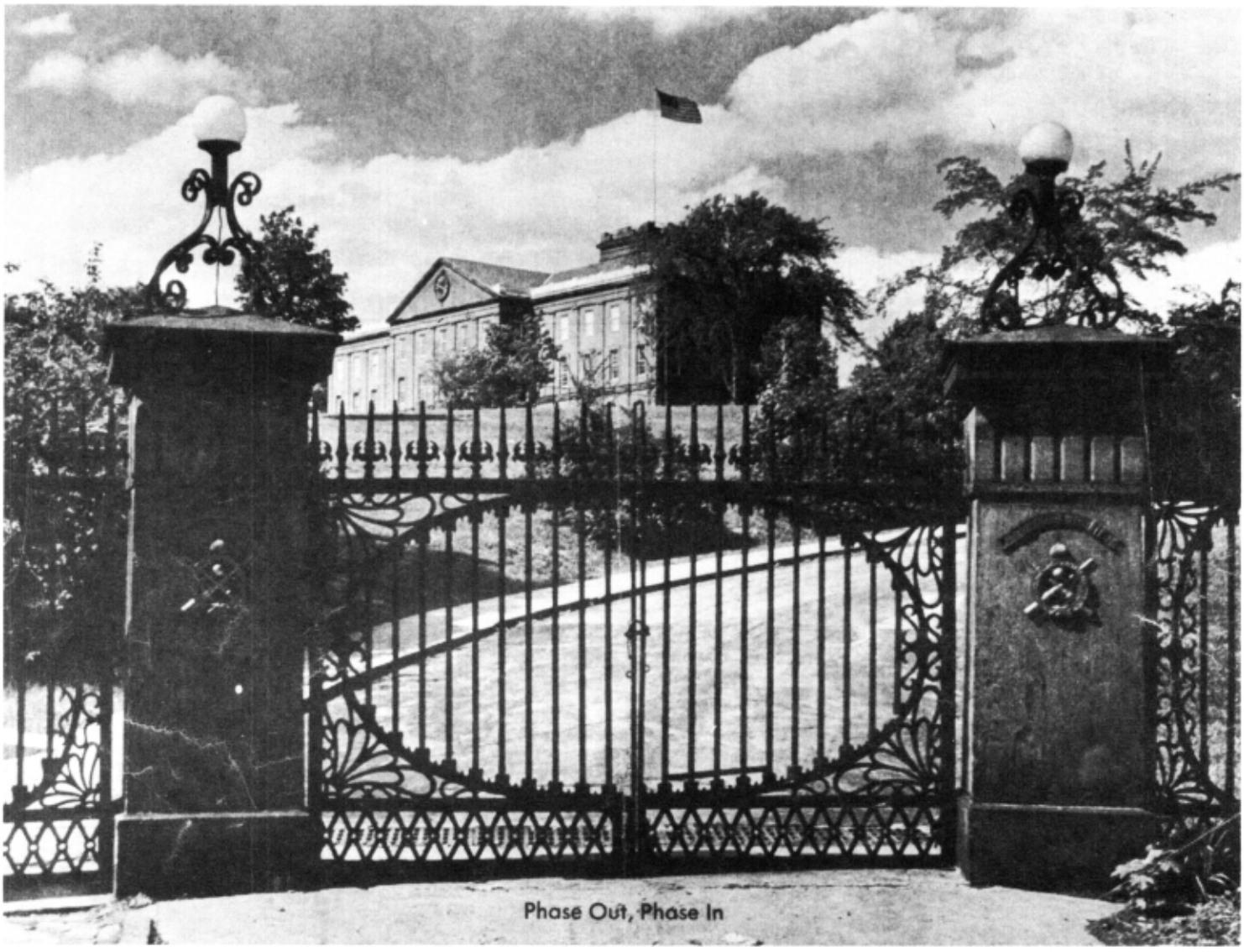
THE SPRINGFIELD ARMORY

by Thomas A. Moore and William P. Goss

A National Historic Mechanical Engineering Landmark
Dedication: Springfield, Massachusetts
February 19, 1980



