00
	.30-cal. carbine	$1.00
	.30 carbine grenade	$0.75
	.30-cal. carbine tracer	$1.30
	.50-cal. blank	$1.50
	.50-cal. ball	$4.00
	.50-cal. armor piercing	$4.00
	.50-cal. tracer	$4.85
	.50-cal. incendiary M1	$4.50
	.50-cal. incendiary T-48	$4.85
	.50-cal. armor piercing I.	$4.85
	.50-cal. armor piercing I. T.	$4.85
	20-mm loaded	$4.50
	.50-cal. unpack and repack	$0.70
	.50-cal. unpack, inspect, repack	$1.00
	.60-cal., all types	$15.00
Supplement 44		
approved January 24, 1946	.30-cal. repack	$0.40
	.30-cal. carbine grenade repack	$0.70

[1] I. = incendiary
[2] T. = tracer
* Data taken from LCOP 1943a:Appendix III

The fees for the operation of GOCO facilities were a specified amount per unit of output, determined in advance of production on the basis of estimated costs. In the case of small arms ammunition, initial contracts placed throughout 1942 generally used the same cost estimate and the same fees for all plants. As large-scale production proceeded, cost trends dropped to permit the downward negotiation of fees (Smith 1991:297). Data presented by Smith (1991:297) show that the actual fixed fee percentage differences for the different types of ammunition produced at the six principal small arms GOCO facilities were not large, ranging between 2.77 and 3.88 for .30-caliber ball and 3.96 and 6.02 for .50-caliber armor-piercing rounds. In comparison, fees at shell-loading plants, which performed final operations on an assembly line basis, averaged 2.3 percent, and at the newly developed ammonia plants fees averaged 6.5 percent of the total cost (Smith 1991:297-298).

Administration of CPFF contracts improved substantially between the time the early construction contracts were let and the last years of the war. Noteworthy improvements included the expansion and refinement of policies, procedures, and organizations for the advance estimating of costs, setting and revising fees, defining allowable elements of cost, and auditing contract operations (Smith 1991:297-298). However, the production conditions of a nation at war gave rise to numerous problems and questions not covered in regulations. The policy concerning specific reimbursement by the government of such costs as employee bonuses, overtime and shift premiums, vacation pay, retirement programs, and various welfare activities were not considered. Also of concern was that the fees of professional accountants and attorneys were included as operating costs, payable by the government even when being used in litigation against the government. Limitations on advertising expenditures, entertainment, and contributions were several of the many other concerns not covered by regulations. Until definite answers were found, all cost reimbursements paid to contractors were purely conditional, with the Comptroller General having the power to audit all CPFF contracts, to disallow specific cost items, and to suspend specific payments made by disbursing officers (Smith 1991:298-299). Using the traditional peacetime accounting methods put a burden on the War Department's often inadequate accounting services; thus, as much time and effort was spent on small inconsequential items as on large important ones. Additional results included slow payments to contractors and hindered war production (Smith 1991:299).

In May 1942 an elaborate memorandum was sent to all technical services and other major components of the War Department announcing a new policy of selective and flexible audit procedures for work under CPFF contracts. These were designed to minimize routine checking, eliminate duplication of audit activities, and expedite payments to contractors. The philosophy underlying the new approach was the development within the contractor's own accounting organization of a system of internal controls which would automatically reveal irregularities and enable trained government auditors using selective audit techniques to protect the interests of the government (Smith 1991:300).

At the end of 1943 the War Department employed approximately 6,400 auditors, most of whom were devoted to the auditing of CPFF contracts. There was a general desire to shift to fixed-price contracts. While the refinement of auditing controls was an important element in protecting the government against improper charges and wasteful expenditures under CPFF contracts, the War Department was equally concerned with fostering cost-reduction techniques in the basic process of production (Smith 1991:300). It was the belief of government officials that regular publication and analysis of production costs on a plant-by-plant basis would stimulate competition among the various plants. With every plant manager, as well as all employees, anxious to make a good showing, the competitive spirit could be harnessed to pride and patriotism in lieu of the profit motive (Smith 1991:301).

The new changes in auditing controls resulted in cost reduction, increased output and technical improvements in both end products and production process. Abandonment of the CPFF procedure in the ammunition procurement program would have resulted in grave damage without benefits. Unit costs of ammunition were highly sensitive to changes in volume, and unpredictable fluctuations in ammunition requirements continuing up to V-J Day rendered the use of fixed prices unsatisfactory. Also, the safety hazards of munitions production made it desirable to eliminate profit-motivated pressures upon cost. Throughout all of the efforts of the War Department to convert its CPFF contracts to a fixed-fee basis, the Ordnance Departments GOCO contracts were exempt (Smith 1991:302).

TECHNOLOGY

Background and Context

During World War II the Ordnance Department constructed 77 GOCO industrial facilities in 26 states. These included small arms ammunition plants at Denver, Des Moines, Lake City, Lowell, Kings Mills, Milwaukee, St. Louis, and the Twin Cities (Thomson and Mayo 1960:111). With a base knowledge developed for the Unit Plan of 1938, GOCO planning commenced in mid-June 1940. Construction began on the 29 First Wave plants that same year. During the months leading up to the U.S. entry into the war, construction at the Second Wave small arms ammunition plants commenced (Fine and Remington 1955:309-341; Thomson and Mayo 1960:45-59).

The main mission of the LCOP was to produce .30-caliber, .30-caliber carbine, and .50-caliber ammunition. Additional and supporting production of primer manufacturing and mixing and tracer, igniter, and special composition manufacturing also took place at LCOP during World War II. The small arms carried into battle by U.S. troops had not appreciably changed in their basic design since the interwar period: however, numerous modifications to existing arms were made between 1940 and 1945. These modifications primarily involved the use of more reliable ammunition and improved ammunition feeding systems for automatic weapons. The basic World War II infantry weapons included the standard equipment .30-caliber M-1 or Garand rifle that had gone into service in 1932; the older .30-caliber Springfield rifle of World War I vintage; the .30-caliber M-1A1 carbine designed in 1940; the .30-caliber Browning Automatic Rifle (BAR) adopted by the U.S. Army in 1918; the .45-caliber automatic pistol, standard issue since 1911; the .45-caliber Thompson submachine gun, which had entered service in the early 1920s; the .50-caliber Browning air-cooled machine gun, developed in 1918; the .30-caliber Browning water-cooled machine gun that had been developed in the 1910s; and the air-cooled version of the .30-caliber machine gun. Many of these weapons were also in service with Allied forces, particularly the .30 and .50-caliber machine guns (Thomson and Mayo 1960:154-182). It should be noted that most of these were rapid-firing, semi-automatic or automatic weapons fed by clip, magazine, or belt loading systems which held between five and 250 rounds.

Substantial advances were made in the prewar period to improve the quality of small arms ammunition. New materials and processes had been adopted for the manufacture of rifle, pistol, and machine gun bullets, expanding production line capabilities, improving quality control, and conserving strategic materials (Green et al. 1955:487-494; Thomson and Mayo 1960:213-217). The original machines built for the LCOP were derived from prototypes developed at the Frankford Arsenal in the late 1930s and early 1940s.

The original design of LCOP included eight .30-caliber lines and four .50-caliber lines. The rated daily capacity (three eight-hour shifts) was 2,000,000 .30-caliber and 600,000 .50-caliber rounds. Later expansions at LCOP included two .30-caliber, five .50-caliber, and five .30-caliber carbine lines, increasing the daily capacity to 2,500,000 .30-caliber, 1,400,000 .50-caliber and 2,400,000 .30-caliber carbine rounds. The actual overall daily capacity during World War II reached a maximum of 8,900,000 rounds (LCOP 1943a:2). LCOP small arms production, based on government acceptances, is outlined in Table 5.

Between October 1941 and October 1945, the LCOP produced over five and one-half billion rounds of small arms ammunition, amounting to approximately 16 percent of all of the small arms ammunition used by Allied forces during the war. Tons of ammunition manufactured at the LCOP were shipped to combat forces in every theater of wartime operations. Additional LCOP ammunition was shipped to friendly nations under Lend-Lease. LCOP produced ammunition of high quality, with 87.7 percent of the.30-caliber and 89.2 percent of the .50-caliber cartridges accepted as "Grade A" (LCOP 1943a:Appendix 1:3).

Table 5
Summary of World War II Yearly Small Arms Production at LCOP*

Year	.30-caliber	.30-caliber carbine	.50-caliber	Totals
1941	18,227,695	—	361,414	18,589,109
1942	824,723,789	3,412,831	253,417,576	1,081,554,196
1943	1,014,526,552	711,005,141	465,587,668	2,191,119,361
1944	465,418,391	417,977,070	376,299,185	1,259,694,646
1945	347,403,912	380,162,422	255,866,665	983,432,999
Total	2,670,300,339	1,512,557,464	1,351,532,508	5,534,390,311

* Data taken from LCOP (1943a:Appendix I:1-3)

Note: In addition to the above production, LCOP produced a total of 24,482,052 rounds of training and gun functioning ammunition. LCOP also loaded 24,960,256 20-mm incendiary shells.

The LCOP output between 1941 and 1945 reflects the staggering small arms ammunition requirements of the Allied war machine. U.S. soldiers fighting their way across Europe in 1944-1945 expended more than 293 rounds of rifle and machine gun ammunition in a single month at the peak of the fighting. Deliveries of .30-caliber ammunition alone reached more than 800 million rounds in one month. The authors of the official history of the Ordnance Department in World War II provide the context for interpreting these figures:

> Rounds of small arms ammunition were produced during World War II in greater numbers than any other item of Army supply. Whereas most Ordnance material was counted in the thousands or millions, small arms ammunition was numbered in the billions of rounds, total production for the 1940-45 period amounting to more than forty-one billion. Some measure of the magnitude of small arms ammunition production may be gained by comparing it with total wartime production of artillery ammunition (excluding bombs, grenades, and mines) of one billion rounds, or with procurement of high-volume Quartermaster items such as men's socks, about 145,000,000 pairs. If fired at a rate of twenty rounds per minute, night and day, year after year, the small arms ammunition procured by Ordnance in World War II would have lasted for almost forty centuries [Thomson and Mayo 1960:188].

Between 1940 and 1945, the Ordnance Department delivered 10,042,259,000 rounds of .50-caliber and 25,065,834,000 rounds of .30-caliber ammunition. During World War II, the U.S. spent $184.5 billion on munitions, $18.1 billion of which went to the production of ammunition, most of which was purchased by the U.S. Army. In addition, $8.2 billion was invested in war plants and another $7.9 billion went to purchases of industrial machinery and equipment (Smith 1991:6-13).

Manufacturing Technology

From the time the component parts for the cartridges started in production until the finished cartridge were boxed for shipment, movement of the parts was accomplished by operating personnel and mechanized machinery. Handling of the rounds by operators took place during such tasks as hand feeding certain machines, moving the cartridges from machine to machine and inspection of the final product. The ammunition was also moved mechanically through the production processes associated with each machine. The hand feeding at LCOP may be significant, as the production process at the Remington-operated Denver Ordnance Plant has been reported as being entirely hopper-fed (Herb 1943).

During World War II, small arms ammunition had to be manufactured to very strict specifications. With the beginning of the use of this ammunition in large quantities on airplanes, specifications became even more strict. This was because many of the guns were not accessible to the crew, and the failure of one round would render a gun useless until the plane returned home. This brings to light another comparison between the LCOP and the Denver facility. The Denver plant has been reported as not only meeting the required ammunition specifications, but as producing ammunition accepted as aircraft quality in quantities far beyond the original expectations (Herb 1943). It is unclear as to what quantity the LCOP produced airplane-quality ammunition.

The differences between the separate types of .30-caliber cartridges shown in Figure 16 generally illustrate the end product of most LCOP production techniques. The differences in the cartridges pictured in Figure 16 are in the bullets. A ball-type bullet consists of a solid lead core with a gilded-metal-clad steel jacket. An armor-piercing bullet is made up of a steel core with a small lead core at the point end and a lead cap at the heel, all of which are covered by a gilding-metal jacket. A tracer bullet consists of a comparatively short lead core backed up by a tracer mixture and an igniter mixture, all of which are contained in a copper-alloy jacket. As has been discussed earlier in this report, LCOP produced variations of the above, including incendiary, which upon impact would spread a highly flammable compound to ignite the target; grenade, which would be used to launch an explosive projectile from the distal end of a rifle or carbine; armor-piercing incendiary, which would pierce armor and then ignite the target; armor-piercing incendiary tracer, for better accuracy; ball frangible, which would shatter into pieces upon impact; and blanks. The last two types were used for practice firing in training exercises.

While Kane (1995) gives an overview, based on Thomson and Mayo (1960), of the small arms production process, a description of the process derived from LCA (1947) documents and Herb (1943) is given below. While Herb described the process as it was set up at the Denver Ordnance Plant, the Denver plant was constructed by Remington at the same time as the LCOP. It is assumed that the production processes were very similar. The production of the cartridge case will be discussed first. These were made from small copper alloy cups. For economical reasons, cups were blanked, drawn to specific dimensions, thoroughly washed, and shipped to LCOP by outside manufacturers. The cartridge case was formed to government specifications from the cups through drawing, annealing, heading bump, taper, and trim operations (Figure 17).

Single-stroke duplex presses were used for the first drawing operation (Figure 18). Each side of the machine was provided with two punches, so that four cartridge cases were drawn per revolution of the crankshaft. The cups were fed to the table by a rotary hopper driven by the crankshaft at a speed of approximately 34 RPM. A notched ring ensured that the cups slid down through the chutes with the closed or base end downward. The weight of the cup was sufficient to push them forward on the table, and they were distributed by the operator to two disks that revolved in a horizontal plane, one of these disks being on either side of the machine. The disks fed the cups into separate gates that led to each of the four dies. The case slid from the dies down chutes that led to the back of the machine, where they were trapped by a gate until a quantity had been accumulated.

The case was next transported to natural gas-fired annealing furnace. Here the drawing lubricant was burned off, leaving a residue and discoloring the case. To remove the discoloration and residue, they were dumped into the first unit of the pickling, washing, lubricating, and drying unit. Here they were first discharged into a revolving wash tank, next into a rinsing tank, and then into a tank that contained a soapy solution which served as a lubricant in the next drawing operation. Finally, the cases were passed through a drying oven. From here the process started over again as the case passed through the second draw stage. Then they were taken to be "bumped."

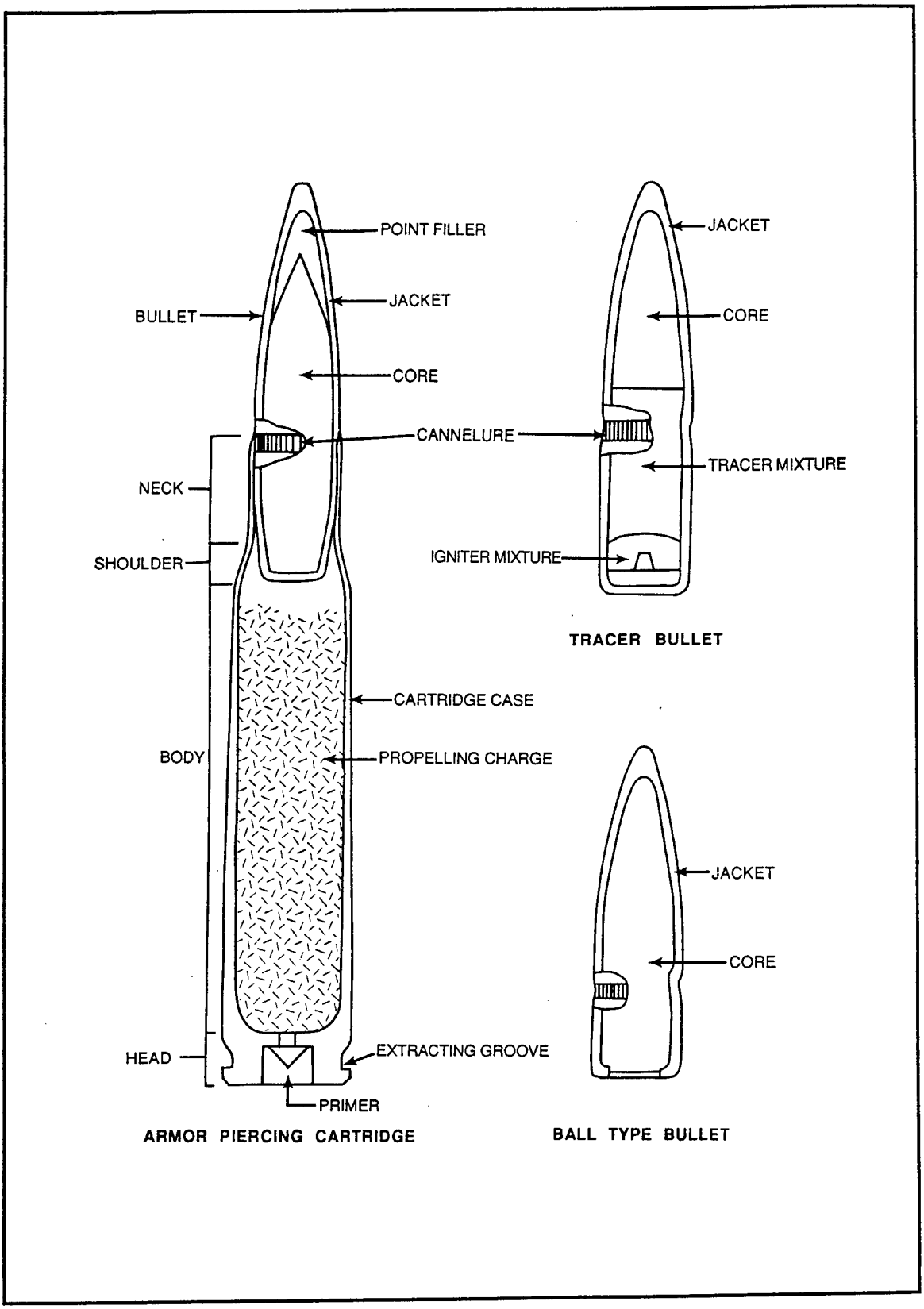


Figure 16. Representative cartridge and cartridge components produced at LCOP during World War I.

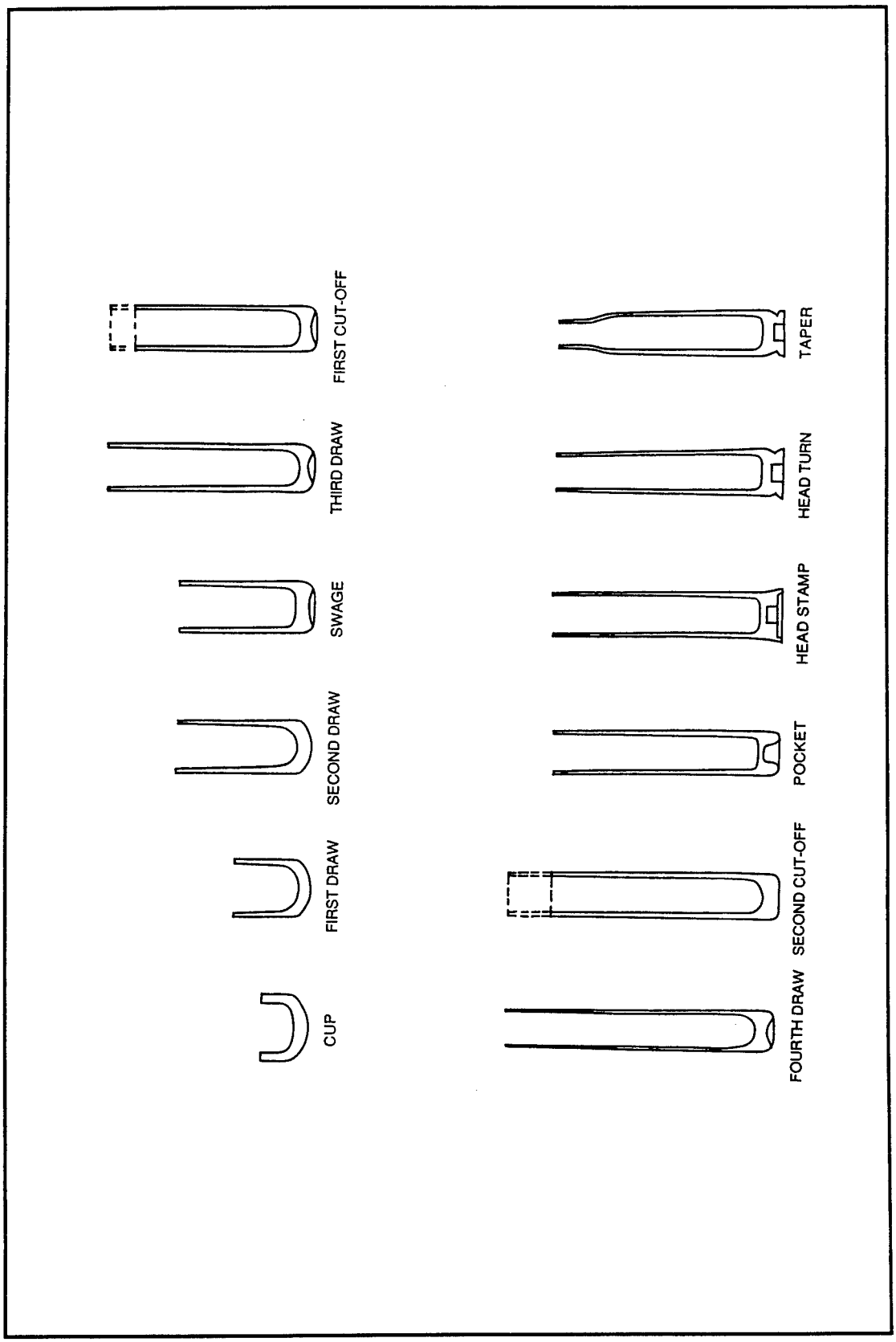


Figure 17. Steps involved in case manufacture at LCOP during early World War II years.

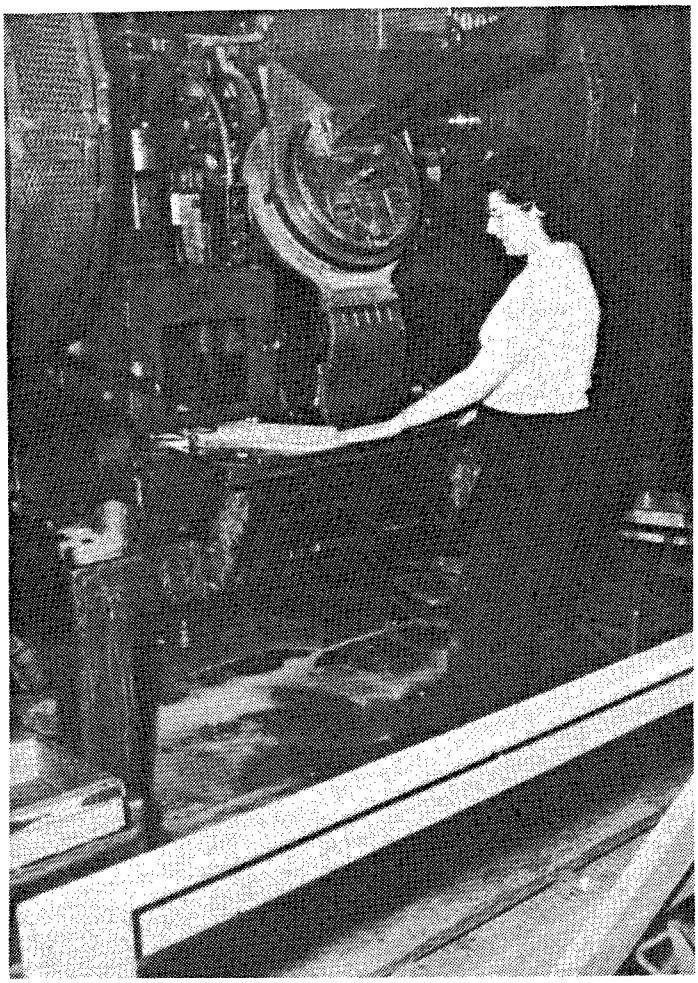


Figure 18. Case first draw, ca. 1951 (original photograph on file, LCAAP).

Bumping or swaging the base end of the cases was performed on horizontal toggle and crank machines. During this operation a punch struck the base or head end of the case. From this operation the case was transported through annealing (Figure 19), pickling, washing, and drying machinery once again, then into hoppers until they were taken to the third draw. This operation was performed on the same type of machine as the second draw, with the exception that only three punches were employed. From the third draw, the cases were transported to a horizontal-spindle machine which employed a rotary cutter. Here, a preliminary trimming operation removed the uneven open end of the case to bring them all to a uniform length for the fourth and final draw (Figure 20). If there was any oil or lubricant remaining inside the case from the preceding drawing operation, it would not rotate with the trimming machine spindle. This would be stripped off with the scrap when the trimming cycle was complete. The previous cleaning was designed to prevent this. The case was then passed through annealing, pickling, washing, lubricating, and drying operations for a third time in preparation for the fourth and final draw. The fourth draw was completed on a single-crank machine similar to those used on the second and third draw, with the exception that there were only two punches on the machine. During this operation the walls of the case reached their specified thickness; therefore, great care was taken to see that the punches and dies were of proper size and closely aligned. Inspection after the fourth draw included determining, through use of a dial gauge, the diameter and wall thickness of the case. This was performed only on a small percentage of cases.

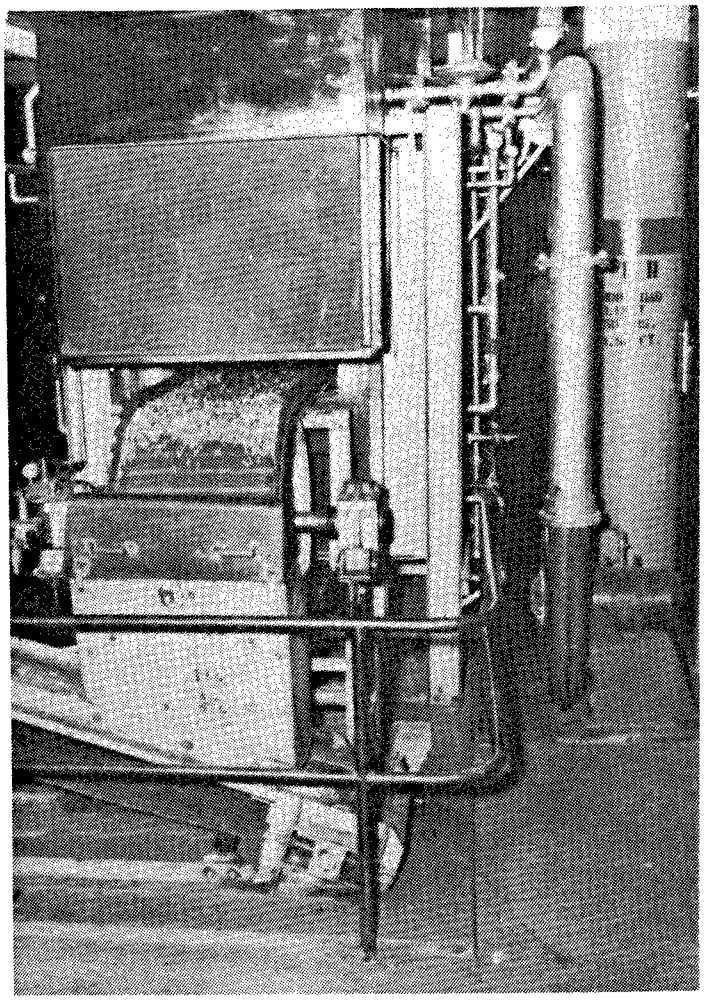


Figure 19. Case second anneal, ca. 1951 (original photograph on file, LCAAP).

After the second trim, the case was carried to a machine for the rough forming of the primer pocket. Immediately after the fourth draw, the case was once again washed and dried in preparation for the second trim. Afterward, a machine of the same type used to rough head the case was employed to head the base end. In this operation the primer pocket was resized and the head was formed to a somewhat larger diameter than the case proper. This cold-working method of forming the cartridge case head gave the high degree of hardness desired. Another washing and drying took place after heading.

The case was next transferred to a machine which turned the head end. Here, a forming tool turned a groove to the proper depth in the base end of the cartridge case, cut a taper at one side of the groove to a specified angle, and turned the head to the required diameter. All of these cuts were made to exceptionally close tolerances. It was important during this step that the cutting tool be kept sharp. A dull cutter would leave burrs on the heads of the cases and cause the rejection of cartridges during final gauging and weighing.

The trimmed cases were next taken to body annealing machines. During this process the head ends were submerged in a trough of water to keep them hard, while the bodies moved through a series of open gas flames directed from jets in pipes that extended horizontally along the front and back of the machines. As the cases were transported along, they were revolved to ensure uniform annealing around the entire body.

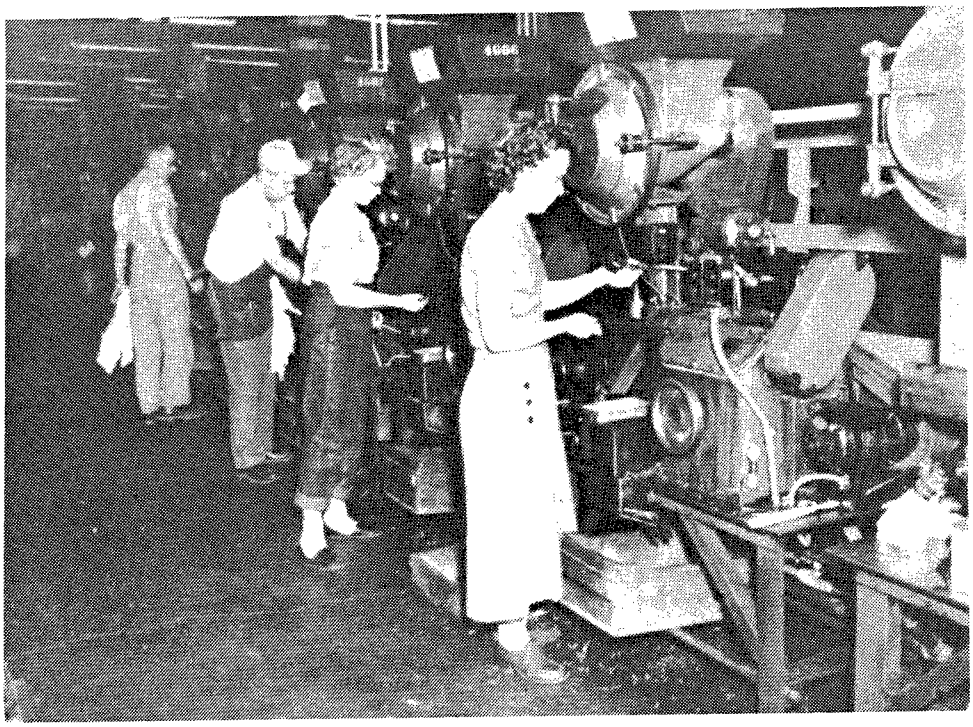


Figure 20. Bullet trim, ca. 1951 (original photograph on file, LCAAP).

This operation prepared the cases for tapering of the open end; this was essential, as unannealed cases wrinkled and split near the open end. Too high of an annealing temperature, though, caused equally disastrous results. Before the tapering of the open end, a lubricating process occurred. During the tapering process, small irregularities in the mouth of the case, which caused folds and creases, were first removed. Then dies formed the taper and shoulder of the case. Finally, a second "mouth-ironing" punch was used to smooth and round the neck portion of the case. All lubrication was washed away with a more concentrated cleaning solution and the cases were dried, as it was essential that the they be clean and dry for the next operation.

The following operation consisted of a final trimming on a vertical type machine. At the completion of this operation, the cases were transferred to large annealing furnaces and heated to approximately 450° F. This operation was designed to relieve the cases of all strains that were set up in the operations following the third annealing. After it was complete, the cases were given a bath in diluted sulfuric acid to remove oxide formed during the stress-relieving operation. A fresh water rinse and another complete washing and drying followed the acid bath. Another annealing, to soften the neck and mouth of the case, followed. This was done to facilitate bullet assembly and prevented cracking of the necks while the cartridges were in storage.

Bullet jacket cups of gilded metal and clad steel, like case cups, were obtained by LCOP from outside vendors. At LCOP, these were formed to government specification through draws and trims. Jacket production took place in the main manufacturing areas of the separate ammunition buildings in a manner similar to that of the case manufacture (MacDonald and Mack 1984:31):

> Starting with strips of gilded metal, disks were stamped out and formed into cups which then went through a whole series of annealing, pickling, cleaning and drawing operations, before they were ready to be slipped over lead (core) [Thomson and Mayo 1960:206].

Bullet cores were also obtained from outside vendors. Lead slugs, as well as activated bullet charges such as those found in tracers and incendiaries, were manufactured at the LCOP. At the lead shop, powerful extruding presses turned lead "pigs" into strands of wire, which were then cut and shaped into cores on swaging machines (MacDonald and Mack 1984:31). After manufacture, these passed through production flow channels in the bullet assembly machines to produce the complete bullet. Specific types and calibers of propellant powder were procured through government sources (i.e., GOCO propellant and explosives installations). Tracer, incendiary, and primer mix were manufactured at LCOP (Figures 21 and 22). Tracer and incendiary ingredients were processed in accordance with the individual government specifications in regard to the specific types and calibers to obtain the desired results. Primer cups and anvils were also produced at LCOP, specifically, in Building No. 35. Control banks of cups and anvils stored in the hazardous area were channeled to the various manufacturing buildings in accordance with ammunition type and demand. The cartridge cases and bullets traveled along parallel production lines, picking up the priming, powder pouring, and bullet charging operations en route to form the assembled complete round (LCA 1947:45; Figures 23 and 24). At LCOP the putting together of the final round was usually accomplished on straight-line loading machines:

> cases are fed from a hopper to a dial under a powder-filled hopper. At the first station, a metered charge of powder is admitted to the cartridge case, which is moved to the next station, where the bullet, which has been fed from another hopper, is inserted. The bullets and cases are then carried to another station, where the bullets are forced into the cases. At the next station, a crimping tool comes down and closes the mouth of the cartridge around the mouth of the bullet. The finished cartridge is then turned over, dipped into . . . lacquer, and fed into a drying dial, from which it is later ejected from the machine [Thomson and Mayo 1960:191-192].

Inspection and ballistics testing functions were conducted throughout the various stages of production (Figures 25-27). Accepted ammunition was then packed for shipment. Straight line production was accomplished in Buildings 1, 2, and 3 on a two-floor basis. Buildings 3-A, 4, and 35 were operated on a single floor plan, with the exception of powder pouring in Buildings 3-A and 4, which was accomplished from the mezzanine in the powder loading wing (LCA 1947:45-46).

Throughout the World War II operation of LCOP, numerous changes were made to the production lines due to persistent problems or new developments. These changes were both large and small. Additionally, there were both simple innovations developed by operators and major technological advances which were adopted by the entire small arms production industry. In the contextual overview for the Ordnance Department's World War II GOCO industrial facilities (Kane 1995), several potential research areas associated with LCOP were developed, including the production of ball frangible, .30-caliber carbine, armor-piercing incendiary, and carbine grenade rounds; the change from copper to steel bullet jackets; innovations in packing for shipment; innovations in inspection; the use of plastic cartridge components; and the use of high speed computer monitored machinery. These and other technological aspects of the LCOP are discussed below.

The copper shortage of 1941 (Green et al. 1955:486-487) led to the development of a way to use steel in bullet jackets. Conversion to the use of steel in bullet jackets was quickly and successfully made, and many were being manufactured by the fall of 1942 (Kane 1995:166). The first lot of LCOP .30-caliber ball cartridges with steel clad bullets was received by Ordnance Inspection in January 1943 (LCOP 1943c:19). Consistently increasing quantities were presented until this type of ammunition was converted 100 percent on March 5, 1943. By the end of June 1943, steel clad bullet jackets had replaced brass 100 percent in .30-caliber tracer and .50-caliber tracer rounds. On May 26, 1943, it was reported to the LCOP that this ammunition's quality was satisfactory and that 225,700 rounds were expanded in the Battle of the Bismarck Sea with "no malfunctions reported" (LCOP 1943c:30). Experimental and developmental work in the substitution of steel and steel clad components for brass was consistently carried on at LCOP from the time of the original directive.

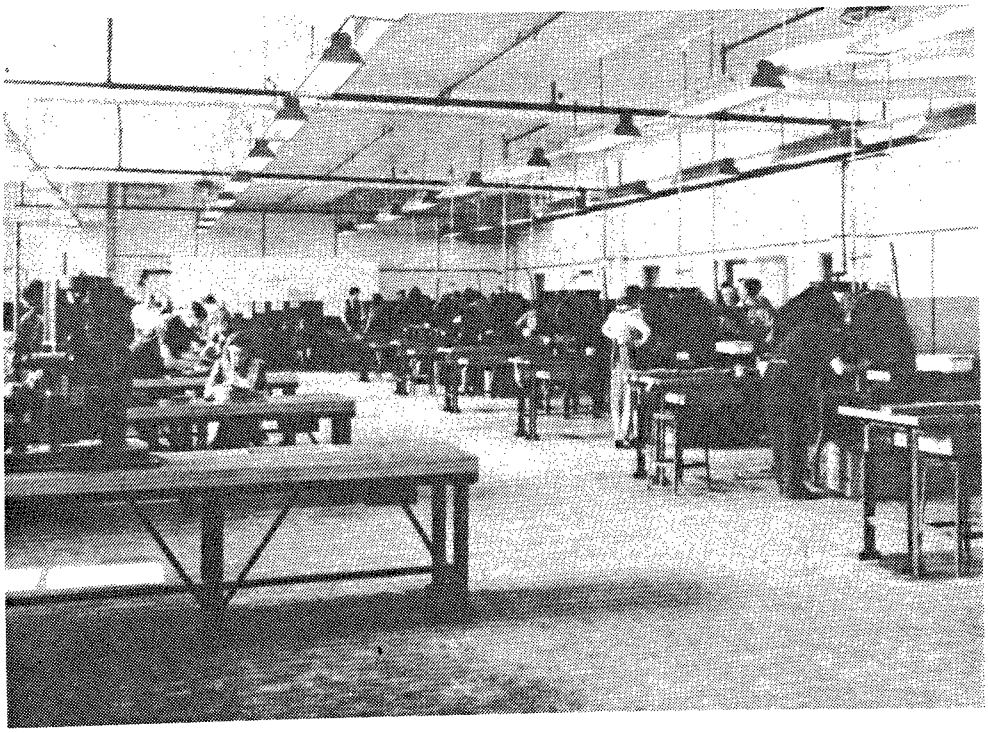


Figure 21. Primer Manufacturing area .30-caliber wing, World War II era (original photograph on file, LCAAP).

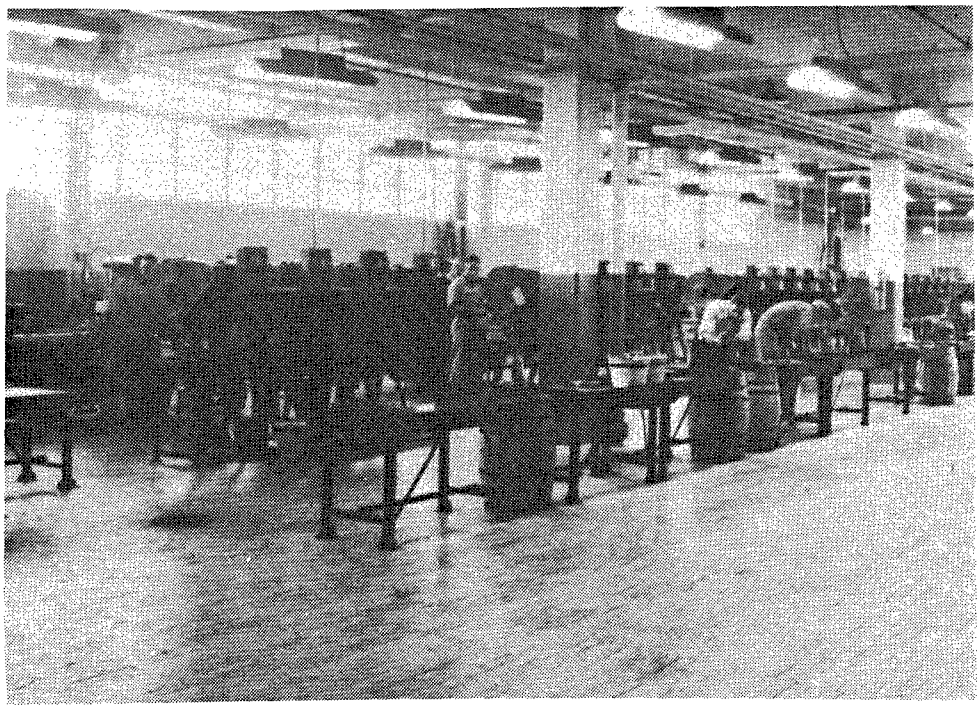


Figure 22. Primer Manufacturing area cup and anvil machines, World War II era (original photograph on file, LCAAP).

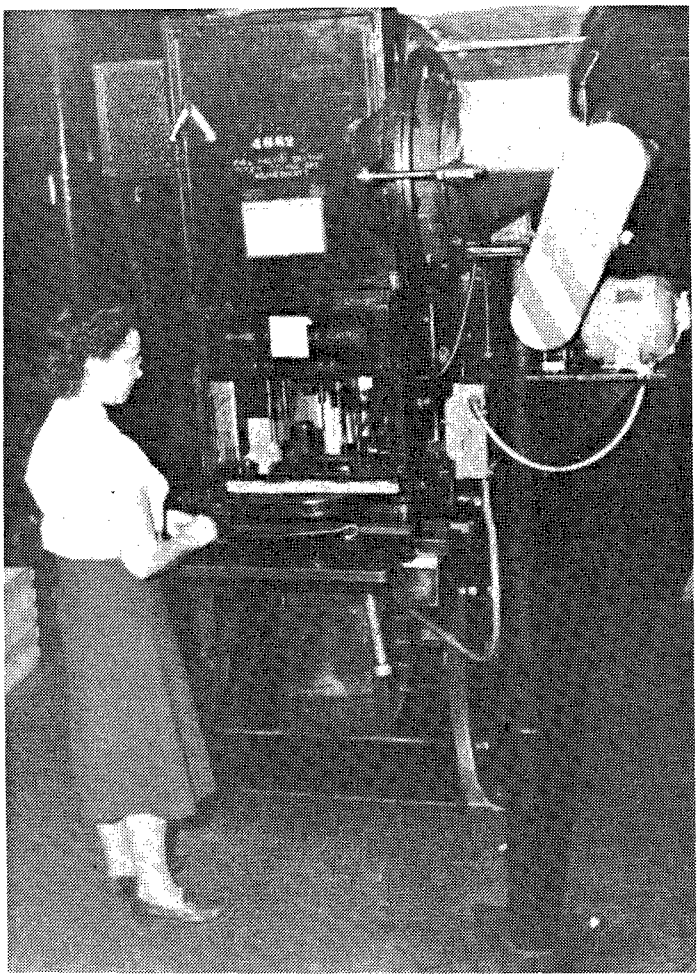


Figure 23. Primer insert, ca. 1951 (original photograph on file, LCAAP).

The use of clad steel bullets presented difficulties that required both time and effort to resolve. The steel was a harder metal and increased tool mortality to a considerable degree. Drawing out of the bullet points to specifications was not readily achieved, as there was found to be a variance of .120 to .150 (LCOP 1943c:35). Corrective measures taken included the use of special lubricants and the redesigning of tools and dies. The use of steel clad bullet jackets was found to be most valuable in the making of .50-caliber ammunition, where the amount of gilding metal involved was large. While no lessening of production occurred, the making of steel clad .30-caliber and .30-caliber carbine bullet jackets was less economical.

Steel cases presented more difficult problems, and none were actually manufactured for other than experimental purposes at LCOP. However, this experimentation made a significant contribution to the new technology. The first difficulty in the manufacture of steel cases was adaptation of the specified cup to the same processes that were used with brass cups. While tools had to be changed to accommodate the hardness of the new material, engineering skills at LCOP demonstrated that this was possible. The greatest difficulty of all was the achievement of a steel case tempered to the exact hardness necessary for proof performances, not to mention the production of it in large enough quantity for complete usage (LCOP 1943c:36). The elasticity of steel was not the same as that of brass. In testing it was discovered that a case that was too hard split under the severe stress of firing and that one that was too soft could not be extracted from the gun chamber after being fired.

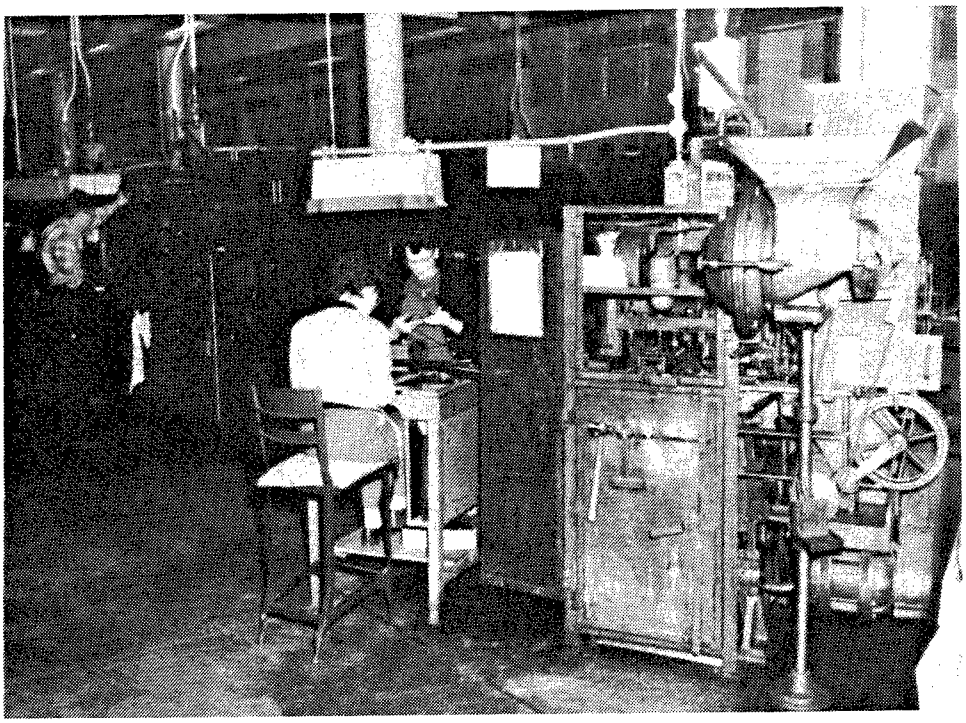


Figure 24. Bullet assembly, ca. 1951 (original photograph on file, LCAAP).

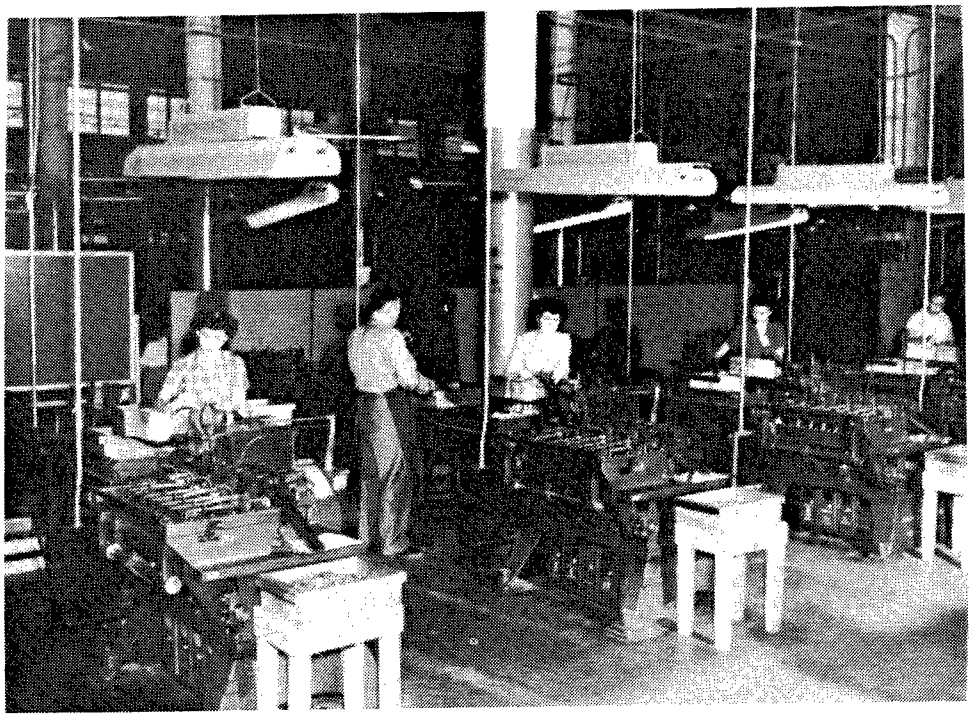


Figure 25. Final Inspection, ca. 1951 (original photograph on file, LCAAP).

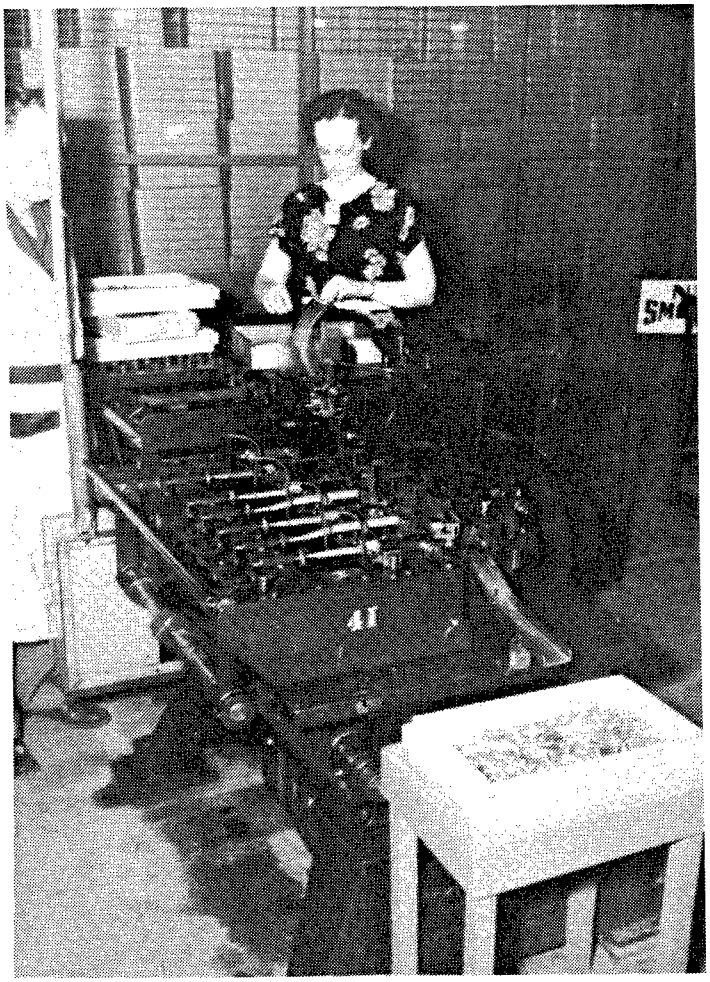


Figure 26. Final inspection, ca. 1951 (original photograph on file, LCAAP).

Experimentation with the steel case proceeded to the point where it was demonstrated that it could be satisfactorily produced in small lots. While successful quantity production remained to be proven, LCOP personnel had no doubt that the information gained from the experimentation would be of great use if the disappearance of brass should ever force the complete conversion to steel (LCOP 1943c:36). Three thousand rounds of steel case cartridges were readied for shipment to Aberdeen Proving Ground in April 1943; however, the Ordnance Department wanted further tests to be conducted at LCOP before testing was done at Aberdeen. The rigidity of the specifications for the weapons, as well as the processes to be used, made developmental work difficult. Of even more importance to the Ordnance Department was the current state of wartime emergency. While it was believed that certain processes might be better than those currently in use, time was of an essence. During the early part of World War II, development on steel cases was less important than building the supply of ammunition up to a safety point; little further experimentation on steel cases was carried on at LCOP. Pressure for a substitution for brass had eased off by October 1943, and LCOP officials reported that complete conversion would probably not be necessary or advisable (LCOP 1943d:60). A letter from the Small Arms Ammunition Sub-Office dated November 29, 1943, states that "No further developmental work is authorized on the manufacture of steel cased ammunition except caliber .45 or on the use of gilded clad steel except for that necessary to complete production of clad metal bullet jackets cups already fabricated" (LCOP 1944a). Volume XI of the LCOP history (LCOP 1945b:273) states that

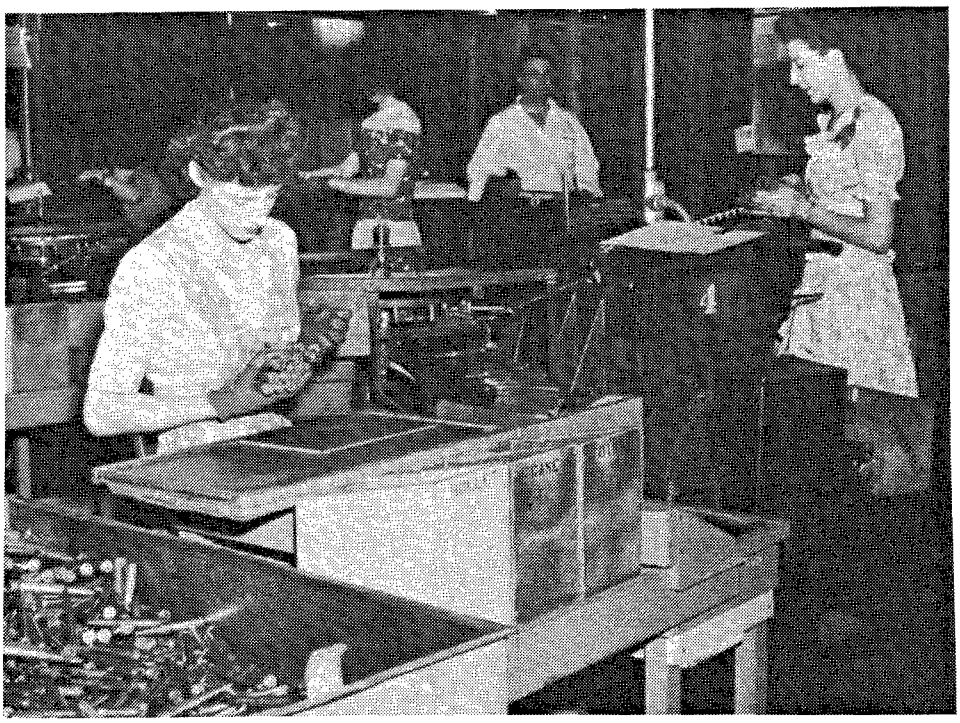


Figure 27. .50-caliber gauge, weigh and visual inspection, World War II era (original photograph on file, LCAAP).

equipment was to be retained for the production of steel case ammunition and was to be processed for standby storage. Today, equipment for steel case production lines exists intact in an out-of-the-way area on the mezzanine of Building 4. This structure is presently used to house original LCOP standby equipment and machinery received from other GOCO small arms plants, as well as a small pull-down operation. Tags on the pilot steel case equipment for .30-caliber rounds are dated 1953, and it appears that this equipment was never used. Pilot steel case equipment for .50-caliber ammunition appears to have been used enough to have been contaminated with cyanide (William Melton, personal communication 1995). Kane (1995:174) reports that research into the use of steel .30- and .50-caliber cases was undertaken at the Denver, Lowell, Milwaukee, and Twin Cities ordnance plants. Of these facilities, the Twin Cities plant is the only one in the present-day U.S. Industrial Operations Command (IOC, formerly the Army Armament, Munitions and Chemical Command [AMCCOM]) inventory, and most of the equipment from this plant has been transferred or scrapped-out (Vogel and Crown 1995). The presence of steel case machinery at the LCOP appears to be of some significance; this will be discussed later in this report.

Carbine ammunition was intended for use in the .30-caliber carbine and it differed from other types of .30-caliber ammunition in size, shape, and amount of propellant (Kane 1995:164). As LCAAP is the only current IOC facility where these rounds were produced, their World War II production at this plant may be of significance. The production of .30-caliber carbine ball, tracer, and grenade rounds was accomplished in Building 4, with the production process being such that all manufacturing operations were done on one floor.

Unfortunately, no status reports were required for standard cartridges, and defining production problems proved to be somewhat difficult. One problem that came to light during the current investigation was associated with the production of the .30-caliber carbine tracer cartridge. This product was originally made for the British government by Remington at its Bridgeport, Connecticut, facility. Considerable flash trouble

was encountered during testing. This was attributed to the use of a magnesium powder of too fine a grain (LCOP 1944b:197). Difficulties were also experienced in securing the desired velocity due to the extra length of the bullet; this was caused by the powder being packed too tightly in the cartridge case (LCOP 1944b:197). Another problem, cracks in the carbine cartridge case, was revealed by mercury crack testing. This problem was eliminated by a stress relief anneal, which softened the case sufficiently to allow the insertion of the bullet without cracking the case (LCOP 1944c:173). While the elimination of the cracks did not include major changes in the production process, it is worthy of note as a production improvement. A comparatively small quantity of 17,067,679 .30-caliber carbine tracer cartridges was produced at LCOP, the entire amount except one lot having been completed between January 1, 1945, and the initial acceptance date of November 20, 1945.

As of 1947, all the machinery and equipment for .30-caliber carbine production was in "standby under power" status and had been processed for long-term storage under surveillance (LCA 1947:47). All of this equipment was reported as being in good to excellent condition. The .30-caliber carbine machinery and equipment was used extensively during the Korean War. At the end of this conflict it appears that the machinery was put back on standby status. The war in Vietnam saw the introduction of several new items at LCAAP, one of which, the 5.56-mm round, was produced using part of the facilities in Building 4 (Remington Arms Company 1967:22). This production, which began in 1966, incorporated the .30-caliber carbine lines, with the only major changes being retooling of the machinery (William Melton, personal communication 1995).

Carbine grenade ammunition was used to propel a rifle grenade and during World War II was manufactured only at the LCOP GOCO facility (Kane 1995:164). Preparation for the production of the .30-caliber carbine grenade cartridge was ordered on May 17, 1943. A tentative schedule for the manufacture of 20,000,000 rounds by October 1943 was prepared but soon found impossible to achieve. Experimentation with production of this new cartridge proceeded. This type of ammunition had not been produced before, and no specifications or drawings were available. During the development of this new cartridge, a new type of launcher, the M8, was substituted for the M6 (Figure 28). In the original cartridge it had been planned that the powder charge would consist of 20 grains of propellant powder (Du Pont EX-4809-6) to one grain of mortar powder (60-mm ignition; LCOP 1943e:32). With the addition of a high compression ring on the new launcher, a reduction of the powder charge to 18 grains of propellant to one grain of mortar powder was necessary (LCOP 1943e:32).

Remington began production of the .30-caliber carbine grenade round with a few hundred hand-loaded cartridges. Some of these were transferred to the Ordnance Department for experimental ballistics purposes. The change in the launcher and the lack of specifications made the original production schedule impossible. While the same visual inspection tests used for ordinary .30-caliber ammunition would be used with the new rounds, a more exact gauging was also necessary; this was because malfunctions resulted if slight variations existed due to the crimping of the rosette. As the cartridge contained no projectile, perfection in length and size of the finished case were also vital because the full force of the powder charge had to be exerted against the grenade. The new powder charge reduced the original projectile velocity from 175 to 145 feet per second (LCOP 1943e:33). While some trouble was experienced with the velocity and the distance traveled by the grenade due to the variation in the weights of the practice grenades, production of the grenade round was soon started. It was understood by LCOP personnel that the specifications which would eventually be issued for the new cartridge would be the result of production at LCOP.

Ball frangible ammunition was ball ammunition that broke into pieces on impact and was used for training purposes. Bakalite and a lead composition plastic were compression-molded into a bullet that had no actual penetration power but would shatter into powder when it hit the target (*Lake City Tracer* 31 May 1945). LCOP was the only World War II GOCO facility to produce ball frangible rounds (Kane 1995:164). The production of the frangible round represented the greatest departure from standard production at LCOP. The frangible disintegrating-type bullet was not manufactured at LCOP but was provided by vendors as a formed

Figure 28. Rifle grenade launcher and cartridges, World War II era (original photograph on file, LCAAP).

slug. Fabricated of lead and plastic, this round presented problems during its manufacture, including lead dust, which was a safety and health hazard. One of the requisites of the frangible cartridge was a minimum variation in velocity; this was difficult to achieve due to the differences in ratio of powder volume to case volume and the subsequent location of the powder within the case at the moment of firing (LCOP 1944c:161-162). The hydroscopicity of the propellant powder also affected velocity. Difficulties were also found in holding the bullet to weight specifications while keeping to the length specifications (LCOP 1944c:162). Also, bullets received from vendors tended to be five or six grains over maximum weight, and some vendors, after accepting orders, canceled their contracts for the plastic components (LCOP 1944c:162). All of the problems listed above caused a delay in reaching top production of this cartridge type.

Frangible cartridge production continued, and the first status report included plans for the use of only existing machinery at LCOP (LCOP 1944b:199). Difficulties continued, as Remington found it hard to find vendors who could produce the slugs, and the lead dust problem remained unsolved (LCOP 1944b:199). By November 13, 1944, production had started, and the first lot was accepted by the government in November. Early status reports indicated improvements in the production process, including: seating of the bullets from profile rather than point to reduce the number of broken points; the use of a mouth-opening punch and trimming a larger chamfer on the bullet heel to eliminate forcing of bullet heel in loading; discontinuance

of the cannelure; and improved receiving inspection for frangible slugs (LCOP 1944b:199). The improved receiving inspection included additional frangibility impact testing and the generation of a photographic chart for identifying visual defects (LCOP 1944b:205). While certain problems had been dealt with and the T44 frangible test cartridge was standardized as the ball frangible M22, testing continued.

Continued problems with the .30-caliber frangible cartridge were dealt with by improving the quality of slugs through closer inspection and eliminating the extreme variability in the velocity of the finished product. Velocity variability was the topic at a meeting held at the St. Louis Ordnance Plant in February 1945. This meeting was attended by representatives from the Frankford Arsenal, the Small Arms Division, and all GOCO plants making frangible cartridges. While it is unclear as to which of the 13 GOCO facilities were represented at this meeting, LCOP personnel were present, and it is assumed that St. Louis Ordnance Plant personnel were also involved. The fact that this meeting was held at the St. Louis Ordnance Plant indicates that this facility may also have produced ball frangible ammunition. This adds to the GOCO contextual overview information presented by Kane (1995:164), who suggests that only the LCOP was involved with frangible ammunition production. Data presented at the St. Louis Ordnance Plant meeting were taken from the many tests and comparisons dealing with frangible production, which included comparisons of methods of manufacture as carried on by Frankford Arsenal, the St. Louis and Lake City plants, and Western Cartridge; firing of hand-loaded cartridges; results of bullet insertion with and without crimping; special testing of Frankford Arsenal and St. Louis cartridges under similar conditions; comparative bullet pull tests on Ordnance Department hand-loaded and contractor-loaded cartridges from Frankford Arsenal and St. Louis; determining effect of bullet weight on velocity; determining effect of cannelure on velocity and standard deviation; determining firing results with bullets of different length; determining effect of use of bullets with broken points; tests of cartridges loaded with bullets from various molders and with various curing times during molding; results of use of different powder lots; results of waterproofed unannealed cases and regular annealed cases; tests with regular and chamfered cases; determining whether the primer pellet weight should be increased or not; determining effect of moisture content due to storage conditions; determining variation in velocity with change in amount of charge; tests with E.C. blank powder and 60-mm booster powder; control tests with stuffed cases, paper wad control, and cotton to hold powder in place; and control data for firing, using Universal receivers and pressure barrels, changing position of the terminal screen, use of a gate type target versus a ball disjunctor, and investigation of instruments on the ordnance range (LCOP 1945c:232-233).

The findings of the St. Louis meeting were not completely satisfactory, and no major changes in manufacturing procedure were ordered. However, close control of several factors was advised: these included powder weight, waterproofing, and bullet pull (LCOP 1945c:233). Production of the frangible cartridges was restricted at LCOP during the first few weeks of March 1945, due to the poor quality of both received slugs and the finished product. Production was resumed on March 21 at the rate of 50,000 rounds per shift, and this rate was doubled shortly thereafter. Certain test procedures had been decided upon for all facilities manufacturing T44 frangible cartridges. These included strictly controlled ballistics testing, as well as changes in manufacturing procedures. During the manufacturing process, experimental control tests were to be made for bullet stability by shooting through 50- and 100-foot screens. Additional procedures included bullets being sized in a die that produced an outside diameter within specification tolerance; plate loading to be used with a ring die crimp and a mouth punch, as for the standard .30-caliber ball mouth spreader; a range of weight for powder charge within .5 grains in a sample of 13 weighings from one plate loading; inspection to prevent double charging; screening by gauge and weigh machine to eliminate light or no powder charge (LCOP 1945c:234). Even with the addition of the procedures listed above, frangible production continued to be plagued with problems.

Between March 21 and April 23, 1945, Remington was forced to produce frangible ammunition that it knew would not be accepted. While one lot might meet the specifications, the next test of the same lot or an apparently identical one produced under the same controls would fail. Reproducibility was uncertain until the particularly major problem of standard deviation was solved. The conclusion of the frangible problem

was reached with the use of a waterproofing compound called NRC on the mouth of the case. No written account is available to show precisely how or when the discovery was made that specification for standard deviation could easily be met if NRC was used (LCOP 1945c:236). Since all plants, as well as Frankford Arsenal, had consistently been making tests to meet the specification for standard deviation and no contractor had been willing to outline its methods until the success had been achieved, research was not placed on record.

Very little data were generated concerning the use of plastic in the manufacture of small arms during the present investigation. As described above, the production of .30-caliber frangible rounds included bakalite and a lead composition plastic. As the use of plastic in frangible rounds was limited to the bullet, and this component was produced by outside vendors, its use does not appear to be significant in relation to LCOP production other than experimentation to meet government specifications.

Armor-piercing ammunition was designed to pierce the protective armor of tanks and other heavy vehicles, while armor-piercing incendiary rounds were designed to penetrate armor and ignite the target (Kane 1995:161). Specifications for the armor-piercing incendiary round were not received at LCOP until January 1945. While these rounds generally followed the characteristics of the armor-piercing and incendiary cartridges they were designed after, they were identified by an aluminum-painted tip. One important difficulty presented itself during the manufacture of armor-piercing incendiary ammunition at LCOP; this was the relationship between the performance rating and the armor-piercing qualities (LCOP 1944a:81). When the rounds were loaded with more than 15 grains of incendiary powder, the results were perfect armor penetration but low performance rating. When the powder load was reduced to 12 grains or less, the performance rating went up but the armor-piercing quality dropped. To alleviate this problem, a new method of inserting the cores into the incendiary mix under a uniform pressure was developed. This included the incendiary mix being set at between 12 and 15 grains. Loose core, which affected the concentricity of the bullet and resulted in imperfect penetration, were also eliminated. Some trouble was still experienced with dislodgment of the core after insertion during the coning process, but in general the difficulties with the armor-piercing incendiary round were quickly and satisfactorily worked out.

In the manufacture of the .50-caliber armor-piercing incendiary tracer rounds, the T28, considerable difficulty was experienced with the trace performance. Production was halted several times in the hope of improving the trace quality through extensive experimentation. These tests were primarily based on the effects of various granulations of magnesium and charge pressures. Slight modification of the tracer mixture R-256, which increased the strontium nitrate by five percent and decreased the strontium peroxide by five percent, resulted in an improvement in the length of trace. While it was revealed that the amount of tracer and igniter powder was an important variable, two main trace defects continued. These were failure of the R-256 tracer mixture to ignite and failure of the tracer mixture to ignite the R-257 mixture (LCOP 1945c:237). Ignition failures were partially corrected by addition of a 20,000-PSI compression immediately prior to the addition of the igniter charge. Reduction of pressure at the first compression station in the manufacturing process to approximately 40,000 PSI also helped to correct the ignition problem. After these process changes were made, approximately 90 percent full-trace was obtained on control tests.

Innovations in the small arms industry during World War II allowed ten times the amount of ammunition to be inspected using machinery than could be done by visual inspection (Kane 1995:175). The gauge and weigh machine was developed at the Twin Cities Ordnance Plant (Vogel and Crown 1995:32) and was "made standard for all small arms ammunition plants" (Voight 1945:300). Additionally, personnel at the LCOP improved the inspection methods and thus improved cartridge quality.

Preliminary steps toward the use of gauge and weigh machines were taken in the latter part of 1943, when a LCOP committee held meetings to formulate procedure for the use of the machines (LCOP 1944a:88). At the LCOP, the main objective of the use of the machines was to secure a more reliable method of gauging than was possible by manual inspection. Of secondary importance was the advantage to be gained in saving

manpower. Personnel from the LCOP were sent to the Twin Cities Ordnance Plant for training in the operation of the new gauge and weigh machines. During this training, problems such as procurement of machines, modification and adjustment to ensure perfect functioning, the amount of hand gauging necessary to check the work of the machines, and the limitations of the machines were worked out. Final approval for the project was given in November 1943. At this time it was estimated that one machine and its operators could take the place of six women inspectors using hand gauges. While approval was given, certain steps had to be taken when using the machines, including final acceptance inspection of all ammunition; use of the Seven Station Waterbury-Farrel Gauge and Weigh machine; an adequate staff of properly trained machine adjusters; a maximum of five percent hand-gauged cartridges; two months of satisfactory machine operation; and a complete record of all ammunition handled under this plan (LCOP 1944d:116).

Prior to the summer of 1943, field service depots were responsible for packing ammunition for shipment; however, in the summer of 1942, responsibility for packing was transferred to manufacturing facilities (Thomson and Mayo 1991:216-217). Innovations in packing for shipment were developed at LCOP; in fact, LCOP improved packing methods continually, including the use of hermetically sealed cans which were first used in June 1944; from that time on, all cartridges were so packed (Kane 1995:175).

Packing and packaging of ammunition was a phase of production that had caused considerable difficulty at LCOP from the very beginning. Never before had it been necessary to ensure against such extremes of heat and cold, action of salt water and desert sand, as well as the long distances to be traveled with rough handling of the materials. Reports were received at LCOP that some cartridges were arriving near the front lines in bad conditions of corrosion, and some had to be repacked or relinked (LCOP 1943e:40). Wax packing was used, but proved to be insufficient, and packing in turne plate liners was also found to be inadequate. At one point a combination of the two was tried, but a report of the results was not available. Types of packing that the government requested had varied throughout the World War II operation of LCOP. This was due to changes in the practical needs of the armed forces as they arose, rather than dissatisfaction on the part of the government.

Packing at LCOP was in either cartons or belts (Figures 29-31), with variations as to the number of cartridges per container and, in the belt loading, the proportion of armor-piercing to tracer or incendiary. The most common proportions for linking were nine armor-piercing to one tracer; four armor-piercing to one tracer; and the combination of two armor-piercing, two incendiaries, and one tracer (LCOP 1943e:41). Carbine cartridges were packed in paste-board cartons, 50 to the carton and 1,500 rounds originally packed in a waxed container. The waxed container proved unsatisfactory and was changed to a turne plate liner. The turne plate liners were placed in a wooden crate with two or more to the crate for shipment. At LCOP, a method was devised whereby 69 carbine cartridge cases could be packed in a metal case. This was six more cases than had been previously packed and required a modification of the metal box, as well as a special arrangement of the cases within the box (LCOP 1943e:41). When it became aware of this LCOP innovation, the government requested drawings and information showing the method in order that it might be put into use at other plants.

The hermetically sealed M6 metal packing can was first used at the Evansville Ordnance Plant in Indiana; LCOP began using the M6 in early June 1944. This type of packing for the grenade cartridges was later discontinued in favor of waterproof envelopes. The grenade cartridges were packed six or ten rounds to the envelope, depending on the type, and 216 or 148 envelopes in a wooden chest (LCOP 1944b:209). Several early problems with the M6 can included difficulty in procurement of equipment and materials; disagreement between the government and plant contractor operators on the number of cans to be packed per box; and details of the can itself, such as location of handles and type of paint to be used (LCOP 1944e:146). The sealed cans resembled very closely the vacuum cans used for commercial products. It was equipped with a key-operated tear-strip and a large carrying handle located just below the location of the tear-strip. This allowed carrying after the can had been opened. It was also designed for temporary reclosure. After the

Figure 29. .50-caliber belt loading, 1943 (original photograph on file, LCAAP).

the can was filled with ammunition, it was treated on the surface, oven-dried, and then paint-dipped (LCOP 1944e:147). After the paint dried, the can was stenciled with a commercially prepared silk screen.

The M6 can was designed for superior performance in rough handling tests and for mass production in manufacture and assembly. Problems that arose in connection with the can packing included selection of paint that would dry properly without application of heat beyond hazardous levels; devising a method of applying paint to eliminate thick spots and runs; designing a new 10-round carton that would not distort the .50-caliber can; detection of leaks, necessitating building or procuring of special equipment; and procurement of equipment and components in sufficient quantities to keep up with production schedules (LCOP 1944b:207). A satisfactory method for applying and drying the paint proved to be the most difficult of all problems to solve. A rigid salt-spray test also complicated the painting problem.

In mid-1945, a serious packing problem arose when contamination of packed .30-caliber frangible rounds with armor-piercing and tracer ammunition was discovered. Immediate steps were taken by both the government and Remington to discover the source of the contamination. The entire process of making and packing frangible cartridges was reviewed, and employees were questioned as to their knowledge of all proper procedures. It was believed that mixing of ammunition had taken place during packing and that this

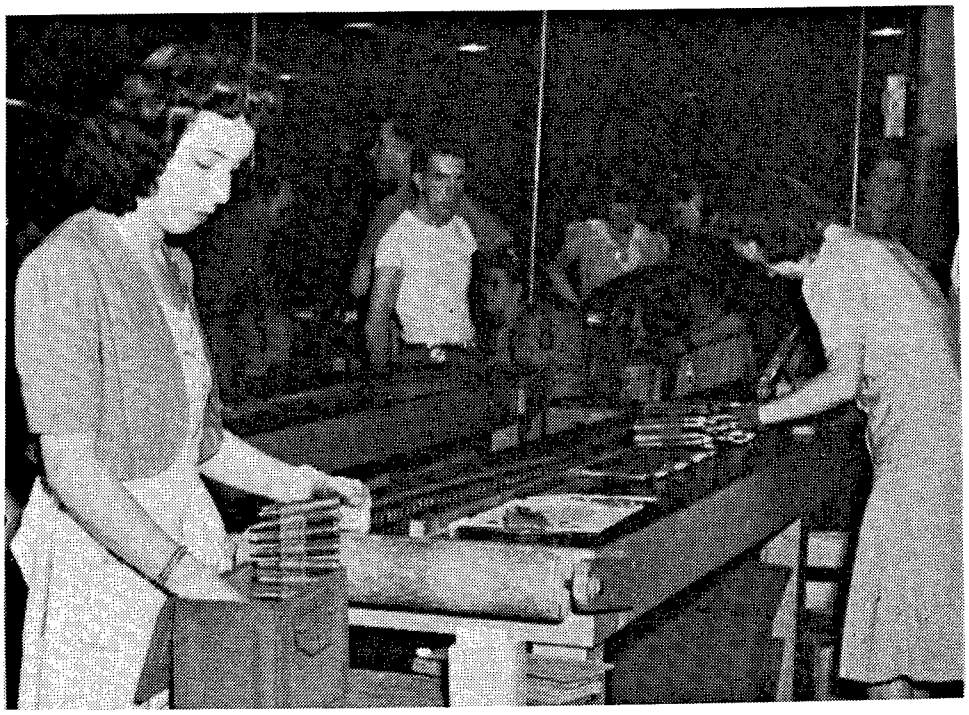


Figure 30. .50-caliber belt loading and boxing, World War II era (original photograph on file, LCAAP).

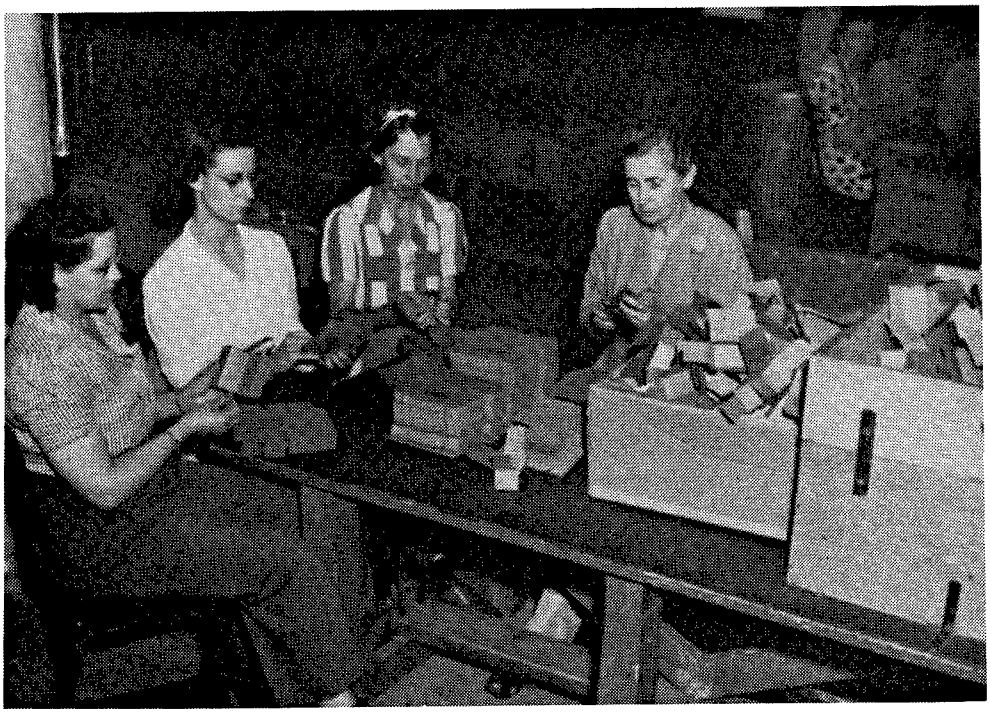


Figure 31. Hand folding 50-count .30-caliber carbine cartridge boxes, World War II era (original photograph on file, LCAAP).

mixing was entirely due to carelessness rather than deliberate intent (LCOP 1945d:288). As nearly as could be determined, the reuse of cartons previously containing other types of .30-caliber ammunition and the failure to make certain that no cartridges remained in the carton were the cause of the contamination.

Other technological developments at the LCOP during the World War II included modifications of the production process; these modifications met with success and failure. Toward the end of 1943, Remington set up Standard-Knapp unscrambling machines as feeding devices for the Molins linking machines to speed up packing. It was soon discovered, however, that the overflow cartridges from the unscrambling machines were damaged. Further investigation revealed that the linked ammunition was also damaged. While various adjustments to the unscrambling machines were made, it was finally decided that hand feeding was the only safe method, and the use of the machines was discontinued (LCOP 1944a:101).

Over a period of several months during 1944, two important process changes had been made in the manufacture of ammunition. The first involved the substitution of one-shot heading for all cases to replace the separate operations of pocketing and heading (LCOP 1944b:202). This process had been used at other small arms GOCO plants and proved to be successful at LCOP. The second process change involved replacing the 4-draw case with one made by a 3-draw process. The experimental project for this change was delayed by a shortage of personnel and more important plant changeovers to hermetically sealed packing cans, 20-mm shell loading, .50-caliber blank manufacture and .50-caliber delinking and repacking programs. After some delay, 510,000 test rounds of .50-caliber were manufactured to determine the feasibility of the process (LCOP 1944c:171). Results of testing were satisfactory, and the 3-draw process was eventually used for all .50-caliber ammunition. Both changes outlined above reduced labor and tool costs. It was estimated that the 3- to 4-draw change alone would save $80,000 per year (LCOP 1944b:203).

Somewhat later, in mid-1945, the elimination of the first trim operation took place. This was preceded by the manufacturing and testing of 1,000,000 rounds. After the testing, the changeover was ordered as standard process. The annual savings from this change were estimated at $80,700 (LCOP 1945d:273).

Throughout its World War II production, the LCOP lines saw numerous changes and modifications. These changes show a temporal trend toward experimentation and improvement of ammunition quality as contrasted with an earlier emphasis on quantity. Due to the number of changes, numerous problems were encountered. These problems were due to many reasons, and their development and subsequent corrections have been discussed above. Experimentation led to innovations that improved efficiency and saved the government money. As shown by the adoption of gauge and weigh machines and experimentation in the use of steel as a substitute for brass in cartridge cases, LCOP was on the cutting edge of small arms production technology. Despite the many technological changes developed since World War II, the LCOP retains much of its World War II character. With the exception of the automated small arms ammunition production equipment added in the 1970s (MacDonald and Mack 1984:39), the retooling of certain production lines in the 1950s (MacDonald and Mack 1984:36), and the Vietnam War-era introduction of certain modern machinery such as high speed blanking and forming processes in the Primer Manufacturing building (MacDonald and Mack 1984:38), the production technology in use today at the LCOP resembles World War II manufacturing practices. MacDonald and Mack (1984:executive summary) even point out that one .50-caliber production line is almost completely unaltered.

The experimentation with steel cases at LCOP does not appear to have been recorded by Voight (1945) in his ordnance facility inventory. As stated above, Kane (1995:174) reports that research into the use of steel .30- and .50-caliber cases was undertaken at the Denver, Lowell, Milwaukee, and Twin Cities ordnance plants. With the Twin Cities plant being the only one in the present-day IOC inventory, and most of its equipment having been transferred or scrapped out, the existence of this equipment at LCOP should be considered of significance. The machinery was associated with a new method of production that was in turn associated with a product significant in the history of small arms technology. While other machinery of this type was in existence during World War II, the equipment at LCOP may be the only surviving examples.

It appears that the equipment has not been modified: however, its integrity of location is questionable. Still, in its present location of the dimly lit, out-of-the-way mezzanine of Building 4, it conveys the feeling and association of its original World War II integrity.

SOCIAL HISTORY

Numerous short and long term social changes have been attributed to our nation's participation in World War II. Kane (1995) gives a well-developed overview for these changes as they were related to the GOCO program as a whole. While the previous pages discussed the technological facets of the LCOP, the following pages will examine the more people-oriented social aspects surrounding the LCOP just prior to and during its World War II operation. Following Kane's (1995) overview format, a discussion of why Jackson County, Missouri, was chosen, as well as the land acquisition and the following boomtown phenomenon, will be presented first. This will also include discussion of problems surrounding the early period of LCOP's existence. Following will be a discussion of such topics as labor shortages, safety, absenteeism, and other factors which were involved in the wartime operation of the facility. Effects of the end of the war and an analysis of the environmental legacy of the LCOP will finish out the discussion of the social aspects during World War II.

Land Acquisition, Construction, and the Boomtown Results

When construction was complete, the LCOP's original boundaries encompassed 3,908.22 acres. While the decision to locate the plant in Jackson County, Missouri, was discussed above, the factors surrounding this decision are briefly outlined below. Remington chose the Kansas City and Denver areas over several other locations based on industrial facility location studies which they had previously undertaken. In September 1940 the Kansas City area was defined as the best location, and somewhat later, the Lake City area in Jackson County was picked for the construction site. This final decision was based on labor supply, housing conditions, transportation, flood hazard, and other pertinent factors. To avoid land speculation, options on the properties to be purchased were undertaken in secrecy. Optioning began on October 10, 1940, and the final prices paid per acre for the entire plot were between $160 and $165, with the average having been increased by a higher price paid for a few key parcels (LCOP 1943a:15). It was reported that some land owners also would receive a bonus for possession of their land as soon as the government wanted it (*Independence Examiner* 29 November 1940). On the basis of the $160 to $165 an acre, it would appear that the entire site cost approximately $670,000 (LCOP 1943a:15).

Mayor Roger T. Sermon, of Independence, played a significant role in the selection of the Lake City valley site. Sermon, "the one man in Jackson County to put the project over," put up the money for the original options (*Independence Examiner* 31 October 1940). Sermon asked for assistance from Senator Harry S. Truman and Representative C. Jasper Bell by requesting that they get in touch with officials at the War Department who were helping to locate the site. Options, taken in the name of Remington representative J. L. Warner, were obtained at a price fair to both the farmers and Remington.

Sermon and other local officials were ecstatic, calling the decision to locate the plant in their neighborhood "the biggest thing in the industrial history of Jackson County" (*Independence Examiner* 31 October 1940). Sermon realized that the plant would mean many jobs and business for local communities, and that the construction of new housing would be necessary:

> Assuming a minimum wage of about $20 per week this will mean an annual payroll of almost $15,000,000, a figure which when multiplied by a figure of three to determine the amount of turnover it will receive before it goes out of their community increases to $45,000,000. It means our merchants

> will sell more materials, our bankers will probably land [*sic*] more money, our professional men will find a larger field for their services [*Independence Examiner* 7 November 1940].

The oral history informants for the present investigation all stated that the public's reaction to the news of the plant's location was positive. Locals realized the potential for increased employment and a boost in the local economy. Alice McEldery (interview 1995), a lifetime resident of the area and former box factory worker at the LCOP, recalled that "[t]here was a lot of talk about it and what it was going to bring into . . . our area, and the business that it would give, the opportunity for employment." Frances Brasington (interview 1995), another long-time resident of the Kansas City area and former worker at the LCOP, recalled that "everyone was tickled, very thrilled, because there would be more work for everyone."

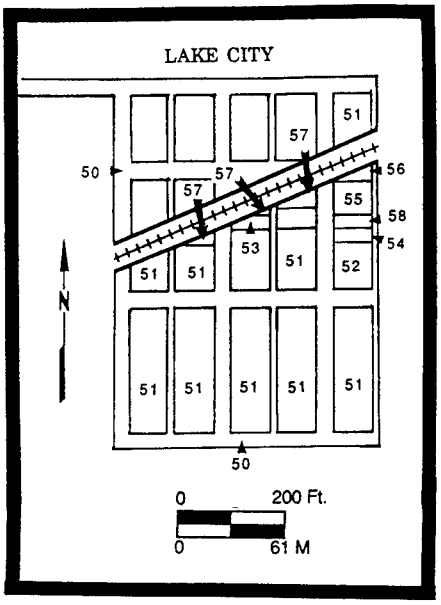
In addition to the emphasis on future prosperity, Mayor Sermon also called for an alertness to crime and vice with the expected boom:

> We must be careful that we do not allow gambling and other vices to gain foothold here. We should feel proud that our city has a minimum of such activities now, but our pride must not stop there. We must be alert at all times to meet situations which will probably arise when this great boom gets under way [*Independence Examiner* 7 November 1940].

Another concern of local officials was the amount of taxable land and personal property to be taken out of the county revenue, as government land was not taxable. This would be especially critical for the Jackson County rural school system (*Independence Examiner* 4 February 1941). A more direct threat to the Jackson County school system was the location of the new plant. The Lake City school was located in the river valley on the north side of the railroad. Prior to the beginning of construction, Jackson County Superintendent of Schools Homer M. Clements reported that it would be reasonable to expect that the school would be moved farther away from the plant grounds not only to ensure the safety of the children, but to take them away from the expected noise associated with it (*Independence Examiner* 22 November 1940).

While more than 3,908 acres were acquired from 67 different landowners (Figure 32; Table 6), very little has been recorded concerning the fate of these families, and oral history informants had no first-hand knowledge of those who sold their land or the prices they received. As survey crews were at work in early December 1940, farmers with large crews of helping hands were busy dismantling buildings and loading up equipment (*Independence Examiner* 5 December 1940). At Cravens Store, a local Lake City establishment, it had been reported that many men had been in the vicinity seeking jobs. Perhaps some of these men were local farmers whose land had been claimed by the government. The fate of many of the buildings which stood on the former agricultural fields, pasture, and swampland was discovered through investigation of both LCOP construction and operation documents and by reviewing local newspaper articles. Many farm structures were dismantled by their owners and hauled away, their final fates being unknown (*Independence Examiner* 5 December 1940). Numerous other structures were dismantled after the government took possession of them (LCOP 1943a:26). Several farm houses were left standing. One, a small bungalow farmhouse which had belonged to Charles Clark, was used for the temporary quartermaster headquarters until a permanent facility could be constructed (*Kansas City Star* 26 December 1940). After the quartermaster's permanent facilities were built, the Clark house became the construction infirmary (*Independence Examiner* 15 January 1941). A one-story original farmhouse was used during the World War II operation as a bachelor officer's quarters, and after the war it was maintained as a family unit. It is unclear as to whether this residence was the same building used to house the quartermaster headquarters during the early construction work.

On a national level, many people looked forward to land acquisition and the ensuing construction. These people included the unemployed, some landowners who wished to sell, and local business owners. Others fought against it. Throughout the country, numerous lawsuits were filed over land prices thought to be too low. Another nationwide source of anger with the government was the displeasure with the way the



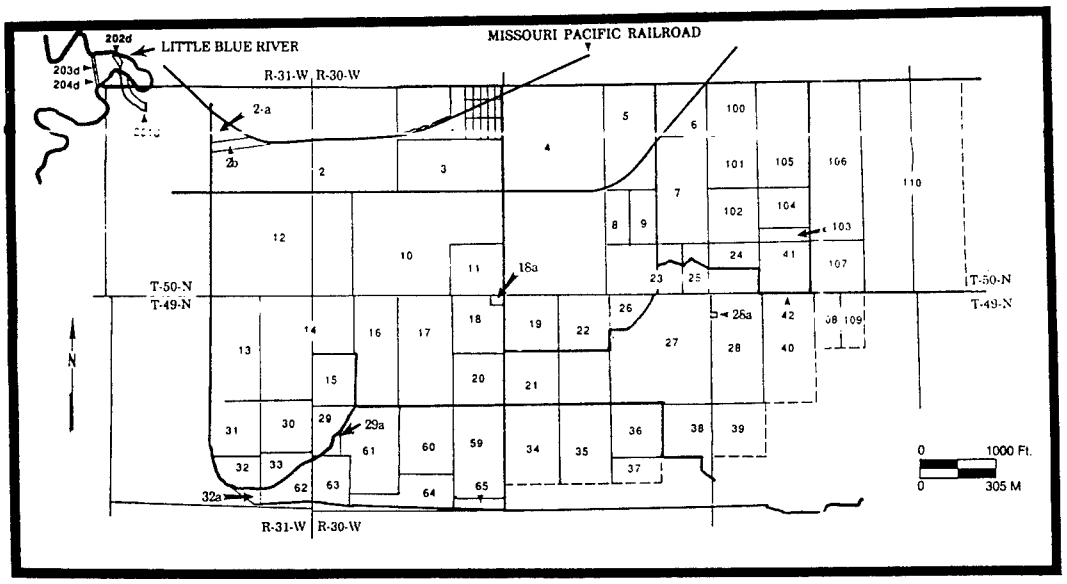


Figure 32. Scale map showing land ownership prior to government acquisition.

Table 6
Property Owners Whose Land was Acquired by the Government in Association with LCOP*

Tract No.	Name of Owner	Acres
1	Mary H. Elsea	15.00
2	Dudly G. Francis et ux	139.25
2a	John W. Lenox et ux	13.00
2b	James H.L. Franklin Estate	2.80
3	Earl A. Hendrix et ux	80.00
4	John H. Stephens et al.	158.14
5	Maud Thompson	80.00
6	Gearge E. Milligan	40.00
7	Mary H. Elsea	80.00
8	Vinnie H. Harvey	20.00
9	Fred Kevetter et ux	20.00
10	Lewis S. Webb et ux	352.00
11	Deuward L. Owen et ux	40.08
12	Charles E. Clark et ux	224.00
13	Mary V. Hereford	80.00
14	Harry G. Kyle et ux	122.00
15	Grant Dixon	35.44
16	Ray T. Dickenson et ux	76.00
17	Deuward L. Owen et ux	83.59
18	Richard M. Powers et ux	43.32
18a	City of Blue Springs, Mo.	**
19	Gearge W. Harris et ux	43.45
20	Deuward L. Owen et ux	40.00
21	William L. Jones et ux	39.47
22	Cassie F. Owen et al.	83.45
23	William E. Peffer et ux	60.00
24	William E. Peffer et ux	40.00
25	William E. Peffer et ux	20.00
26	Zack Bean	15.49
27	Clyde M. Van Dyke et ux	154.00
28	Lou Rogers Jones Jr. et al.	85.42
28a	Luther H. Clements, Trustee et al.	.14
29	Harly Lowe	19.67
29a	Harly Lowe	3.75
30	Robet Alcorn et ux	40.00
31	John O. O'Rear	43.00
32	Joel E. Bridges et ux	19.50
32a	Joel E. Bridges et ux	5.10
33	E.B. Neal	19.04
34	Kenneth Kowen Owen et al.	60.00
35	Harvey Zumwalt et ux	60.00
36	Clyde M. Van Dyke et ux	40.00
37	Mildred Kincaid et vir	20.00
38	Lillian Bailey et al.	45.00
39	Ophilia M. Van Dyke	40.00
40	Eugene F. Corn et ux	85.47

Table 6 (cont'd)

Tract No.	Name of Owner	Acres
41	Burns Strader et al.	40.00
42	Jackson County, Mo., Highway Dept.	**
50	City of Lake City, Mo.	**
51	John F. Stephens et al.	15.85
52	Claude L. Owen et ux	.60
53	Joseph Willetts	.16
54	Mary P. Lindsey Estate	.18
55	Thomas M. O'Neill	.42
56	J.L. Hudspeth et al.	.08
57	Union Pacific Railroad Co.	.32
58	Blanche M. Vaughn et vir	.42
59	Deuward L. Owen et ux	70.00
60	Deuward L. Owen et ux	53.00
61	E.B. Neal et al.	73.53
62	Harry P. Draper et ux	20.00
63	James Bourne Mitchell et ux	32.00
64	David Spease et ux	40.00
65	Mell S. Stewart et ux	10.00
100	Elizabeth Milligan et al.	40.00
101	William F. Harra	40.00
102	Bank of Independence, Mo.	40.00
103	Claud Bowling et ux	10.00
104	Maud Bowling et vir	30.00
105	Robert E. Jones et al.	40.00
106	James E. Phillips et al.	160.00
107	Otis R. Scrimager et ux	40.00
108	Eugene F. Corn et al.	22.59
109	Burns Strader	22.50
110	Charles E. Clarke et ux	320.00
115	Josie E. Powers et al.	.41
201-D	Charles D. Elliott	6.90
202-D	Harry K. Waggoner	3.54
203-D	Bessie B. Rolan	8.07
204-D	Harry K. Waggoner	5.50

* Data taken from LCAAP 1944
** Acreage described in Civil-962 covering roads and streets included in adjoining tracts

government and its agents conducted the process. Some farmers complained that appraisers and brokers did not treat them respectfully. Several difficult situations in association with the LCOP land acquisition were uncovered during the present investigation. These included accusations of the unfair treatment of African American landowners and civil actions brought against the government. According to local tradition, displaced African American landowners were treated unfairly as compared to the white landowners (Charles Triplett, personal communication 1995); that is, the land which belonged to the African Americans was more likely to be assessed at a lower value. Nine separate case numbers involving numerous tracts of land were filed against the government between December 1940 and November 1942 (Blanca Roberts, personal communication 1995); however, at this point it is not known whether these cases involved African Americans. While the civil action documents are on file at the City Hall in Independence, Missouri, time and monetary constraints did not allow for their individual investigation. Minimal data concerning these legal proceedings are described in Table 7.

Table 7
Litigation Associated with the LCOP Land Acquisition

Civil Action	Date Filled	Subject Land Parcels
#763	12-23-40	tracts 2d, 14, 15, 31, 32, 53, 54, 56, and 57
#837	4-2-41	tracts 18a, 28a, 64, and 65
#889	6-3-41	tract 32a
#910	6-18-41	tract 41
#962	8-11-41	tracts
#1239	8-19-42	tracts 105 and 106
#1239	9-14-42	tracts 101, 102, and 110
#1239	11-3-43	tract 109
#1302	11-28-42	tracts 201d, 202d, 203d, and 204d

Some of the Jackson County community reactions to the establishment of the new plant have been discussed above. The majority of the community's "planning" appears to have been concern for the established social order: keeping crime and vice out and concern for the local school system. While preparation for other GOCO facilities included the establishment of local building-trade councils (Shaffer and Crown 1995:70), little planning appears to have taken place in Jackson County.

Early in December 1940, supplies and equipment started arriving at the construction site. Construction was begun on temporary buildings on December 16, 1940, and the official groundbreaking took place on December 26. Kansas City offered the largest pool for both skilled and unskilled workers; workers were also hired from local communities in Jackson and the surrounding counties. During construction, LCOP competed with existing and expanding industry in the Kansas City area for experienced workers. In fact, the limited supply of competent labor was unusual. "Green" men had to be trained on the job, and this added to the cost of construction (USACE 1943:230). At first construction workers were issued passes to be admitted to the plant grounds; these were shortly replaced by photo identification badges. Construction was conducted in shifts, so many workers were needed. These workers performed a high percentage of overtime and double time work, again adding to the construction cost. This also reduced the efficiency of the workmen.

On January 15, 1941, there were 400 workmen at the plant, with the only reported problem being parking space (*Independence Examiner* 15 January 1941). The parking situation was alleviated within several days by the construction of the first of three main parking lots. By early March 1941, 1,500 construction workers were employed. This number gradually rose and reached a peak of 6,277 in July (LCOP 1943a:26). Construction proceeded rapidly (Figures 33 and 34), with the Construction Quartermaster commenting that LCOP "has the jump" on most defense projects started at the same time throughout the country (*Independence Examiner* 15 January 1941). During construction, the food situation was taken care of by a box lunch service, which was being used extensively.

Dale Pollard, who worked on the construction of LCOP and has been a supervisor at the plant for over 40 years, recalls the scope of the construction project as going "24 hours a day, and they had skilled craftsmen . . . doing the concrete brickwork and carpentry work. It went fast. . . . They had enough bricklayers, when they laid these big buildings—you see, they're a block long—that they worked elbow to elbow, and they'd

Figure 33. Overview of LCOP during construction, ca. 1941 (original photograph on file, LCAAP).

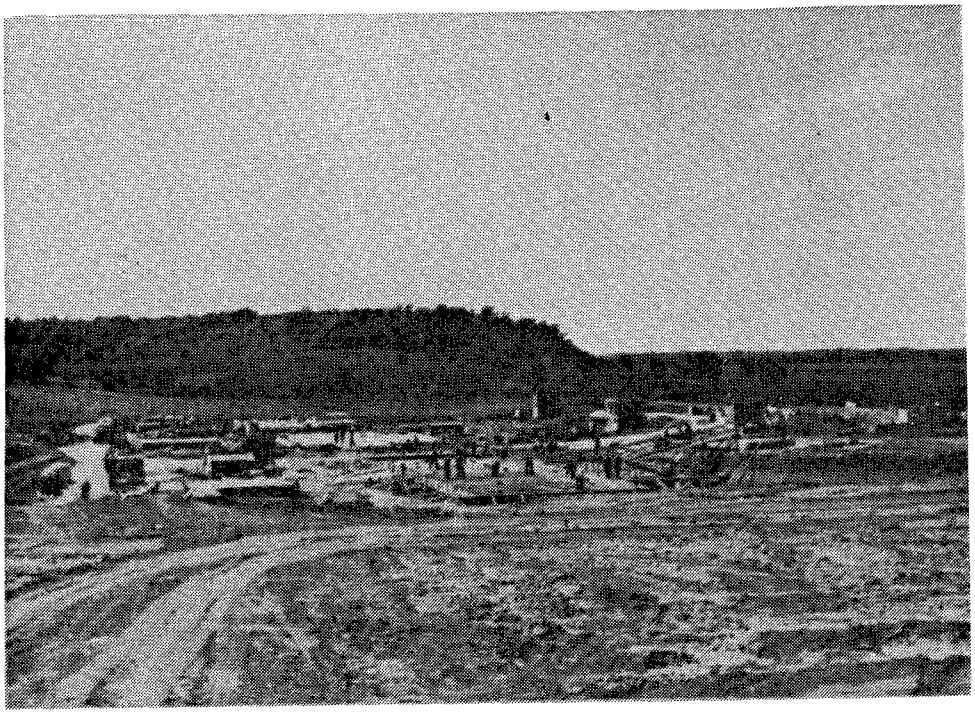


Figure 34. Overview of LCOP Tracer Manufacturing area construction, ca. 1941 (original photograph on file, LCAAP).

start in the morning and the wall would be up as high as it's gonna go at the end of the day on some of the buildings. . . . It was around nine months later that they had equipment installed in some of the buildings" (Pollard, interview 1995).

Weather during construction was favorable; however, several work-days were lost to rain, and mud slightly slowed the progress after a week of unusually heavy rainfall in June (*Independence Examiner* 10 June 1941). This wet weather also hampered utility installation, as considerable volumes of water had to be pumped out of ditches excavated for water and steam lines. Toward the middle of June, construction at LCOP had reached the final stages. Though 6,100 men were still employed in the plant's construction, the transition from construction to manufacturing was evident. A spokesman for the government reported that "real production is not far distant," a fact further confirmed by "the presence of many young men in attendance upon weird machines, that vibrated, dripped soapy solutions, and spat forth brass cylinders of varying lengths and dimensions" (*Independence Examiner* 19 June 1941). Cornelius Lundy, who worked both on plant construction and in the plant, recalls the transition from construction to manufacturing:

> To me it was easy. . . . While we was out there on construction, the plant was operating. . . . It was operating ammunition before we got through working outside. . . . I can remember this: I can remember when they told us that we didn't have no more construction, they didn't have any more construction for us to do, I went to the building No. 1, I believe it was, and I asked for an inside job, and I was told to get my birth certificate and they would give me one, and I got it, and they did, and I worked inside the plant [Lundy, interview 1995].

Rosalind Priest, another lifetime resident of the area and former plant worker, speaks of her first days working at the plant, at a time when the transition was still in progress:

> In the first days, well, when I worked there, they were just starting it up, and some days we wouldn't have very much work at all to do and we'd just kind of have to fool around . . . because the cases . . . wouldn't come through . . . because they were, they had lots of trouble . . . getting the machines to work and do what they wanted them to and everything. . . . We stayed right there and read a magazine or something like that, we had to stay right where we were supposed to. . . . We had to stay right in our division. . . . That wasn't every day, but . . . they wanted the people there, so . . . when the cases did come through, they could get them on out [Priest, interview 1995].

The rapid development which took place in Independence, Missouri, during the construction of the LCOP increased the demands upon the Independence Chamber of Commerce (*Independence Examiner* 5 September 1941). The demands increased daily, and additional funding was needed to take full advantage of the opportunities placed before the community. A drive for $10,000 to provide an adequate working budget was undertaken in Independence; this amount was to fund all community activities throughout 1942. The effects of the LCOP construction on the local transportation system have been well documented: these included the construction of a divided concrete access road which conducted Independence traffic from the Spring Branch road to the new traffic circle on Missouri Route 7, located just west of the main entrance to the plant.

While certain effects of the construction-era boom on the community's housing, health care, law enforcement, and other social infrastructure probably existed, little additional data concerning these effects could be developed. This is due to official government and Remington documents not being overly concerned with these aspects and the local media seeming only to have documented highly patriotic events such as an Arms and Patriotism parade and the plant dedication ceremonies (*Independence Examiner* 11 October 1941). Most, if not all, communities receiving a GOCO facility experienced the boomtown phenomenon and its attendant problems to some extent (Kane 1995:192). The communities of Jackson County were probably no different, but the problems which arrived with the new plants appear to have not been well documented. Oral history informants did not have much to add in this area. All noted that the construction workers seemed to get along well with the residents; there were no tensions noted, but none of

the informants could point out any effects on the town that they would attribute to the construction phase of LCOP.

Wartime Operation

As construction was nearing completion, the numbers of operating personnel increased. This number rose steadily and peaked at 20,688 during June 1943 (LCOP 1943a:2). During the World War II period, certain factors played more importantly into the everyday operation of the LCOP, with some having a greater effect than others. These social variables affected the LCOP employees at work and continued to influence their lives when they left the plant. These included a diversified work force, safety training and education, absenteeism, organized labor, a suggestion program, and a number of other daily influences on the workers.

The workers came from urban Kansas City as well as from the rural areas of Jackson and the surrounding counties. Statistics generated late in the World War II operation, July 27, 1944, show that the average daily distance traveled by the 6,729 employees on the wage roll was 36.7 miles (LCOP 1944b:Appendix). Approximately 55 percent, or 3,715 of these employees, lived in the Kansas City area; another 19 percent were from Independence. The existence of large numbers of potential employees was a factor in placing the plant in Jackson County. While it has been reported that ample "white and colored labor" existed with supervisory, skilled, semiskilled and unskilled qualifications and that Kansas City and the surrounding towns supplied all the inflated war-time demands for labor (LCA 1947:13), labor shortages did occur.

Throughout the war-time operation, the need for production personnel fluctuated with the military's need for certain types of small arms. The first time that ammunition production had to be curtailed—subsequent to full production being attained—occurred in December 1943 (LCOP 1944a:106). Production was placed on a six-day-a-week two-shift instead of three-shift basis. Among the 7,135 persons whose services were terminated were a large number of voluntary resignations and some transfers to other plants. Most government personnel who left LCOP at this time left through furloughs to the armed services and were not replaced. All employees leaving the LCOP were immediately offered positions at other war plants in the Kansas City area, principally the Pratt-Whitney aircraft plant (*Inter City News* 19 November 1943).

The hiring of 7,000 additional employees at the plant in the latter part of 1944 and the early months of 1945 presented problems that had not earlier confronted the LCOP management. LCOP had been in an advantageous position when the plant opened. At that time, other war plants in the area were still under construction or had not yet reached the construction stage. Additionally, Remington's wage scale was higher than that prevailing in Kansas City, this being due to the distance and transportation difficulties faced by prospective employees. Indeed, the oral history informants for this project all stated that the prevailing reason for working at the plant was the wages offered, as well as patriotism. Well-paying jobs were hard to come by, and as Cornelius Lundy (interview 1995) puts it: "Well, I didn't have any thoughts about it. We was just coming out, just coming out, we wasn't out, coming out of the depression, and everybody was just glad to get a job. Everybody was happy to get a job, a place to work. It wasn't, I don't think, no, wasn't happy to be making ammunition to kill somebody, but it's a job." Rosalind Priest (interview 1995) stated that the pay was "better than you could get anyplace else . . . you didn't start in at so much, but you got raises . . . if you stayed there. Jobs outside the plant didn't pay as well." The higher wages offered by LCOP were advantageous to acquiring workers initially, but by late 1944, the wage differential had disappeared due to increased wages in Kansas City. The Sunflower Ordnance Plant (located just across the state line in Kansas), the North American Aviation Plant, and the Pratt-Whitney Aircraft Corporation, as well as such establishments as Oldsmobile, Sheffield Steel Works, and numerous other contractors engaged in war production, had almost completely absorbed the labor supply in the intervening time (LCOP 1944b:213). Unfortunately for Remington, these plants were at their highest peaks in production, military calls increased, and transportation was becoming increasingly difficult (LCOP 1945c:251).

Some experienced production personnel were found by issuing calls for former workers who had been let go during the work force reduction in late 1943-early 1944. A program of manpower conservation with every effort being made to simplify procedures also helped somewhat (LCOP 1945c:251). The LCOP was classified as essential and was not affected by the ceiling on employment of male workers which had been established in January 1945 by the War Manpower Commission. An officer was stationed at LCOP by the Office of the Chief of Ordnance. This individual was to assist in employment, and he reported that the situation was not alarming. However, he did report that while needs were being met for unskilled labor, a critical need for skilled labor existed, one which showed signs of becoming more acute as production increased (LCOP 1945c:252).

To assist in employment, a recruiting caravan for the plant began a tour of the surrounding communities in February 1945 (LCOP 1945c:254). The LCOP Traveling Employment Department included a weapons carrier equipped with a standard 37-mm antitank gun and mounted .30- and .50-caliber machine guns. A truck and trailer equipped as a field employment office and containing a public address system followed the weapons carrier. Accompanying this truck were three interviewers and a representative of the U.S. Employment service, who issued referrals to the plant when needed. When the caravan was set up in a community, Private Albert Beyers, a paratrooper wounded in the D-Day invasion of France, would demonstrate the use of machine guns using blank ammunition. Beyers also related his battle experience. An exhibit of the types of cartridges made at LCOP and shoulder weapons in which the ammunition was used completed the caravan. Local media reported that applications for work at LCOP increased appreciably toward the end of March with "a home front reflection of the continued drive of the Allied armies into Germany" (*Kansas City Star* 28 March 1945). One day later, however, it was reported that the number of applications dropped 25 percent (*Kansas City Star* 29 March 1945).

Government employees were most needed by the LCOP to fill clerical positions. Typists were very scarce, and it was hoped that the close of the school term might make available a limited supply of teachers desiring temporary employment for the summer months and students completing their training. Some alleviation of the situation was found when permission was granted to employ those under 18 years of age. Aside from the manpower situation, inadequate staffing of government positions at LCOP was the result of differences between government and contractor pay scales and benefits (Table 8).

A fluctuating want for jobs at the LCOP seems to have been acting independently of the government's fluctuating needs for employees to be used in the production of certain types of ammunition. An individual's need for a LCOP job was influenced first by lack of employment in the post-Depression Kansas City job market. The rise of the war industry in the area gave the worker more power in obtaining a higher paying job, one which included benefits and favorable working conditions.

On the national level, labor shortages grew so severe that national service legislation was proposed. While this "work or fight" law was supported by President Roosevelt, the War Department, the American Legion, and the American Communist Party (Fine and Remington 1972:612; Polenburg 1972:176-181), it was opposed by facility management, who believed it would interfere with their right to hire whom they wanted, and by labor groups, who saw it as a form of involuntary servitude. Judging from early local media reports and governmental documents associated with the LCOP, it is clear that men were considered to be the main source of unskilled and skilled labor. As facility after facility was given over to support the war and more and more young men went off to fight, "underutilized labor" was employed in unprecedented numbers.

Women made up the largest supply of potential labor in the U.S. in 1940 (Fairchild and Grossman 1959:169). During the war years, the number of women in the work force climbed from two to 16.5 million, and by mid-1945 women constituted 36 percent of the civilian work force (see Kane 1995:198). While some historians have argued that the large numbers of working women during World War II gave rise to the woman's rights movement and still others have argued that the war did not inaugurate or even set the stage for the feminist campaign, this issue is beyond the scope of the present investigation (Kane 1995:198-206 for an overview of the woman's role in the GOCO program). The subject of the following discussion will focus on the everyday working environment for women ordnance workers (WOWs) at the LCOP.

Table 8
Salary Comparison Between Remington and Government Employees at LCOP*

Occupation	Remington	Government
Ballistics		
Gunner, velocity and pressure	3,350.36	2,433.33
Gunner, casualty	3,350.36	2,433.33
Gunner, accuracy	3,150.20	2,433.33
Chief Ballistician	5,880.00	4,128.33
Visual, Gage and Packing Inspection		
Chief Inspector	5,820.00	4,128.33
Building Supervisor, production	6,450.00	3,603.33
Building Supervisor, inspection	5,184.00	3,603.33
Visual and Gage Inspectress	2,704.00	1,752.00
Packing Inspectress	-	1,971.00
Line Inspectress	2,758.08	-
Trucker, general labor	2,568.80	2,082.08
Gage and Weigh Machine Adjuster	3,163.68	2,516.80
Gage Laboratory Supervisor	5,580.00	3,380.00
Administrative		
Staff Secretaries	2,778.72	2,190.00
Chief Accountant	7,200.00	6,228.24
Asst. Chief Accountant	5,880.00	4,228.33
Cost Accountant	5,280.00	4,128.33
Material Checkers	2,676.96	2.190.00
Time Checkers	2,622.88	2,190.00
Pay Roll Clerks	2,342.88	2,001.00
Salvage Representatives	4,020.00	3,528.33

* Data taken from LCOP (1945c:Exhibit C)

At the LCOP, the increasingly high number of inductees into the armed forces necessitated their replacement by women. In August 1943 the *Lake City Tracer*, the facility's employee newspaper, reported that 65 percent of the new employees were women (*Lake City Tracer* 1 August 1943). As of June 1943, 50.9 percent of all wage and 43.1 percent of all salary labor was conducted by women (LCOP 1943e:Appendix E; Figure 35). Women gunners in the Ordnance Ballistics Section had been used for some time, and had handled all except the .50-caliber guns (Figure 36). All ballistics testing of carbine ammunition was performed satisfactorily by women, and positions associated with the .30-caliber testing were given over to women as men left for the armed forces (LCOP 1943e:45). The .50-caliber gun proved too heavy for the women to handle. In comparison, no women guards were employed at any time by the LCOP during the World War II operation (LCOP 1943d:61).

Figure 35. Silk-screen labeling .50-caliber boxes, 1943 (original photograph on file, LCAAP).

Figure 36. Woman gunner operating .30-caliber carbine rifle in the Ballistics building, World War II era (original photograph on file, LCAAP).

As the number of women in the LCOP work force grew, the management dealt with the special problems that surrounded them. "In the interest of promoting happiness and efficiency and combating absenteeism among the coveralled women whose work on the line sends the bullets in a stream to fighting fronts over the world," Remington employed 21 women counselors (*Kansas City Star* 4 July 1943; Figure 37). A large number of LCOP's WOWs were married and had children; almost all of these woman had to squeeze their regular household duties into a week already filled with 48 hours of war work. A WOW's job was described as being "a big order in adjustment and stamina. . . . Every day is a 50 yard dash, with cooking and housecleaning calling for swift attention the moment the woman worker reaches home. . . . Darning the children's socks becomes a race with time. . . . Under such tension, the simplest problems assume gigantic proportions (*Kansas City Star* 4 July 1943)." No problem was too small for the counselors. Conditions in the locker rooms, discipline regarding smoking in the hazardous areas, locating child care facilities, and aid in finding suitable living quarters were only a few of the special problems handled by the counselors (LCOP 1943e:45). When it came to finding a suitable place to live, single WOWs could also seek assistance at the local Kansas City USO Club (*Lake City Tracer* March 1942). From marital problems to cooking suggestions, the problems faced by the LCOP WOWs called for "motherly" advice, and the counselors fit the role perfectly. They were selected for their mature, "motherly" appearance, as well as for cheerful friendliness. Some had college training in psychology or personnel work and many of them had taught school (*Kansas City Star* 4 July 1943).

Absenteeism, discussed further below, was a particular problem with which the counselors dealt. Absenteeism was most serious among women employees. Plant managers saw some excuse for this, as the LCOP was located away from all banking, shopping, and mailing facilities; however, they could make no final judgment because of the lack of comparative absenteeism rates from other plants (LCOP 1943e:44). The LCOP supervisor of counselors often visited WOWs homes when they did not show up for work. Often she found them doing house work, cleaning, and cooking for the family as well as war-industry-working borders. Male foremen, who had been skeptical of the counselor program, later contended that a lower absenteeism rate was due to their presence (*Kansas City Star* 4 July 1943). Occasionally, the women counselors found themselves assisting the male plant workers. On one occasion, a supervisor called a counselor and asked her to send a pair of man's trousers soon as possible. As it turned out, one of the men had spilled acid on his pants, and they literally had been eaten away (*Kansas City Star* 4 July 1943).

Child care was the greatest single problem facing women workers at LCOP, and the women counselors worked closely with the Child Care Information Center at the plant (*Kansas City Star* 4 July 1943). A particular problem was that most available child care in the area was only offered during the day. This included the Children's War Service Program operated by the Kansas City Board of Education during the summer of 1945 (*Lake City Tracer* 30 June 1945). Traditional day care was of no use to mothers working the night shift. While a ceiling of 50 cents per day was put on all day care facilities operating in Kansas City, prices at private 24-hour care facilities were not regulated (*Lake City Tracer* 16 November 1943); the 24-hour nurseries were the ones most widely utilized by the LCOP workers. Some assistance was offered in 1942 when a program was set up whereby war workers could make appointments to place their children in the care of recommended day nurseries and day and night foster homes (*Lake City Tracer* 5 September 1942). A Child Care committee would find and inspect prospective homes for children. Parents would then discuss their particular needs with the committee and receive a list of facilities suitable for their children's welfare. The parents would make their own final choice of places and financial arrangements, the charge being based on the type of child care offered.

The women interviewed for this project shed additional light on the roles of women workers at the plant. None recalled any plant-sponsored day care. Rosalind Priest didn't recall any day care in the community; she managed by hiring her own sitter:

Figure 37. Women counselors at LCOP, World War II era (original photograph on file, LCAAP).

> My boy . . . he was just little, and I had, I always had somebody stay here . . . a girl, usually, that would stay, and . . . she'd cook the meals and send him to school and things like . . . well, that's all you could do, either send them to some relatives or have somebody stay at your house [Priest, interview 1995].

Alice McEldery recalled her experience of beginning work at the plant:

> Well, it was different, rather exciting, and such a different atmosphere than anything I'd been into . . . you worked around a lot of people, men as well as women, which most of the things I'd been involved in was just women, like clerking in a store, and then to go out there, and it was noisy, lots of noise in there. It was just different and . . . fun [McEldery, interview 1995].

Ms. McEldery found that some aspects of work at that plant were less enjoyable. She remembers being reprimanded by a supervisor who "used some foul language, and I wasn't used to that, and I told him nice that 'you can call me in and lecture me and bawl me out, but I don't have to stand there and listen to this foul language, and if you can't clean it up, why, I'm leaving,' and he respected that, and I thought I might lose my job over it, but I didn't. He treated me very nicely after that" [McEldery, interview 1995].

After about a year of working the "swing shift," Ms. McEldery quit her job:

> Well, I quit. My husband didn't really want me to work, and the swing shift was hard because he worked days only, and so I finally decided it was better to quit and stay home with the family. . . . When I first started out here, of course I was excited about it, and I enjoyed it. I was nervous, because I'd never done anything like that before, and it took awhile to settle down and for the job to become routine because I'd never been in a place like that. And then I was surprised, I'd never worked around

> a lot of men, and I wasn't, was not prepared for some of the things that took place out there at that time with that, and I think a lot of the women were in the same boat, and as my time out there progressed I became uncomfortable with it . . . there was always a few that thought he had to pat you where he had no business patting you, or . . . you begin to learn the girls that, I had one friend that worked on the soldering line with me, and she was married, but she was really having an affair with the head guy on the soldering line, and I became uncomfortable with that, and there was a lot of that going on, and I guess I had had a sheltered life and it . . . bothered me . . . and there were two or three that would like to be friendly with me, and I objected to that . . . Maybe there was somebody you could have talked to, but I didn't. . . . They didn't force themselves or anything, but it was just that I was uncomfortable with it, and then the stories that would float around and talking to people that were doing it . . . it could be a temptation, you know, and I didn't want any part of it . . . [McEldery, interview 1995].

Along with the pressures women faced at the work place and those of caring for a family were certainly the tensions faced by those whose loved ones had been, or were waiting to be, called into service. Working at the ammunition plant sometimes brought the war very close to home:

> It was very evident because of what you were working on, and it . . . made you think about it. I could step out the door, like on a break time, and I could see the bunkers where they were firing the ammunition to make sure it worked, and you could see the tracer bullets, and it made you very aware that there was a war going on, and of course we were waiting for him [her husband] to be called too [McEldery, interview 1995].

Ms. McEldery recalls the waiting as:

> . . . kind of scary. We had . . . two children, and he was called up at one time and went and took his physical and told to go home and wait, and it was a year before they called him back, I don't know what happened, but all that year we sat there waiting anytime for him to be called to go out, and it just didn't happen for a year, and that's kind of hard to live with [McEldery, interview 1995].

Women workers in the plant found help in the counselors and friendship in each other. The solidarity of the LCOP WOWs was pictured in the Ordnance Department's *Firepower* magazine, where a group was shown wearing the sky blue denim and red and white polka dot headdress (*Lake City Tracer* 1 February 1943). This unofficial standard uniform became a symbol of the WOWs, and Adolf Treider, one of the nation's foremost illustrators, immortalized it in a war-time propaganda poster (*Lake City Tracer* December 1942). The uniform has been described as "the crucible of a thousand fashion foibles molded into one glorious symbol of Victory production" (*Lake City Tracer* January 1943).

The post-World War II Facilities Analysis stated that the most important quality of the LCOP was the "ample white and colored labor." This brings to light the second group of "underutilized laborers" to be heavily relied upon at LCOP: that of African Americans (Figure 38). As of June 1943, "negro labor" accounted for 7.7 percent of the LCOP payroll or 1,592 people (LCOP 1943e:Appendix E). By September 1944 this number had increased to 11.6 percent (LCOP 1944c:Appendix D), and by December of the same year, 12.5 percent (LCOP 1944b:Appendix D). No differentiation was made between the African American labor force as to unskilled, semiskilled, skilled or supervisory personnel.

Mention of African American employees, as "negros" or "colored," in the plant documents is limited to statistical data only. The *Lake City Tracer* occasionally mentioned "negro employees" in articles concerning plant recreation, in which it appears that many African American workers took part. This recreation included a "negro" chorus and employee dances, which were segregated (*Lake City Tracer* April 1942, June 1942, November 1942, 16 October 1943). In the 1896 Plessy vs. Ferguson case, the Supreme Court had ruled that segregation was constitutional as long as equal facilities were provided; during World War II, segregation was justifiable by the law.

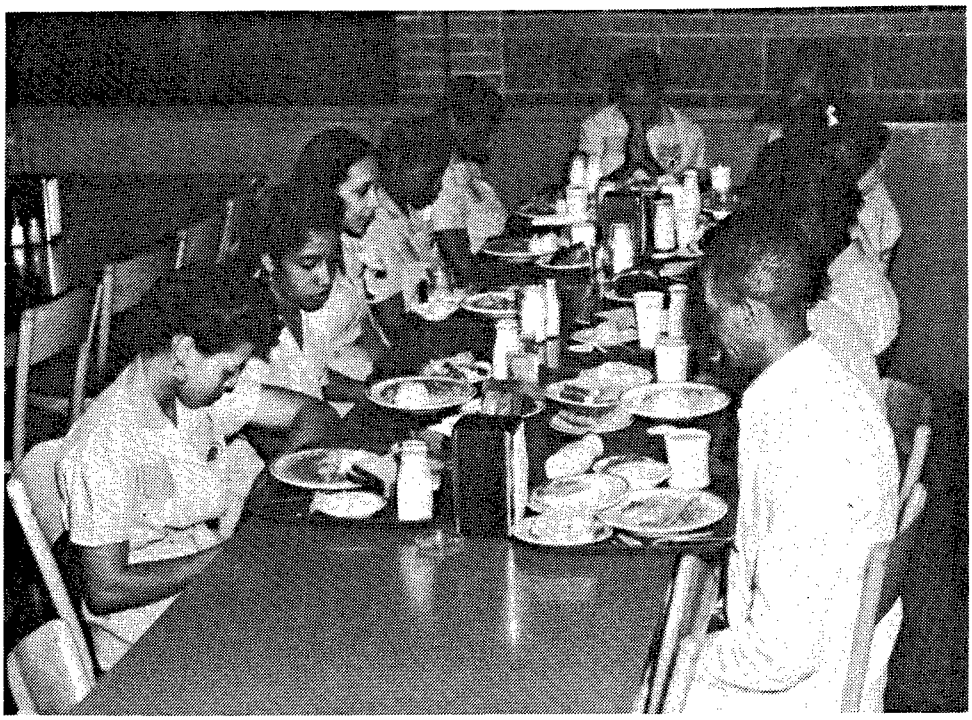


Figure 38. African American workers in a LCOP cafeteria, World War II era (original photograph on file, LCAAP).

Oral informants recalled segregation at LCOP in the form of job assignments. Alice McEldery (interview 1995) didn't recall any African Americans, or members of any other minorities, working in her department, and Rosalind Priest (interview 1995) recalled that "[t]here weren't many colored people, and I never did see any of them. . . . There was one section of colored people, and that's all there was . . . they worked on head and stamp . . . they all worked in the same area . . . we never even hardly saw them or talked to them or anything."

Only two incidents of racism, both involving the same individual, came to light in the documentary searches associated with the current investigation. On October 20, 1943, a group of nine African American workers on their way to work at the LCOP were told to sit in the back of the bus. All but one, the Reverend M. F. Stephens, moved to the rear, with Stephens questioning the drivers authority for such an order (*Kansas City Call* 22 October 1943). This incident was reported, and on the following day, LCOP welfare worker John Scott and five fellow African Americans sought to board the bus and check the story. As the bus approached at 6:30 in the morning, Scott stood at the side of the road to hail it. The driver swerved around Scott and kept driving. Scott and the others jumped into his automobile and followed the bus to the plant. As there were a number of empty seats on the bus, Scott asked the driver why he failed to pick them up. At first the driver said he didn't see the group, then he proceeded to say "he did not intend to pick up any n------" (*Kansas City Call* 22 October 1943). This was the first report of such an incident on the bussing company, and the driver was reprimanded and transferred to another route.

Kane (1995:206-211) gives an overview of African American workers during World War II. In her overview, she states that one area of potential research is to determine if GOCO facility segregation followed the national trend of being more strictly enforced in the southern states. Other potential research areas include the shift from unskilled labor positions, such as from janitor or garage attendant, to skilled and even managerial positions. Information concerning these questions, as well as segregation or desegregation,

discriminatory hiring practices, and race relations on the job, was not found in World War II-period LCOP historical reports or correspondence, and the temporal and monetary constraints did not allow the use of local African American newspapers. However, the present investigation utilized the war-time memories of one African American LCOP worker, Mr. Cornelius Lundy.

Cornelius Lundy began working on the construction of the plant, worked as a janitor during World War II, was promoted to tool setter for final inspection, and worked there until his retirement in the late 1960s. Mr. Lundy recognized some segregation in the early years of the plant. When asked about segregation, he confirmed that

> To a certain extent, it was. It was some segregation in it, and there ain't no use in saying it wasn't, but I think most of that was overlooked . . . because we was trying to do a job. . . . I wouldn't feel justified in saying there wasn't some segregation, it wouldn't be fair for me to say, because there was in some ways. . . . Well at one time . . . cafeterias were segregated . . . there wasn't different ones, they had one kind, but in years to come they did away with it. . . . To my thinking, it wasn't noticeable too much, because I would say . . . most jobs that I worked on were segregated, so I wouldn't say that that one was any more than any of the rest . . . put it that way [Lundy, interview 1995].

Mr. Lundy was also asked about the work performed by African Americans who worked at the plant:

> Well, in the beginning . . . mostly blacks jobs is cleaning up, cleaning up . . . you didn't get any of them upper jobs, but recently it opened up to us, but that was it, when we first went there that was the biggest we did do. . . . It finally worked down to where . . . if you was capable you could do most any job, but it was at one time, that's what I'm trying to say, at one time it was [segregated], but it changed [Lundy, interview 1995].

Mr. Lundy's overall view of his experiences working at the plant was certainly favorable:

> I loved it, I loved it, and I had some of the best people to work under . . . in the United States. . . . They was nice people. I enjoyed working for them. Everybody treated me nice, I was treated nice, and I appreciated it. And today, if I wasn't as old as I am, and they said . . . come back, I'd go back to work [Lundy, interview 1995].

In her GOCO facility overview, Kane (1995:220-238) outlines several conditions which affected the everyday lives of the plant workers. These included organized labor, absenteeism, safety, and training. Plant documents and plant and local newspaper articles documented all of these at LCOP, as well as recreation, the spread of rumors, and other daily occurrences at the facility.

As stated earlier, the Wilson administration created the NWLB, appointing Samuel Gompers of the AFL to one of the seats on the Board. The federal government forced the operators of the GOCO plants to allow for union organization and collective bargaining (Fairchild and Grossman 1959:130). Nationwide, more than 12 million workers were organized in the CIO and AFL during the war. Labor-management committees were set up in most factories, but these seem to have been little more than window dressing (Zinn 1980:408). The Fair Labor Standards Act of 1938, which called for a 40-hour week, also went into effect late in 1940. Organized labor at all levels realized that while the unemployment, economic distress, and social turmoil that had marked the 1930s had been overcome by the war, the biggest gains were in corporate profits, which far outstripped rising wages. From a national perspective, it is interesting to note that despite the overwhelming atmosphere of patriotism and dedication to winning the war, many of the nation's workers went on strike. In fact, during World War II there were more than 14,000 strikes, involving 6,770,000 workers, more than in any comparable period in American history (Zinn 1980:408).

At the LCOP, the first group of employees to join a union was the plant guards. In May 1943, 486 guards cast votes under NLRB supervision, with 88 percent wanting union membership (LCOP 1943a:Appendix VI; LCOP 1943e:50). The largest election to be held took place on January 26, 1944 (LCOP 1943a:19). This election determined the employees' preference with respect to collective bargaining, and three specific groups of workers voted for AFL unions. The first included an agreement with the International Association of Machinists (AFL) and covered 480 people. The United Brotherhood of Carpenters and Joiners of America (AFL) petitioned and entered into an agreement with 51 employees. The final agreement covered 40 employees and was petitioned by the United Association of Journeymen, Plumbers and Steamfitters (AFL) on July 26, 1944. The remaining employees, numbering approximately 5,800, voted for no union representation. All four collective bargaining agreements were canceled upon termination of Remington's GOCO contract at the end of the war.

Most workers at the LCOP appear to have felt that the system was doing well enough for them without collective bargaining, and none of the oral informants interviewed for this project belonged to a union. At the Badger Ordnance Works in Baraboo, Wisconsin, failure of the unions to organize the labor for collective bargaining has been attributed to personnel policies being more liberal, a belief that the plant was to be temporary, it being a government plant at a time of national stress, and the management taking an active interest in handling personnel problems as though a union were actually representing to employees (Shaffer and Crown 1995:95). While it has not been documented during the present investigation, perhaps several of these reasons can be attributed to the failure of the unions at LCOP. Generally worker-management relations appear to have been favorable and no strikes or major work actions were reported at the plant.

The wages paid to the LCOP workers affected their contributions to the war effort and played a part in their not seeing a need for collective bargaining. As stated earlier, the hourly rates at the LCOP were higher than most industries in the Kansas City area toward the beginning of the war; this undoubtedly attracted many workers who had specific skills to offer. Two five-cent an hour general wage increases were given in September and December of 1942, and in January 1943, a policy of equal pay for comparable work performed by male and female workers was made effective. The need for immediate employment arose in 1945, at a time when the well-established Kansas City war industry employed much of the skilled labor force. To help LCOP attract employees, the War Department Wage Administration Agency approved a six-cent per hour general increase for wage role employees. This took effect on March 17, 1945.

Pronounced public and employee relations programs at LCOP also played a role in high worker satisfaction. Public relations schemes ranged from ammunition displays in local store window to a large mural and three-dimensional exhibit at the Kansas City Chamber of Commerce War Show (Figure 39). This display was "outstanding among the exhibits from all war industries in the Kansas City area" (LCOP 1944d:136). It followed the theme "From the Production Front to the Battle Front," with the production angle being a display of operators and attendants running a gauge and weigh machine; a belt loading machine was also demonstrated. The remaining portions of the display were taken up by a battlefront scene which included a large mural of a "Jap" machine gun emplacement and a live actor representing a U.S. Marine manning a .30-caliber machine gun firing on Japanese soldiers. Other public relations activities during 1944 included sponsorship of plant tours and releasing 952 columnar inches of printed publicity to local newspapers (LCOP 1944d:136). Morale boosters targeted for the plant workers included numerous performances staged at local auditoriums. The purpose of one show was reported to have been to "stimulate production, eliminate absenteeism and aid in labor recruitment for the plant" (LCOP 1945c:255). This performance included music by the 306th ASF Band from O'Reilly General Hospital at Springfield, Missouri, and inspirational talks given by six survivors of the 101st Airborne Infantry's "do-or-die" stand at Bastogne, Belgium. Numerous recreational events were also sponsored and organized through the Lake City Employees' Recreational and Welfare Fund or through the office of the plant newspaper. Dances, sports leagues and shooting clubs were all part of this recreation. One dance was reported as being "a good time for all," with

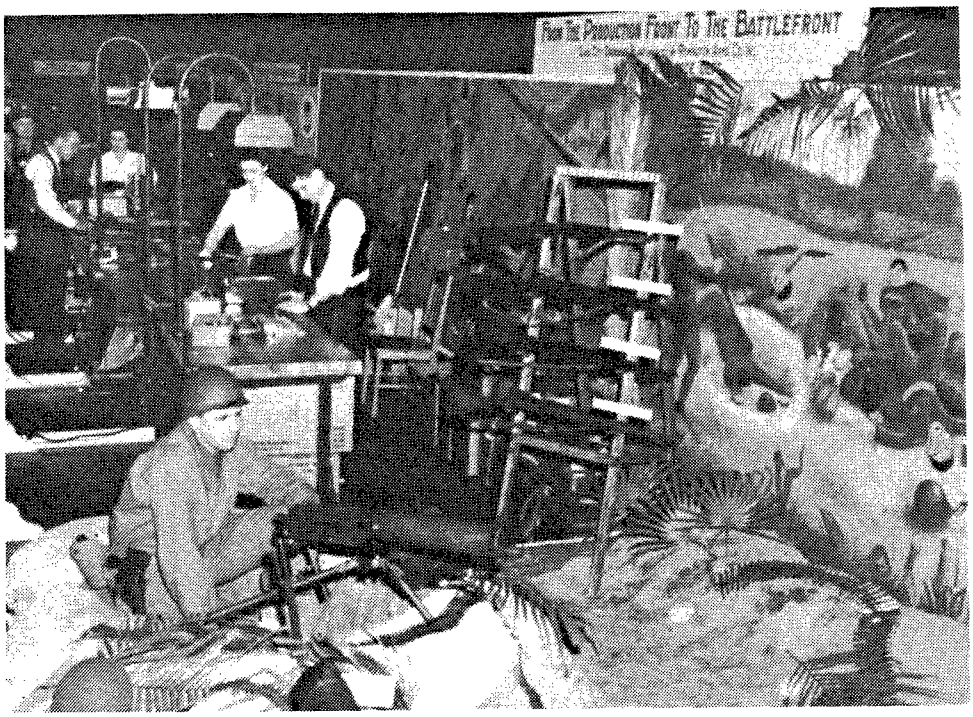


Figure 39. LCOP promotional exhibit at Kansas City Chamber of Commerce War Show, 1944 (original photograph on file, LCAAP).

slacks, tweeds, silks, and formals all in evidence. It was stated of this same affair that "[i]f a gay crowd, a good band and room to dance make a party, brother, this was a PARTY" (*Lake City Tracer* 3 November 1942). Like most social activity during the 1940s, LCOP's recreation was segregated. However, it appears that both the African American and white dances and sporting events were equally popular.

Even with the high profile public and employee relations efforts taking place, labor turnover and absenteeism were problems faced by the LCOP Contractor-Operator, with absenteeism being especially prevalent. By no means was this limited to the LCOP facility (Kane 1995:222-223). Absenteeism was also by no way limited to the "factory-line" workers. At LCOP this was a substantial problem for the government employees. In March 1943, a competition was inaugurated in which the Ordnance Department was broken down into two divisions and the sections of each were put in competition with each other for the best attendance record. The sole purpose of this program was to "reduce to a minimum the short periods of annual and sick leave taken by employees of the Ordnance Department" (LCOP 1943c:Appendix B). As stated earlier, absenteeism was most prevalent among women. While absenteeism among the government employees had been increasing through the year until a high point of 9.8 percent had been reached in August, an improvement was noted during the fourth quarter of 1943 (LCOP 1944a:107).

Absenteeism percentages for the contractor's employees during 1943 continued to rise until a high point had been reached in December with an average of 7.0 percent (LCOP 1944a:107). The breakdown of male and female averages included 2.8 percent for men and 6.57 percent for women. These figures may be compared with the national rate for all industries of six percent, as reported by the Office of War Information (*Lake City Tracer* 15 March 1944). The sharp rise in absenteeism during December 1943 was partially due to an influenza epidemic which was quite widespread, but of short duration.

Comparisons of GOCO absenteeism rates during the first half of 1944 show that absenteeism at LCOP was high in relation to other plants (LCOP 1944d:126). Among all small arms ammunition plants during the same time period, LCOP had the highest, with the exceptions of Kings Mills during February and Denver during April (LCOP 1944d:126). The high rate at LCOP was due to several factors, such as the distance of the plant from housing, shopping, and banking centers, drop in employee morale due to cut-backs in production, and unrest due to reduction in force (LCOP 1944d:126). One interesting point was observed relative to absenteeism rates. It was noted that the absenteeism rate on pay day was approximately 11 percent less than the regular weekly average, while the rate on the day following pay day was about 50 percent higher than on pay day. It was also noted that absenteeism varied from shift to shift, with the lowest rate occurring during the first or daylight shift, progressing to a larger percentage for the second or evening shift and the highest percentage always being found on the third or night shift.

In mid-1944, declining absenteeism rates corresponded to an increase in new employees, indicating that slow-down in production schedules and the resulting fear of layoff was a direct cause of the absenteeism among long-term employees (LCOP 1944c:176). An increasing rate of absenteeism during the early months of 1945 was attributed to a variety of causes, including an increased percentage of female personnel who had children and home duties; increased employment of the less physically fit; reemployment of returned and disabled personnel; and the location of medical, dental, and optical treatment facilities at a distance from the plant. Employees were encouraged to stay healthy; one former employee recalls that at the plant "at all the drinking fountains they had like salt pills that you could take, you know, because it was so hot and you sweat so much, and, and then, in the cafeteria you could always buy vitamins with your meals. They had these vitamin pills that you could take, I guess . . . to keep you healthy. Yeah, they stressed being there every day and not being absent too" (Priest, interview 1995).

Increasing transportation difficulties due to the wearing out of automobiles also contributed to absenteeism problems (LCOP 1945c:257). While no difficulty was experienced in securing commercial carriers, such as buses, to transport employees to and from the plant, 80 percent of the workers were carried in privately owned, pooled automobiles (LCA 1947:13). Throughout the World War II operation, employees at the LCOP, like those at other plants (Gaither 1995:123), were singled out and commended for their attendance records.

Even with chronic absenteeism problems, LCOP managed to obtain numerous production awards. It was the first small arms ammunition plant to receive the Army-Navy "E" award for excellence in production. This was awarded on August 24, 1942. On February 19, 1944, and on March 17, 1945, the plant received additional Army-Navy "E" awards in the form of White Stars to add to their original "E" award flag. These were received for production excellence.

Production excellence involved production safety. While safety was an issue in industry nationwide, it was of particular concern in GOCO industrial facilities, where potentially dangerous chemicals and explosives were routinely handled (Kane 1995:223). In addition to the precautions taken in designing and constructing the LCOP, strict safety rules were developed and implemented for the operation of the plant. The many safety measures implemented by the Ordnance Department gave it the lowest accident frequency rate in the Army Service Forces (Thomson and Mayo 1960:133). Ordnance production became safer than production in many other U.S. industries; in fact, workers were repeatedly told that they were safer at the LCOP than in their own homes.

An Ordnance Safety Booklet was prepared by the safety engineer of the Ordnance Department and a copy given to each civilian employee and each new person upon induction. This booklet was prepared with the office worker in mind, as well as those working in the hazardous areas, and it stressed the types of accidents common to all occupations. An additional safety measure was adopted by both Remington and the government in the appointment of weekly departmental safety supervisors in all buildings (LCOP 1943c:25). The person appointed brought to the safety meeting any incidents and examples of unsafe practices and

hazards noted his week as safety supervisor. In another safety training program, supervisors were instructed during a 40-hour explosives safety course. Supervisors then instructed foremen who, in turn, instructed each new or transferred employee (LCOP 1943e:42). While no figures can be derived as to the extent of the training due to the continuous nature of the training, it was reported as being extensive.

All of the former employees interviewed for this project recalled the plant as being a very safe place to work: "They had a good safety record . . . they wanted to see everybody work safe and nobody get hurt" (Lundy, interview 1995). All recalled regular safety meetings, and most thought that these occurred every one or two weeks. Dale Pollard remembers a nurse stationed in every plant building during World War II. Protective clothing was emphasized; workers were encouraged to wear safety glasses, safety shoes and avoid "loose, sloppy clothing" (Priest, interview 1995). Cornelius Lundy (interview 1995) recalls that "they would give you, if so many, so many working days that the plant went without an accident . . . everybody would get a present . . . they'd have different things, and you'd choose what you would want"; other informants also recalled safety awards. These awards most likely served as morale boosters as well as working to encourage safety. Frances Brasington recalls her experience with the safety shoes plant workers were required to wear:

> They really stressed safety shoes, safety shoes was the big thing. And I had just a teeny foot . . . 3 to 4. . . and I couldn't buy safety shoes because my foot was too little. Finally, I think, and they would, I don't remember what it was, they got . . . points or something for everyone in the department to wear safety shoes, and I remember I had an awful time trying to find shoes to fit me, so, and they really pushed me, even wanted me to wear bigger shoes, you know, in order to wear a safety shoe, and it seems to me like the smallest was a five, and I'm not sure, but whatever it was, it was really too big for me, but I think I ended up with some anyway. . . . They were cheap and they were ugly. They were brown, ugly brown, . . . but they had that metal thing in the toe, you know, which, really, you needed it really, in case you were run over by one of those carts and you were standing right close to them. Seemed to me like they had something under the wheel to keep it from rolling, you know [Brasington, interview 1995].

Rosalind Priest recalled the safety shoes as being nice in a time of wartime shortages:

> Well, they were really nice, some of them. They had, all of them had steel toes, you know, but you couldn't hardly tell it, and you could, at that time you had to have shoe stamps to get your pair of shoes, and you could go up there and get a pair whenever you needed them, and they didn't cost too much either, up at the, they had a building [at the plant] where you could buy supplies. . . . Well, just like they had meat stamps, you had to have stamps to get your meat and stamps to get your shoes, and stamps to get your gasoline, stamps to get your sugar . . . you didn't have to have them for these special shoes, that's the reason it was kind of nice, you could get these shoes . . . and they really looked as nice. . . [as] regular shoes, you could wear them on the street [Priest, interview 1995].

Along with safety clothing, numerous security measures were enacted at the plant, both to protect the workers and guard against breaches in security. Certain areas of the plant were more dangerous than others, and workers stayed in the buildings they were assigned to:

> You had to have a special badge, in fact even today you do. . . . You had a badge, you had a building that you belonged in, that's the building you worked in, that's the one you went to, or you had an explosive area, you would identify what area you worked in and that's where you went. . . . You didn't roam freely around [Pollard, interview 1995].

The policy of keeping workers in their own area undoubtedly reduced the risk of injury inherent with workers having access to unfamiliar equipment. Overall security measures were also strict. Dale Pollard (interview 1995) remembers a '12-mile fence line around' the plant, and Frances Brasington (interview 1995) recalls that when carpooling to work, "We had to come through a big gate, a security gate, then we'd come on

through and park in a parking lot. Then there was a guard at that gate to get you on into the building, we had to walk probably a block to get into the building from the main gate there, not from the main gate but from the gate to the building." Besides the issue of worker protection, there were security issues associated with the government operation in wartime. Mr. Pollard recalls the overall plant security:

> Most people were assigned a job, and they worked in a small area, say six or eight feet from them, operating one or two machines. Now there were 22,000 people here, and it may seem like a lot to you, but there was about 725 or [7]30 guards, and they had guard towers . . . with big searchlights on them, and the guard would get in the tower, the guardtower, and sweep the area with the searchlights, and they had horses, they had a stable here and they had horses, and certain individuals rode the exterior fence lines with those horses, and when they were brought in they had somebody to curry 'em down and feed them. Not only [to keep workers from wandering around], but it was wartime, you know, and there was suspicion of anybody coming in [Pollard, interview 1995].

Despite the vigorous safety regulations and training, accidents did occur at the LCOP. The numbers of major accidents per year can be broken down into the following: 1942, 18 accidents in 29,804,787 exposure hours; 1943, 22 accidents in 42,416,812 exposure hours; 1943, 21 accidents in 21,183,219 exposure hours; and 1945 (10 months), 12 accidents in 18,124,912 exposure hours (LCOP 1943a:Appendix IV). These accidents included minor cases of carbon monoxide poisoning, an explosion in a carbine primer mixing building that entirely destroyed the building with no injury, and the loss of a hand due to failure to use the safety guard provided on a power saw. The loss of the hand was the injury which broke a safety run that included 13,460,000 man hours without a major accident; this was just short of a world's record for safety in an industrial plant (LCOP 1943e:43). The only fatality that occurred during the World War II operation (*Lake City Tracer* 15 February 1944) occurred after an employee suffered severe burns as dim igniter cake flashed in a hopper of micro-pulverize. The employee at first responded favorably to treatment but later succumbed. Much difficulty was experienced in identifying the reasons for increased injuries. In some instances, they were traced to employment of untrained personnel, but other instances were impossible to account for (LCOP 1944d:129).

Throughout its World War II operational history, the LCOP's employees were never in danger of a direct attack by wartime enemies of the U.S. However, during the spring of 1945, a "small, short-haired, light reddish-tan dog, weighing about ten pounds, with long ears and a short nose" nipped and lightly bit several employees. It was later discovered that this canine was infected with rabies, necessitating the giving of Pasteur treatment to several individuals including the wife of one of the Ordnance officers. In retaliation for these attacks, all loose dogs on the plant reservation were tracked down and killed, and all employees warned by the issuance of bulletins (LCOP 1945d:298).

At the peak of employment, over 20,000 employees were working at the LCOP. As would be expected, the large number of employees, coupled with secrecy due to the national emergency during World War II, created an environment ripe for the spreading of rumors and "hearsay." Rumors concerning fears of layoff played a part in the mid-1944 increase in absenteeism and employee turnover (LCOP 1944c:176). To counteract rumors of plant shut-down, a large article was placed in the *Kansas City Star*. This article placed emphasis on stepped up production at the plant and the new 20-mm loading facility (LCOP 1944c:186). At times, a rumor started and swept through the entire working force before it could be counteracted (LCOP 1945d:309). Many were identifiable as to the source, some were entirely ridiculous in nature and so far-fetched as to be recognized immediately as rumors, and some contained a grain of truth which made their recognition difficult. One favorite topic was the postwar use of the plant. These rumors had the plant being used for the manufacture of cellophane baby buggies, nylon hose, barbed wire, 105-mm shell loading, manufacture of .22-caliber sporting ammunition, and the establishment of an Army hospital (LCOP 1945d:309-310).

The disposition of various items after the war was also a fruitful source of speculation. One account, generated from a small local town from which a number of employees had been hired, had all plant refrigerators dragged by log chain and dumped in the plant ditches. From the same source came the rumor that all ammunition on hand was to be dumped in the Missouri River and still another version had all buildings being torn down (LCOP 1945d:309). Numerous tales were told of plant employees who had built houses and bought automobiles from the sale of lumber and other materials carried from the plant site. The most prolific source of rumors seemed to be the guard force, the bus drivers, and the firemen, all of whom had contact with large numbers of employees (LCOP 1945d:310). The "prize story of all" concerned an employee of the production lines who was noticed to have had an unusually plentiful supply of .22-caliber sporting ammunition. Proposed investigation disclosed that this mystery employee had, in some corner of a production building, managed to set up his own private production line using plant equipment (LCOP 1945d:310). Since this story was apparently believed in its entirety, it illustrated the extent to which rumors reached and how difficult they were to combat. At LCOP, there was always the need for great care in discussion of any classified project, and the greater the secrecy surrounding the project, the more numerous and outrageous the rumors.

The greatest danger was in careless statements that did not on first thought seem harmful. Employees were warned that "[t]hey endanger lives of those who work in the plant and hinder production. . . . They may even cause injury and death to those in the fighting forces by disclosure of information to the enemy" (*Lake City Tracer* 3 October 1942). Employees working at a factory in the heart of the American midwest may have considered themselves far from the war front; however, during their daily activities at LCOP, many were exposed to information that might have proven valuable to the enemy. These matters included information concerning the shipment of materials, the numbers of LCOP employees, knowledge of other GOCO plants, knowledge of the movements or locations of military forces, manufacturing methods, manufacturing costs, and types of products being made (*Lake City Tracer* 3 October 1942). Many of these topics may have been harmful if known by the enemy, and other statements—while seemingly harmless—if repeated could have given a distorted view of the facility to the general public. Even the employee newspaper, the *Lake City Tracer*, was reviewed by the government before distribution; it contained:

> [o]nly articles that pertained to the operation of the plant, like . . . about people that worked here and about production and things like that. That was a contractor newspaper. See, these plants were government-owned and contractor-operated, and the newspaper was run by the contractor, but it had to be reviewed by someone from the government to make sure that an article didn't get in there that would bring embarrassment or anything to the plant [Pollard, interview 1995].

A thorough study of rumors in GOCO facilities and their effects would be a valuable contribution to the U.S. World War II history.

Even the apparently mundane aspects of the LCOP had a great effect on the employee morale and production. The production of small arms ammunition and the consumption of food went hand in hand at the plant. The five plant cafeterias included four large ones located in each of the four main production buildings. The total capacity per meal was 5,800 people. World War II-period cafeteria statistics were reported in a local newspaper article (*The Odessan* 10 September 1943). To operate the cafeteria required 530 employees: cooks numbered 36, and there were an additional 46 bakers. A nutritionist was hired to watch food balance in the daily meals. Preparing meals was no small task with the war-time rationing. The weekly quota for eggs alone numbered 43,200; 1,084 pounds of butter was melted on rolls or muffins per week; and 6,000 rolls were eaten a day. The LCOP employees enjoyed tons of high-vitamin salad cut up by 30 salad girls each day. Coffee led the list of drinks, numbering 12,000 to 15,000 cups a day, with milk being consumed at the rate of 9,000 pint bottles a day. In June 1943, the cafeterias at LCOP received a new and valuable addition. Henry Woods, a "sugar worker" of national recognition, joined the staff as baking chief (*Lake City Tracer* 1 June 1943). Woods was for 22 years pastry chef at the Hotel Muehlebach in Kansas City.

Remington relied "wholly upon the Central Boarding and Supply Company for the proper and efficient feeding of its employees on all shifts round-the-clock" (LCOP 1944b:Appendix E). The prompt feeding of the employees was an "important factor in the maintenance of efficient operation of the plant" and proper feeding was "essential to the health and morale of the employees" (LCOP 1944b:Appendix E). With the increase of employees in the summer of 1944, there appeared unsatisfactory sanitary conditions in the eating places of the cafeterias. The cafeteria workers were unable to clear and clean tables, or to keep the floors clean during the meal periods. This condition was caused by a shortage of help to do such work. Cafeteria service was also slow, causing employees to spend more than the one-half hour allowed for lunch eating. This was true even with the lunch periods being staggered over a three-hour period. Remington estimated that 6,500 man-hours per month were being lost due to slow cafeteria service, which in turn was due to an underemployed staff (LCOP 1944b:Appendix E). The shortage of help was due to the low wage scale of the Central Boarding and Supply Company. With Remington, which was having a difficult time finding workers, paying them 75 cents per hour and the cafeteria workers only receiving 55 cent per hour, it is no wonder the cafeteria was short-handed (LCOP 1944b:Appendix E). To help to ultimately meet production schedules, a wage increase was requested and granted by the Regional War Labor Board VII.

Since the cafeteria was run under a subcontract with the Contractor-Operator, the government had little control over the activities. The following conditions also complicated the cafeteria problem: (a) difficulty of securing a rival subcontractor who might replace the current operator if so desired (feeding employees on such a large scale was not attractive to most restaurant operators); (b) food shortages and high prices made menu planning and food preparation difficult; (c) high wages increased demand for better foods which were more attractively prepared; (d) lower wages paid by cafeteria operators compared unfavorably with wages paid to production employees; (e) with the grade of help obtainable, sanitary conditions were difficult to control; (f) audits of cafeteria records were frequently unsatisfactory, with the result being that percentages of profit and other pertinent facts were difficult to determine; (g) there was a shortage of State Board of Health inspectors to the extent that only one survey of sanitation conditions was made, and that approximately 60 days before termination of production (LCOP 1945d:301).

Of the cafeteria operation, Remington complained that "the cost of goods sold with respect to the dollar value of sales appears to be from six to eight percent low. . . and the ratio of net profit to sales . . . of 6.69 percent is high, inasmuch as 6 percent is considered a fair profit for operating a cafeteria when the cafeteria operator is assuming risk and has assumed the investment necessary for the operation" (LCOP 1945d:302). It should be mentioned that the LCOP cafeteria operator assumed no risk and his investment was relatively small. The sole State Board of Health survey revealed numerous points for correction, including ineffective screening against flies; chipped or corroded enamelware in use; improper cleaning of utensils, workboards, and dish washing machines; water used for sterilization of too low a temperature to accomplish its purpose; and improper storage of bulk foods, which allowed rodent infestation (LCOP 1945d:303). The Ordnance Department asked for and received an additional inspection by a local food specialist whose services had been made available by the Quartermaster Depot of Kansas City. This inspection, performed after the State inspection, was not unfavorable toward prices charged, variety of menu, handling of food, sanitation, and profit made by the operator (LCOP 1945d:304). The cafeteria situation was never entirely satisfactory to either the management or the employees of LCOP, and the effects of this situation upon employee morale deserves further study.

Interestingly, contrary to the information obtained from archival documentation, oral interviewees mentioned no dissatisfaction with the cafeteria's quality. Cornelius Lundy (interview 1995) remembers the food as "good, good, man, good," and Rosalind Priest (interview 1995) remembers that "they had a good cafeteria . . . just everything you wanted. It was really good, and it didn't cost very much,"

During World War II, the concept of efficiency, already venerated in American culture (Kane 1995), took center stage. The intensified focus on efficiency reached nearly every aspect of American life, from the battlefront to the home front (Kane 1995:230). At the LCOP, efficiency was influenced by a worker

suggestion campaign. This led to quality products being produced and shipped to the front lines. All suggestions were first studied by a committee and, if considered of value, were recommended for approval. Suggestions which resulted in machinery changes to increase production, improve quality, reduce cost, conserve material, or improve safety hazards were given closest attention. Suggestions of a more tangible nature were not barred, but were more difficult to evaluate. The suggestion system encouraged natural inventiveness, made available all beneficial suggestions and improved industrial relations (LCOP 1944b:218). During the year of 1944, total cash awards of $6,807.50 were paid to plant employees. These awards were a reimbursable item under Remington's prime contract. One example of a suggestion was that of Jerry Ordeal, who submitted the idea of replacing a small part found on many production machines (*Lake City Tracer* April 1942). The original part was constantly breaking and difficult to replace. The substitution was made of less expensive metal, and at the same time substantially reduced the amount of discarded product produced by the particular machines. In order to make it easier for suggestions to be given, a large number of red, white, and blue suggestion boxes were installed in convenient locations throughout the plant. Mr. Cornelius Lundy recalls the words of a supervisor who encouraged suggestions:

> I remember I was cleaning up the plant manager's office one day, and . . . I think I made a mistake . . . something, I did something, and he said . . . that's all right . . . I wouldn't want a person to work for me that didn't make a mistake. He say, you see all these pencils . . . he say you don't see no ball pens, you see all pencils, he say I writes with this pencils . . . cause I makes a lot of mistakes and I have to erase . . . but if I write with that ball pen . . . I can't erase. And he went on to say that we gets half our ideas from you all, we gets half our ideas . . . you all down at work, you operating that machine . . . but I wouldn't know how to go down there and start that machine, see, but you do. He say we get your ideas . . . and he said we're here for each other [Lundy, interview 1995].

A general patriotic atmosphere supported by cash awards created numerous suggestions, which in turn increased efficiency of production and quality of the product. In comparison with other GOCO small arms ammunition producing plants, the quality of LCOP's products ranked neither high or low (LCOP 1945d:Appendix D). However, with nearly every type of cartridge produced, a general improvement in quality was obtained throughout the war.

Effect of the End of the War

While several GOCO facilities were closed before the end of the war, LCOP remained in production for the duration. As the Axis powers collapsed, Hitler committed suicide in his Berlin bunker on April 30, 1945. Several days later the last German forces surrendered. In the Pacific Theater, the noose around Japan was tightened with the capture of Okinawa in June and the annihilation of the remnants of the imperial navy. Allied strategy was to invade Japan late in 1945; however, the development of the atomic bomb made this unnecessary. On August 6, the first atomic bomb was dropped on the city of Hiroshima, and three days later a second device was exploded over Nagasaki. Faced with this appalling weapon, the Japanese surrendered on August 14. On September 3, Japanese and Allied delegations signed the document of surrender ending World War II.

At the LCOP, the summer of 1945 was a contradictory period in the field of personnel requirement and production. The emphasis changed from increased to decreased production more rapidly than had been the case at any previous time. V-E day, May 8, 1945, was a day of "business as usual" at LCOP. While stores, restaurants, and theaters in Independence and Kansas City were closed and special services were held in all churches, a full schedule was worked on all shifts at the plant. The general attitude of employees was one of thankfulness sobered by the realization that production must be continued to end the war in the Pacific. An announcement to all employees stated that production schedules were to be decreased by no more than six percent (LCOP 1945d:Appendix F). Although production schedules were reduced as expected after V-E

Day, there was a noticeable undercurrent of cautious anticipation of a long, drawn-out struggle in the Pacific theater coupled with a belief that experimental postwar production would be carried on (LCOP 1945d:292).

On June 27, 1945, notice was received at LCOP that reductions in small arms ammunition requirements, as well as existing stockpiles, made it possible to reduce production schedules by approximately one-half (*Lake City Tracer* 30 June 1945). On August 14, the day Japan surrendered, cancellations covering the greater portion of the manufacturing operations were received at LCOP. The cancellations necessitated the termination of approximately 5,350 employees (*Independence Examiner* 17 August 1945). The only occurrence in connection with Japan's surrender which affected ongoing work at the plant was the announcement of the surrender at approximately 6 p.m. on August 14 (LCOP 1945a:316). Preparations had been made with local bussing companies, and all employees immediately left the plant following a prearranged signal of 18 blasts on the fire siren. All machinery was closed down, and no damage of any kind was done. Employees departed in an orderly fashion and by the president's proclamation did not return to work until the morning of August 17.

Three days after the Japanese surrendered, the Kansas City Chamber of Commerce held a meeting to establish what the status of local business was and to start thinking about reconversion to peace-time operations (*Independence Examiner* 17 August 1945). Discussed were the possibilities of bringing new industry to the Kansas City area and the encouragement of war workers to return to their prewar jobs. Kansas City area business leaders felt certain that unemployment would be temporary and that expansion of local small industries would take place (*Inter-City News* 17 August 1945). The Kansas City area looked forward to expansion of the Standard Oil refinery in Sugar Creek, a new General Motors' Oldsmobile assembly plant, and the immediate expansions of several smaller businesses. Rural commercial districts in Kansas City were formed to brighten up, clean, and advertise their advantages.

With the discontinuation of all production at LCOP, a small force of approximately 1,200 was kept to help Remington "check out and for the machinery and equipment to be put in standby condition" (*Inter-City News* 31 August 1945). At 12:01 on December 1, 1945, Remington turned LCOP over to the government, relieving itself of all property accountability and responsibility and bringing to a close one chapter in the industrial and economic history of the local community. The LCOP payroll poured many millions of dollars into the local economies during the war, and local businesses had always been busy. The presence of the plant was also a great boost to local patriotism (*Independence Examiner* 30 August 1945). While the LCOP brought opportunities to the local communities during the war, it left these communities with a great responsibility at the end of the war. It appears that the general attitude of local business and community leaders can be summed up by the following contemporary newspaper account:

> as we think of Lake City we look back upon four years of lush wages, big savings and free spending—a pleasant experience that came to us because of the war and without any effort or planning of our own. We enjoyed it while we had it and we profited by it. Now we look to the future and realize that what is done will be of our own planning and our own investment of energy and money or of our ability to induce outside capital to come in and grow and prosper with us [*Independence Examiner* 30 August 1945].

While much has been written concerning the effects of the returning World War II GIs, detailed local studies of the shut-down of GOCO facilities and other war-time manufacturing plants may bring to light interesting aspects of the United State's post-World War II experience.

OVERVIEW OF THE POSTWAR YEARS

When the LCOP was taken over by the government at the end of World War II, the installation's name was changed to the Lake City Arsenal. The LCA was designated as a standby small arms ammunition facility

and remained in such status until 1950. During this period, the total installation population at any one time was approximately 300 (LCA 1947:2). The prime mission of the LCA was the protection and maintenance of the basic buildings; machinery; and equipment, tools and facilities that were necessary to meet future needs for small arms ammunition. Additional responsibilities included the receipt, storage, issue, inventory, upkeep of property records, surveillance, inspection, and preservation of War Department permanent war reserve machinery and equipment and stocks of small arms ammunition, components, materials, and explosives necessary to meet its primary mission (LCA 1947:2). LCA was also to perform assigned manufacturing, repacking, and demilitarization operations as directed by the Chief of Ordnance. An installation analysis summary undertaken during this period stated that LCA was an ideal beginning of a small arms ammunition manufacturing arsenal and that it should be retained permanently by the War Department (LCA 1947:18). The summary further stated that LCA should be developed and utilized in every conceivable manner as a model and as a key facility for manufacturing small arms ammunition (LCA 1947:18).

In August 1950 Remington was advised that a partial reactivation of the LCA was anticipated (LCA 1951:1). While this originally involved 25,000,000 .50-caliber ball and 75,000,000 .30-caliber armor-piercing rounds, production schedules were soon increased. These included the manufacture of ordnance never before produced at the facility. New ordnance production included manufacture and assembly of 30-mm rounds and M505 fuse load and assembly (LCA 1956:7). By July 1951, cartridges were rolling from the assembly lines, and several production schedules had been met (LCA 1947:1). By the beginning of June 1952, all manufacturing buildings were running three shifts, six days a week, and 5,621 people were employed in the production section (Remington Arms Company 1967:22). By the end of June, an employment peak of 11,622 people was reached (*Independence Examiner* 25 January 1972).

Production continued in much the same manner as it had been done during World War II, with the same emphasis on quality, quantity, and safety. Some difficulty was realized during the Kansas City flood of July 1951 (LCA 1951:3); as many roads were flooded, many employees had to drive as much as 90 miles out of the way to get to the plant. Difficulty was also experienced in procuring lead as buyers were not able to order the quantities that were required. Requisitions for unplaced orders totaled approximately 4,000,000 pounds, and attempts were made to purchase pure pig lead from South American sources (LCA 1951:6). Housing, which had not been a major difficulty during the World War II operation, became more of an acute problem, and every effort was made to assist employees in this area (LCA 1951:7). Lack of spare parts also presented some difficulty (LCA 1951:9). A continued emphasis was placed on securing parts from outside of the plant and making parts in the machine shop. While a shortage a general labor had eased by the fall of 1951, machinists, tool makers, machine tool operators, electricians, draftsmen, and engineers were in critically short supply (LCA 1951:10). To alleviate this problem, recruitment trips were taken to local and distant communities.

Production continued until the Korean Armistice. With the signing of the Treaty of Panmunjon in July 1953, schedules were reduced at LCA, and by 1960, only 383 were employed in the production section (Remington Arms Company 1967:22). Between the Korean and Vietnam conflicts, production continued at the LCA on a small scale. In 1958, a new world's safety record in the sheet metal industry was presented to the LCA when 12,719,299 man-hours were completed without a lost-time injury *(Lake City Tracer* February 1958). In 1959, Dr. Benjamin Shratter of LCA and A.J. Wysoczanski of the Pitman-Duun Laboratory at Frankford Arsenal demonstrated a new machine which they had invented (*Independence Examiner* 10 February 1959); the electronic eddy current flaw detector was the only one of its kind that had been successfully tested. Its primary value was that it eliminated defective parts before they were assembled into complete rounds.

The most interesting undertaking at LCA between the Korean and Vietnam conflicts was the facilities involvement with the Davy Crockett weapon system. This man- and jeep-portable weapon system was disclosed publicly in June 1960. It was a low yield tactical nuclear weapon with an atomic warhead that held considerable destructive force. The effective radius was small enough that troops using the weapon, nearby friendly troops, and civilian populations would not be endangered by the blast. The system was described

by Secretary of the Army Wilber Brucker as being able to "significantly enhance the military posture of U.S. ground forces," giving them "organic atomic power which they will be able to take with them to any trouble spot in the world in a matter of hours" (*Lake City Tracer* June 1960). LCA's part in the Davy Crockett development included the manufacture and testing of the system's M101 spotting round. Fired from a 20-mm rifled barrel, this round produced a flash and white smoke in the target area that permitted the warhead-carrying projectile to be zeroed in on target (*Lake City Tracer* July 1963). The component parts of the M101 spotting round included a charged projectile body which was made from a heavy metal.

By the late fall of 1965, the government decided that the Davy Crockett system was not practical. This decision instigated its withdrawal from frontline deployment in Germany and a discontinuation of manufacture. The system's main drawbacks were its relative inaccuracy and that the special handling required for its nuclear warhead limited its use in frontline situations. Secretary of Defense Robert McNamara, before closed sessions of congressional committees, belittled the system as virtually worthless (*Kansas City Times* 28 May 1965). With the end of the system, there was no need for the LCAAP to produce the spotting projectile.

The early 1960s saw the destruction of several interesting World War II-period structures at the LCA. These included the horse stables and blacksmith shop and the last of the eight temporary wooden barracks (Figure 40). Due to reorganization of the Army, the facility's name was changed to the Lake City Army Ammunition Plant in November 1963 (*Lake City Tracer* November 1963).

Escalating conflict in Southeast Asia brought on higher production schedules in 1966. All manufacturing buildings were put in operation and many former employees and new employees were hired. During the Vietnam War, production employment peaked at 5,047 (Remington Arms Company 1967:22). As with the former major-production periods, quantity, quality, and safety were emphasized. Safety procedures were not only stressed, but apparently followed, as on December 5, 1969, Remington employees completed 19,837,015 exposure hours without a lost-time accident. This was a new world's record for the sheet metal industry (*Lake City Tracer* December 1969). One LCAAP employee was killed, however, on May 8, 1968, when the forklift he was operating overturned (*Independence Examiner* 9 May 1968). Apparently this accident was not calculated in the exposure hours which accumulated to the record mentioned above.

Early 1971 saw both racial bias charges in employment practices (*Kansas City Star* 1 January 1971) as well as a production slow down and the ensuing employee layoffs. Only one year later, the plant hired an additional 3,200 employees, and shortly thereafter more government contracts were added (*Independence Examiner* 25 January 1972; *Lee's Summit Journal* 13 April 1972). June 1972 also saw allegations of racial bias charges and unfair rehiring in employment practices reemerge as women picketed at the front entrance of the plant (*Kansas City Star* 20 June 1972). These women complained that in 1971 they were given the choice of "heavy exertion" jobs—which required lifting up to 100 pounds and shoveling snow—or being laid off. A finding by the federal Office of Contract Compliance turned up no evidence of discrimination in employment practices (*Kansas City Star* 16 October 1972).

After the U.S. pulled out of Vietnam in 1975, the need for large amounts of small arms ammunition dropped. Today, due to the reactivation of other Army ammunition plants and the lack of participation in a major conflict on the part of the United States, the demands on LCAAP have eased, and production requirements are presently below peak levels.

Several important events and changes have taken place at LCAAP since 1975. In 1985, five LCAAP employees and one subcontracting equipment supplier were indicted on charges of defrauding the U.S. Army (*Kansas City Times* 14 June 1985). The subcontracting equipment supplier overbilled the government for

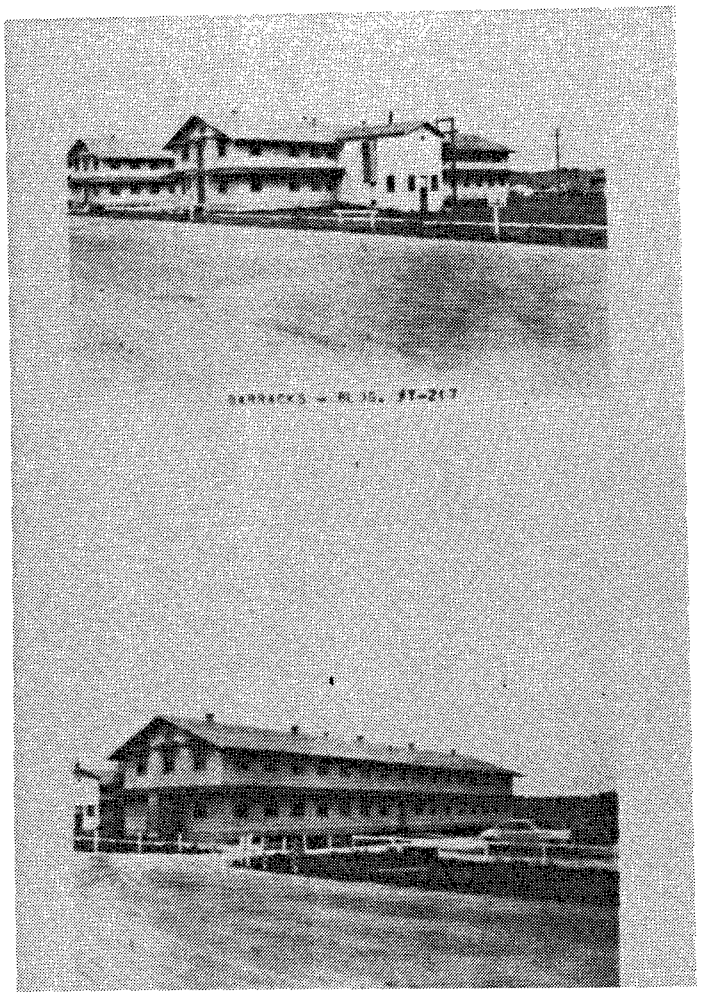


Figure 40. Typical barracks structure at LCOP, World War II era. View NE (original photograph on file, LCAAP).

more than $200,000, while the employees submitted bills to Remington for equipment that was never delivered. The indictment alleged that most of the equipment was diverted to personal use.

Also in 1985 came the biggest surprise since the decision to locate the facility in Jackson County. The government made a decision to award the Operator-Contractor contract to a firm other than Remington. Remington had operated the facility since its creation in the early 1940s. On July 3, 1985, the *Wall Street Journal* reported that the Olin Corporation had received the Army contract, for as much as $200 million, to operate the munitions plant at Independence, Missouri (*Wall Street Journal* 3 July 1985). This choice surprised Remington employees but company officials announced that "[w]hen you're in competition, you have to expect that someone else might win" (*Blue Springs Examiner* 5 July 1985). Plant employees were somewhat apprehensive, and in the absence of any solid statement by the Army as to why Olin was selected over Du Pont and five other bidders, many felt that personal relations between the Army and Du Pont management may have contributed to the Army's decision (*Daily News* 16 July 1985). Through its Winchester Group, Olin Corporation had vast experience in operation of government ammunition facilities. During World War II, the company produced more than 15 billion rounds of small-caliber ammunition at its plants in East Alton, Illinois; New Haven, Connecticut; and at the GOCO St. Louis Ordnance Plant. At the time it became the LCAAP Contractor-Operator, Olin Corporation managed the Badger Ammunition

Plant in Baraboo, Wisconsin, and a recently acquired subsidiary, Rockcor, Inc., operated the 21,000-acre arsenal at Ravenna, Ohio (*Daily News* 16 July 1985).

A third major development at the LCAAP since 1975 has been the introduction and use of high-speed, computer-monitored machinery. During the 1970s, equipment for a new method of highly automated small arms ammunition manufacture was tested at the Twin Cities plant. The equipment had been manufactured as a result of the government's Small Caliber Ammunition Modernization Program (SCAMP; Mac Donald and Mack 1984:38-40; William Melton, personal communication 1995). At the Twin Cities plant, the equipment was soon put in layaway and shortly after, transferred to the LCAAP. The LCAAP received the new equipment in 1977. The SCAMP equipment did not replace the older World War II period machinery; rather, it was an addition to the existing facilities. This addition, which included five separate lines, replaced existing machinery in Building 1, which had housed .30-caliber manufacturing machinery during World War II. The building had undergone "refurbishing" in 1975-1976. The SCAMP equipment was installed between 1976 and 1978. In 1978, a month-long test run of the equipment began, and by December of that year, production began on 5.56-mm ball ammunition. With the new equipment, four operators could run an entire production line. At first, the system did not appear to be an improvement on the old manufacturing process, but in time it proved to be more efficient (William Melton, personal communication 1995). An existing problem with the system is that of electronic obsolescence, with electronic parts having a life-span of approximately five years before they are outdated.

ENVIRONMENTAL LEGACY

Construction of the GOCO facilities altered the landscape where they were constructed, most likely resulted in the destruction of cultural resources, and entailed the destruction of many prewar structures (Kane 1995:239). The installations have also had an impact on the natural environment. While some effects were positive, such as the isolation of certain plant and animal species, there were many adverse environmental effects with long-lasting consequences.

During the initial construction at LCOP, various wells within the plant limits were tested for contamination by the Jackson County Health Engineer (*Independence Examiner* 6 March 1941). This, as well as constant inspection of sanitary facilities, was undertaken as a precautionary measure when the number of construction workers rose. The testing did point out, however, that all parts of the plant were free of water contamination. As the need for small arms ammunition increased, emphasis was on quantity, the quality of the final product, and the immediate safety of the workers. While long-term worker safety precautions were shown by carbon monoxide poisoning testing (LCOP 1943c:24) and precautions taken with lead dust during the manufacture of frangible rounds, the World War II emphasis was placed on the employees rather than the environment. The facility design did include both a sewage treatment plant and an industrial waste treatment plant. It was originally proposed that all process water would be treated and used again in the manufacturing process (USACE 1943:177). After construction had started, this plan was discontinued as it was believed an insufficient amount of water could be recycled. After the abandonment of this plan, an agreement was reached with the State Board of Health that the waste process water could be discharged directly into two small streams which drained the area until the plant was in operation. When production began and representative waste water was being produced, the necessary treatment, if any, could be determined (USACE 1943:177). After the plant was in operation, a detailed study was undertaken This included the participation of representatives from the Des Moines, Twin Cities, and Denver GOCO plants. Because no instance could be found of treatment of similar waste at any other facility, an experimental small-scale plant was erected and operated over a period of several weeks. During this operation, various schemes for treatment were attempted, and experimental equipment was set up and operated. After testing was completed, the treatment proposed included one central plant. This facility was set up close to the water conditioning plant and handled the process water from most manufacturing facilities. The major proportion of wastes from the manufacturing process consists of the discharge of large quantities of wash water

containing soaps, oil, salts, and acids used in "pickling," as well as copper and zinc dissolved from the metal. After extensive processing, water was placed in four sedimentation lagoons. Waste water from Building 83, a Nitrator House, passed through a special disposal tank and into a small pond southeast of the building. The waste from the south wing of Building 35, the Primer Manufacturing building, passed through special neutralizing tanks and emptied into the sewer system. In many of the other buildings where powder or hazardous chemicals were mixed or processed, water was caused to filter through cloth bags prior to its discharge into the sewer or open ditch.

While probably not an intentional disregard, neglect for the environment was shown at the end of the war when the facility was placed in standby status. A complete decontamination program was undertaken on equipment and buildings only (LCOP 1945a:315-316). During this process, unusable equipment was dumped into at least one lagoon (LCOP 1945a:List of Buildings Processed and Accepted for Storage).

As time progressed during the Cold War years, more attention was paid to environmental issues. It appears that the World War II-era water treatment facilities, with the addition of a cyanide waste treatment facility, continued to be used (*Lake City Tracer* September 1963). In April 1965, it was reported that "by the time industrial waste water from the main manufacturing buildings reaches [the] last settling lagoon from which it flows to the drainage ditch and thence to the area streams, it is free of all contamination" (*Lake City Tracer* April 1965). A reforestation program was begun in 1965. This called for the clearing of shrubs and undesirable trees and the planting of 70,000 pine and 26,000 walnut seedlings (*Lake City Tracer* July 1965). The early 1970s saw a rise in environmental awareness. Remington's established program of air, water and soil pollution control was strengthened. Also, programs at LCAAP continued in which substitute components or manufacturing processes eliminated potentially dangerous substances (*Lake City Tracer* June 1971). For example, carbon tetrachloride had been used in making cake for igniter. By experimenting it was found that methyl chloroform could be substituted, the new substance being 50 times less toxic. Air pollution was first controlled with the elimination of burning dry wastes, with once-burned trash being buried on the plant facilities. Later a toxic waste incinerator with emission controls was constructed at the plant.

While environmental protection policies were followed somewhat during the early years of the plant's existence, and expanded upon in later years, contaminated areas did develop, one example being the contamination of the Firing Range by the Davy Crockett system's M101 spotting round which was tested at the LCOP. In the last 20 years at the plant, environmental contamination studies and attempts to clean toxic waste areas have been undertaken. In 1985, the Army submitted a plan to the Missouri Department of Natural Resources to close seven of its 11 waste lagoon ponds at the LCAAP (*Blue Springs Examiner* 20 July 1985). In 1994 an environmental assessment was conducted for the LCAAP (LCAAP 1994); the purpose of this document was to provide a basis for evaluating the environmental impact of activities that occur at the facility. It addressed all current waste management practices in general, but only certain past disposal areas in detail. Although the waste management practices have changed, the waste characteristics from the production facilities have not. Some solvents have been replaced or discontinued, but because the production processes have essentially remained the same, many of the chemicals used today are the same as those used in the 1940s. The environmental assessment declared a finding of no significant impact because of the following: there is no impact on the fauna or flora in the area; there are no species listed or proposed on the federal list of endangered or threatened species within the plant boundary; and there is no significant degradation of environmental quality, public health, or safety as a result of LCAAP's continued operation.

To mitigate the adverse effects of past operations at the plant, an Installation Restoration Program has been set up and is currently in progress. This program has investigated numerous past disposal sites at LCAAP. During the investigations of these sites, contaminated groundwater was found to be the greatest threat to human health. Corrective measures are being planned and will be in place in the near future (LCAAP 1994). No evidence of off-plant contamination has been found.

SUMMARY AND CONCLUSIONS

The Ordnance Department's GOCO industrial facility program has been described as not only reflecting a number of nationwide historical trends that took place during World War II, but as being a significant catalyst for change during both the war and the postwar years which followed (Kane 1995:243). The LCAAP helped to define the experiences of people in the Kansas City area and beyond; these experiences took place during the Second World War and continue to the present day. The national historical significance of the LCAAP is perhaps best understood within the context of U.S. rearmament in 1940-1942 and the role of supplying large amounts of materiel in the defeat of the Axis powers. The U.S. was lacking in defense industries when it began to rearm in 1940; however, by 1941 it was sending large shipments of war materiel to its overseas allies. The shift in public opinion that made the GOCO program politically acceptable in 1940 was signaled by the fall of France and fostered by the Roosevelt administration. The alliance between big business and the federal government that developed and intensified between 1941 and 1945 produced the largest sustained expansion in history.

During World War II, LCOP contributed over five and one-half billion rounds of small arms ammunition to the fight against the Axis powers. In addition, millions of rounds made at other plants were unpacked, reinspected, and repacked at LCOP, and numerous experimental projects facilitated the production of small arms rounds. The Lake City area was chosen for a GOCO ammunition manufacturing facility for strategic, technical, and economic reasons. Preinstallation-era investigations revealed a fair employment market, and this was the case up until the time when other war-time industries had been established in the Kansas City area. After this, the plant was frequently in need of employees.

LCAAP, like many GOCO facilities, was constructed in record time, and production far surpassed what was expected. It had undergone the majority of its construction before major changes were prompted in GOCO architecture and engineering design. Additionally, this facility was the first of the small arms ammunition plants to be constructed. Kane (1995:244) has stated that of all architecture and engineering considerations, the least data are available on the typical plans for facilities that were developed during the years between World War I and World War II. The construction of the LCAAP demanded a close working relationship between the government and Remington; this relationship had been fostered between the world wars through cooperation in the development of typical plans. While data exist which illustrate this working relationship, little has been found during the present investigation which will shed light on the typical plan designs for GOCO facilities. It is known that during the planning of the main manufacturing units for LCOP, the process was laid out in such a way that basic raw materials would enter at one end and the finished product would be stored and shipped at the other end. Each unit was to be a self-contained factory, including machine and maintenance shops, a cafeteria, changing areas, first aid stations, and other supporting facilities. Also, many small changes were made before the adoption of the final plans. The final architectural and engineering forms reflected the industrial function in the design of the individual buildings and in the overall layout of the plant.

All structures at the LCAAP have been evaluated for their historic architectural significance and several have been designated as Category III Historic Properties (MacDonald and Mack 1984:53-54). These structures include: Building 1, currently used for SCAMP 5.56-mm ammunition production; Building 2, currently used for 7.62-mm ammunition production; Building 3, currently used for .50-caliber ammunition production; Building 5, the Administration building (Figure 41); Building 10, the tool and gauge building; Building 11, the lead shop; Building 15, the boiler house; and Building 35, the primer manufacturing building. Constructed in 1941, these eight buildings were designed by Smith, Hinchman and Grylls, Inc., and served as prototypes for the major administrative and manufacturing facilities built at first and second wave, small arms ammunition manufacturing plants in Denver, Colorado; Des Moines, Iowa; New Brighton, Minnesota; and Salt Lake City, Utah. The Administration building and the tool and gauge shop survive in virtually their original form, while the other six buildings have been altered by post-World War II additions (MacDonald and Mack 1984:53). However, all retain their characteristic safety and defense features and the clean-lined

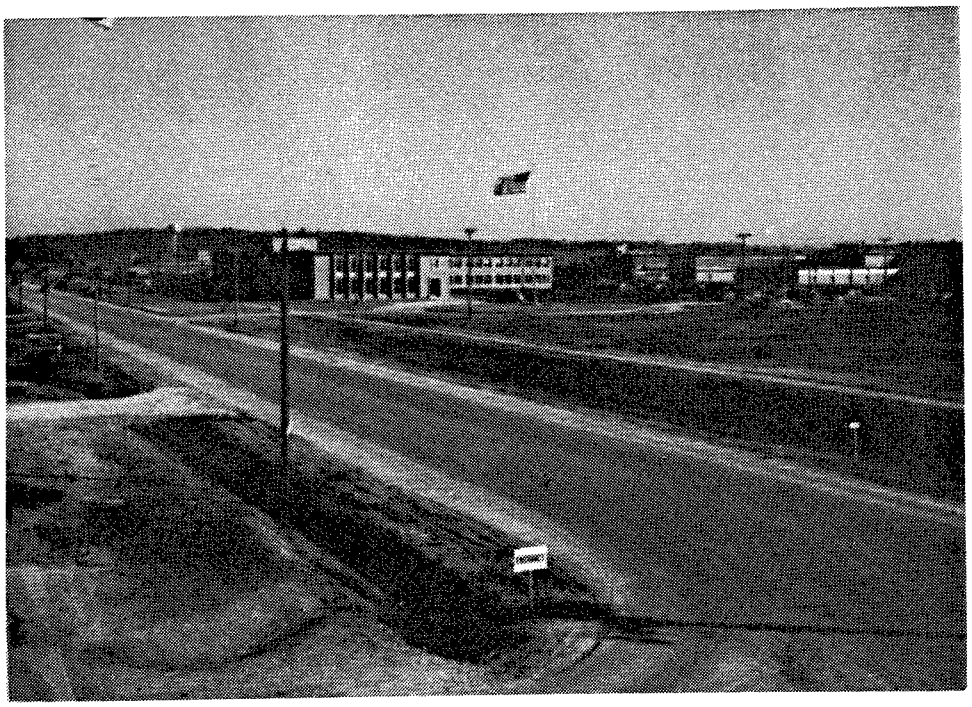


Figure 41. Administration building, World War II era. View SW (original photograph on file, LCAAP).

detailing of their original design. While several of these buildings are in standby and several are actively used for production, all are in good condition and receive routine maintenance. MacDonald and Mack (1984:51) suggest that "these properties should not be destroyed and their facades, or those parts that contribute to the historical landscape, should be protected from major modification."

As stated above, data have been developed which illustrate the working relationship between Remington and the government before and during World War II. Due to government insistence, cooperation also existed between the individual contractor-operators—who were also competing corporations—in areas such as site location, construction, machine procurement, and plant operation. It is interesting that while cooperation took place, contractor-operators were also not willing to outline some methods until success had been achieved, such as in the development of the use of NCR in relation to specifications for projectile-flight standard deviation. Further detailed investigations into such cooperation and apparent competition might shed light on business practices during the national emergency of World War II.

The GOCO industrial facilities program took place following several developments in industrial technology that permitted mass production of complicated munitions using what was essentially unskilled labor (Kane 1995:244). Several innovations in ordnance manufacture were utilized at GOCO facilities during World War II, and many more were developed at these facilities. At LCAAP, there were both simple innovations developed by operators and major technological advances which were adopted by the entire small arms production industry. Experimental and developmental work in the substitution of steel and steel clad components for brass was consistently carried on at LCOP. While the use of clad steel bullets presented difficulties that required both time and effort to resolve, by the end of June 1943, steel clad bullet jackets had replaced brass 100 percent in .30-caliber tracer and .50-caliber tracer rounds.

Steel cases presented more difficult problems, and none were actually manufactured for other than experimental purposes at LCOP. However, this experimentation made a significant contribution to the new technology. Experimentation proceeded to the point where it was demonstrated that it could be satisfactorily produced in small lots. While successful quantity production remained to be proven, LCOP personnel had no doubt that the information gained from the experimentation would be of great use if the disappearance of brass should ever force the complete conversion to steel. LCOP historical documents state that equipment was to be retained for the production of steel case ammunition and was to be processed for standby storage. Today, equipment for steel case production lines exists intact in an out-of-the-way area on the mezzanine of Building 4. Tags on the pilot steel case equipment for .30-caliber rounds are dated 1953, and it appears that this equipment was never used. Pilot steel case equipment for .50-caliber ammunition appears to have been used enough to have been contaminated with cyanide. Kane (1995:174) reports that research into the use of steel .30- and .50-caliber cases was undertaken at the Denver, Lowell, Milwaukee, and Twin Cities ordnance plants. Of these facilities, the Twin Cities plant is the only one in the present-day IOC inventory, and most of the equipment from this plant has been transferred or scrapped-out. The presence of steel case machinery at the LCOP appears to be of some significance. This will be discussed later in this report.

The LCAAP is the only current IOC facility where .30-caliber carbine rounds were produced. This ammunition differed from other types of .30-caliber ammunition in size, shape, and amount of propellant. Unfortunately, no status reports were required for standard cartridges, and defining production problems proved to be somewhat difficult. One problem was experienced in securing the desired velocity due to the extra length of the bullet. Another problem, cracks in the carbine cartridge case, was revealed by mercury crack testing. As of 1947, all the machinery and equipment for .30-caliber carbine production was in "standby under power" status and had been processed for long-term storage under surveillance. This machinery was used extensively during the Korean War. At the end of this conflict it appears that the machinery was put back on standby status. The introduction of the 5.56-mm round during the Vietnam War incorporated the .30-caliber carbine lines with the only major changes being retooling of the machinery.

Carbine grenade ammunition was used to propel a rifle grenade and during World War II was manufactured only at the LCOP. This type of ammunition had not been produced before and no specifications or drawings were available. During the development of this new cartridge, a new type of launcher, the M8, was substituted for the M6. Remington began production of the .30-caliber carbine grenade round with several hundred hand-loaded cartridges, some of which were tested by the Ordnance Department. While some trouble was experienced with the velocity and the distance traveled by the grenade due to the variation in the weights of the practice grenades, production of the grenade round was soon started. The specifications which would eventually be issued for the new cartridge would be the result of production at LCOP.

Bakalite and a lead composition plastic were compression-molded into a frangible bullet that had no actual penetration power but would shatter into powder when it hit the target. The only World War II GOCO facility to produce ball frangible rounds was the LCOP; however, the frangible disintegrating type bullet was not manufactured at LCOP but was provided by vendors as a formed slug. The production of the frangible round represented the greatest departure from standard production at LCOP. Production problems with the frangible rounds included a lead dust health hazard, difficulty in achieving a minimum variation in velocity, and holding the bullet to weight specifications while keeping to the length specifications. Additionally, bullets received from vendors tended to be five or six grains over maximum weight, and some vendors, after accepting orders, canceled their contracts for the plastic components. All of these problems caused a delay in reaching top production of this cartridge type. Production status reports state that only existing machinery was used for the manufacture of the frangible rounds. Some problems continued with the frangible rounds, and a meeting was held at the St. Louis Ordnance Plant in February 1945 to discuss these. This meeting was attended by representatives from the Frankford Arsenal, the Small Arms Division, and all GOCO plants making frangible cartridges. While it is unclear as to which of the 13 GOCO facilities were represented at this meeting, LCOP personnel were present, and it is assumed that St. Louis Ordnance Plant personnel were also involved. The fact that this meeting was held at the St. Louis Ordnance Plant indicates that this facility

may also have produced ball frangible ammunition. This adds to the GOCO contextual overview information which suggests that only the LCOP was involved with frangible ammunition production. While frangible round production continued with close control over powder weight, waterproofing, and bullet pull, some problems continued. These problems, however, were overcome in time. Very little data were generated concerning the use of plastic in the manufacture of small arms during the present investigation. While the production of .30-caliber frangible rounds included a bakalite and a lead composition plastic, this was used in the bullet which was produced by outside vendors. Its use does not appear to be significant in relation to LCOP production other than experimentation to meet government specifications.

In the summer of 1942, the responsibility for packing ammunition to be shipped to the front lines was transferred to manufacturing facilities. Innovations in packing for shipment were developed at LCOP. One method was devised whereby 69 carbine cartridge cases could be packed in a metal case. This was six more cases than had been previously packed and required a modification of the metal box, as well as a special arrangement of the cases within the box. This method was adopted by the government and made standard for this type of ammunition.

The hermetically sealed M6 metal packing can was first used at the Evansville Ordnance Plant in Indiana. LCOP began using the M6 in early June 1944. After the can was filled with ammunition, it was treated on the surface, oven-dried, and then paint-dipped. After the paint dried, the can was stenciled with a commercially prepared silk screen. A satisfactory method for applying and drying the paint proved to be a most difficult problem, complicated by a rigid salt-spray test.

During 1944, two important process changes were made in the manufacture of ammunition. The first involved the substitution of one-shot heading for all cases to replace the separate operations or pocketing and heading. The second involved replacing the 4-draw case with one made by a 3-draw process. Somewhat later, in mid-1945, the elimination of the first trim operation took place.

As World War II progressed, production modifications at LCOP tended toward experimentation and improvement of ammunition quality. This contrasted with an earlier emphasis on quantity. Experimentation led to innovations that improved efficiency and saved the government money. The adoption of gauge and weigh machines and experimentation in the use of steel as a substitute for brass in cartridge cases show that LCOP was on the cutting edge of small arms production technology. The majority of post-World War II changes included only slight modifications and retooling, and despite the many technological changes developed since World War II, the LCAAP retains much of its World War II character (Figures 42 and 43). This is especially true of the .50-caliber production lines which are almost completely unaltered and should be considered of historical significance. The .50-caliber machinery located in Building 3 has the distinction of being the nation's only intact World War II-era .50-caliber production lines (MacDonald and Mack 1984:54). Because of its rarity and intactness, the .50-caliber production equipment should receive Historic American Engineering Record (HAER) Level II documentation (MacDonald and Mack 1984:54). Also, when this machinery is retired from active service, representative examples should preserved at an appropriate military or technological history repository. The existence of apparently complete .30- and .50-caliber steel case test lines should also be considered significant. This machinery was associated with a new method of production in the history of small arms technology. While other machinery of this type was in existence during World War II, the equipment at LCOP may be the only surviving examples. It appears that the equipment has not been modified; however, its integrity of location is questionable. In its present location of the dimly lit, out-of-the-way mezzanine of Building 4, however, it conveys the feeling and association of its original World War II integrity. In all probability, this equipment is the only surviving example of its kind. Because of its rarity and intactness, this machinery should receive HAER Level II documentation. Also, when this machinery is retired from active service, representative examples should be preserved at an appropriate military or technological history repository.

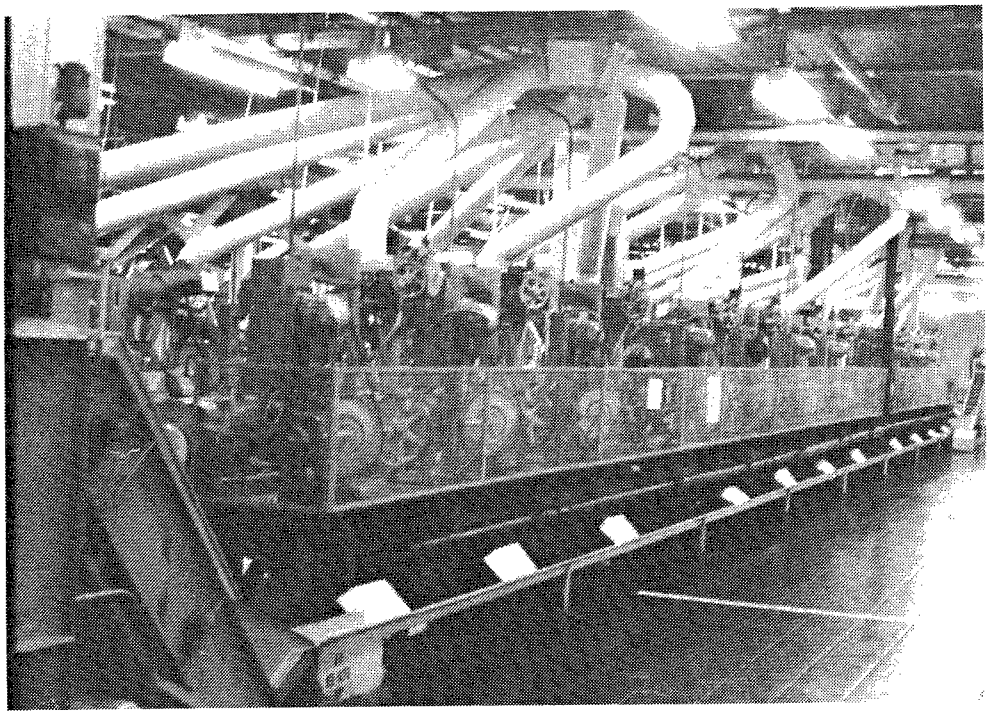


Figure 42. 7.62-mm case trim operation showing numerous World War II-era machines automated off a single drive shaft (original photograph on file, LCAAP).

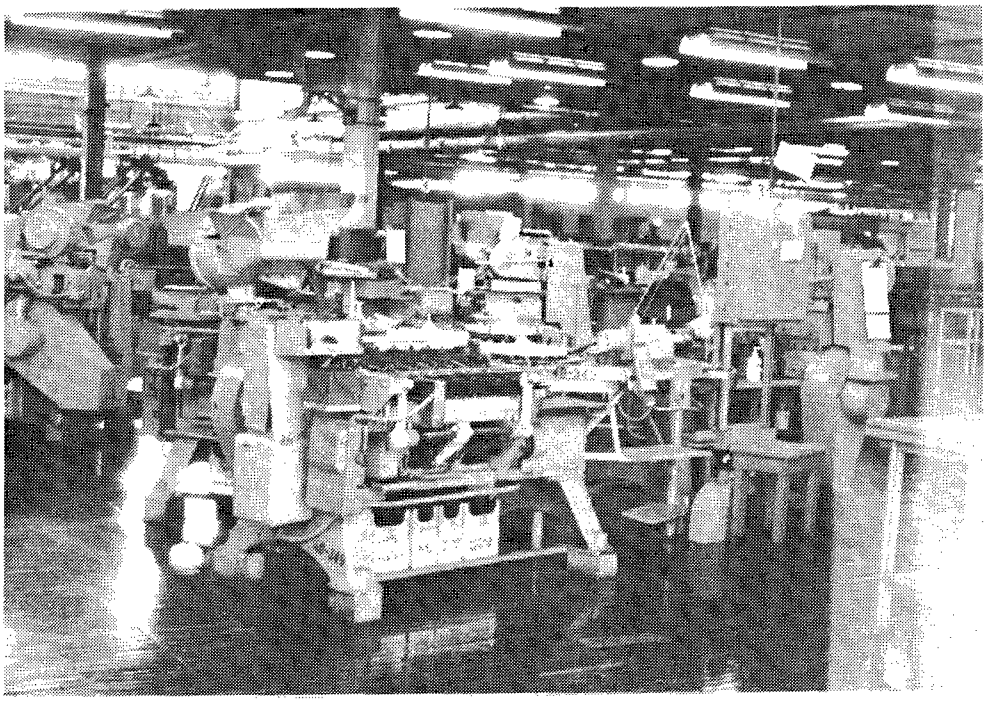


Figure 43. Semi-automated 7.62-mm gauge and weigh operation showing several World War II-era machines operating together (original photograph on file, LCAAP).

The operation of the LCOP was outstanding in several aspects. During World War II, and afterwards, the facility's safety record was remarkable. The technical skill developed and the vast quantities of small arms ammunition produced were astounding. The fact that the technical skill was developed almost entirely from unskilled labor in an agricultural community with little industrial experience is also notable. No time was ever lost to labor difficulties, and the employee loyalty to both Remington and the government was a noticeable characteristic. While there may be no reason to suspect that the human experiences of the LCOP World War II workers was fundamentally different on a national scale from that of any other large rural-based munitions plant, it offers both important insights into local historic contexts and individual experiences which, when considered on a national level, may add to our current understanding of the homefront World War II experience in the U.S. For Americans, World War II was a "people's war" against totalitarianism, militarism, and expansionism. Defense plant work paid high wages and brought prosperity to thousands of people whose increased purchasing power compensated somewhat for the wartime disruption of society. The extent to which the boomtown phenomenon which followed the LCOP to Jackson County brought about unwanted changes is unclear. This war was fought against incalculable German evil and boundless Japanese military aggression, and it seems to have bolstered the pride in American values and way of life for the typical LCOP employee. Few unwanted changes were reported in the contemporary literature, and perhaps throughout the last 50 years they have been obscured by the "good war" consensus that most Americans had during this period (Adams 1994).

The social impacts of war work at the LCOP were as significant as the economic benefits from rising wages, increased savings, and better working conditions. Faced by recurrent labor shortages, GOCO plants welcomed women and minorities into the work force. This was part of a recurring historic pattern in which large numbers of women had been incorporated into the industrial labor force during times of national emergency. While social historian Howard Zinn (1980:493) has described this process as the "escape from the prison of wifeliness, motherhood, femininity, housework, beautification, isolation, when their services have been desperately needed," it is probable that the social implications go far beyond this simple statement. Not only did men and women work side by side, but female war workers redefined the norms for dress at home and at work. Sleeveless blouses, two-piece swimsuits, trousers, and shorts reflected a redefinition of gender roles that would have a profound impact on postwar America. One important facet of the women workers' daily lives at LCOP is apparent sexual harassment. While this was no new phenomenon associated with women workers, very little concerning its part in World War II munitions production has come to light. Oral interviews with surviving woman counselors may be the best way of obtaining insights into this phenomenon.

The employment of large numbers of African Americans also took place at LCOP. During World War II, segregation was justifiable by the law and it was a common practice at the plant. While the lives of African Americans working at LCOP do not appear to have been significantly different than those of the white workers, racism directed toward the African Americans took place at the facility. Interestingly, opposition to the established segregation took place on at least one documented occasion. This opposition, which probably took place more often than the one time documented in this investigation, would be an interesting area of further study. Other potential research areas involving African Americans include the shift from unskilled labor positions to skilled or managerial positions, the extent through time with which segregation or desegregation took place, any discriminatory hiring practices, and further race relations on the job.

Efforts to record the workers' impressions of everyday life (whether they are substantiated by the archival record or not) should be initiated in a timely fashion, as many of the people working during World War II are now in their seventies and eighties. Oral history interviews should be targeted toward specific research questions, rather than being general questions concerning the plant.

During World War II there were more than 14,000 strikes, involving 6,770,000 workers; this is more than in any comparable period in American history. While several small groups of employees unionized at LCOP, the majority seem to have felt that the system was doing well enough for them without collective

bargaining. The present investigation failed to document why this was the case. Further detailed investigations might uncover information surrounding worker-management relationships.

Even with high wages and high profile public and employee relations efforts taking place, labor turnover and absenteeism were problems faced by the LCOP Contractor-Operator, with absenteeism being especially prevalent. By no means, however, was this limited to the LCOP facility. Many of the national trends in absenteeism seem to have been followed at the LCOP. These include increased female personnel who had children and home duties, increased employment of less physically fit, employment of disabled personnel, and increasing transportation difficulties due to the wearing out of automobiles. The LCOP appeared to have its own specific absenteeism factors, including the location of medical, dental, and optical treatment facilities, as well as banking facilities, at a distance from the plant and. Interestingly, a mid-1944 declining absenteeism rate corresponded to an increase in new employees, indicating that slow-down in production schedules and the resulting fear of layoff was a direct cause of the absenteeism among long-term employees.

The large number of employees coupled with secrecy due to the national emergency during World War II, created an environment ripe for the spreading of rumors and "hearsay," with the rumors growing more numerous and more outrageous the greater the secrecy surrounding a project. A thorough study of rumors in GOCO facilities and their effects would be a valuable contribution to the World War II history of the U.S.

As evidenced by at least one Remington subcontractor—the cafeteria operator— the practice of overcharging the government and presenting low quality services and goods seems to have been the norm. Perhaps investigations focusing on this topic would uncover further instances of individuals or businesses taking advantage of the government during the national emergency of World War II.

While the LCOP brought opportunities to the local communities during the war, it left these communities with a great responsibility at the end of the war. These responsibilities fell on the small local communities just as many had done when the plant arrived. The plant attracted large numbers of "outside" workers, and their presence created strains on local government resources. Associated with the LCOP were local community leaders like Independence Mayor Roger T. Sermon, who, if not partly responsible for the locating of the plant in his community, played a significant role in helping to ease the industrial transition of the community. The impact of the defense plants on local units of government has largely escaped the attention of social historians. Detailed investigations into the effects of the plant arrivals and departures on small community governments would aid in our interpretation of the World War II period homefront. Also, the LCOP may offer the opportunity to examine the war-time phenomenon of the daily movement of large numbers of individuals from urban to rural areas and back again, a phenomenon which was surrounded by its own set of particular problems.

While not the primary focus of the current investigation, research into the post-World War II operations of LCAAP uncovered several potentially historic developments associated with the installation. First was the facility's involvement with the Davy Crockett weapon system. This man- and jeep-portable weapon system was a low yield tactical nuclear weapon with an atomic warhead that held considerable destructive force. Second was the facility's participation in the development and installation of new highly automated small arms ammunition manufacturing machinery. This equipment had been manufactured as a result of the government's SCAMP. The SCAMP equipment did not replace the older World War II period machinery; rather, it was an addition to the existing facilities.

The construction and operation of the GOCO industrial facilities had a number of profound short- and long-term effects at the local, regional, and national level, and long after the end of World War II, the LCAAP's presence is still being felt. As the U.S. entered the Second World War, thousands of men and women entered into work in the war industry on the homefront. For most workers, including those at the LCOP, employment brought high wages and safe working conditions, and their new-found prosperity made it much easier to live with wartime restrictions. The average household incomes of plant employees

throughout the U.S. jumped as much as 100 percent between 1939 and 1945, and many workers were able to save money that was used to pay for homes, cars, and college tuition in the postwar period. It would also be impossible to overstate the importance of our country's participation in World War II in changing social behavior in the U.S. The LCOP left a noticeable impression on both rural Jackson County and the urban Kansas City area, with plant workers remembering the years 1941-1945 favorably.

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