THE SPRINGFIELD ARMORY

BY

THOMAS A. MOORE
AND
WILLIAM P. GOSS

A NATIONAL HISTORIC MECHANICAL ENGINEERING LANDMARK

SPRINGFIELD, MASSACHUSETTS

FEBRUARY 19, 1980

A Century of Service 1880★1980

DEDICATION CEREMONY

National Historic Mechanical Engineering Landmark

SPRINGFIELD ARMORY
SPRINGFIELD, MASSACHUSETTS
4:30 PM, FEBRUARY 19, 1980

PROGRAM

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Larry Lowenthal, Park Historian, Springfield Armory
National Historic Site

PRESENTATION OF PLAQUE

Earle C. Miller, Past-President, The American Society of
Mechanical Engineers

ACCEPTANCE OF PLAQUE

Larry Lowenthal
and
Dr. Robert C. Geitz, President
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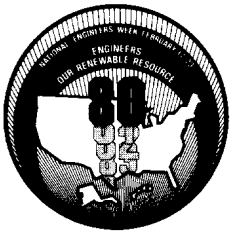
CLOSING REMARKS

Lawrence L. Ambs



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ENTRANCE TO THE SPRINGFIELD ARMORY

"The Springfield Armory, dating from 1794, is the United States government's oldest manufacturing arsenal. Since the date of its establishment, the Armory's ordnance products have figured in every American war, and its name has become synonymous with some of the finest of the world's military arms.."

INTRODUCTION

The quotation on the preceeding page is an excerpt from a plaque which was presented to the Springfield Armory on the occasion of its being established a national landmark in 1963. Although the Armory was retired from service five years later, its 174 years of service lives on at the Springfield Armory Museum. Located in the heart of Springfield, Massachusetts on the former Armory site which also now houses Springfield Technical Community College, the Museum displays one of the largest (over 20,000) collections of small firearms in the world along with some of the machines used to manufacture these firearms.

The Springfield Armory served the United States well from its beginning in 1777. The following is an excerpt from a speech made by Colonel MacFarland, former Commander of the Armory. In the excerpt is found the many contributions made by the Springfield Armory to arms development and the place these arms played in keeping the United States secure.

> "The model 1795 Flint Lock, patterned after the French Charleville, was the first weapon to be produced at the Springfield Armory and, with a slightly modified model, which was produced the following year, was used in the Indian War of Ohio in 1799, in the war with Tripoli in 1804, and in the war of 1812. It also saw service in the battles of Tippecanoe, Lundy's Lane, and New Orleans, as well as in the first and second Seminole wars, the Black Hawk War of 1832, and the Mexican War of 1845.
>
> "In 1842 manufacture of a percussion-lock musket was started, and, although this gun was not officially adopted until 1846, it saw service in the Mexican War. The last appearance of this old weapon as a military piece was in Custer's massacre in 1876.
>
> "The tape-lock musket, one of the early weapons with a rifled barrel and using the old 'minie ball' ammunition, went into production in 1855 and, with subsequent designs, was used during the Civil War by both the Northern and Southern armies. This rifle was manufactured at the Armory until 1865, when a breech loader replaced it.
>
> "The breech loading rifle, during the ensuing 20 years, was used in the Apache and Sioux Indian wars and during the Spanish American War of 1898, as well as in the Philippines in 1899 and in China in 1900.
>
> "The first bolt action magazine rifle came from the Armory shops in 1892. It was improved and manufactured here as the well-known Krag Jorgensen. This gun was also used in the Spanish-American War.

> "In 1903 one of the most widely-known rifles ever to be manufactured was put into production: and that weapon is still playing a major part in today's war after its admirable record of World War I. That rifle is the famous Springfield, admired by soldiers and sportsmen everywhere.
>
> "Today a new type weapon is being manufactured in quantities seemingly unbelievable two years ago. This rifle, the M-1, even more than preceding types, is in the process of furthering the fame of Springfield as the father of the Arsenals of Democracy by having her rifles play a dominant role in this present great conflict as the finest rifle ever to see service on any battlefield."

The list of achievements does not end with the M-1; the M-14 was so highly developed that it replaced four other weapons. The following is a list of other weapons developed either entirely at the Armory or under a joint effort with private industry.

1) 7.62mm General Purpose Machine Gun, M60

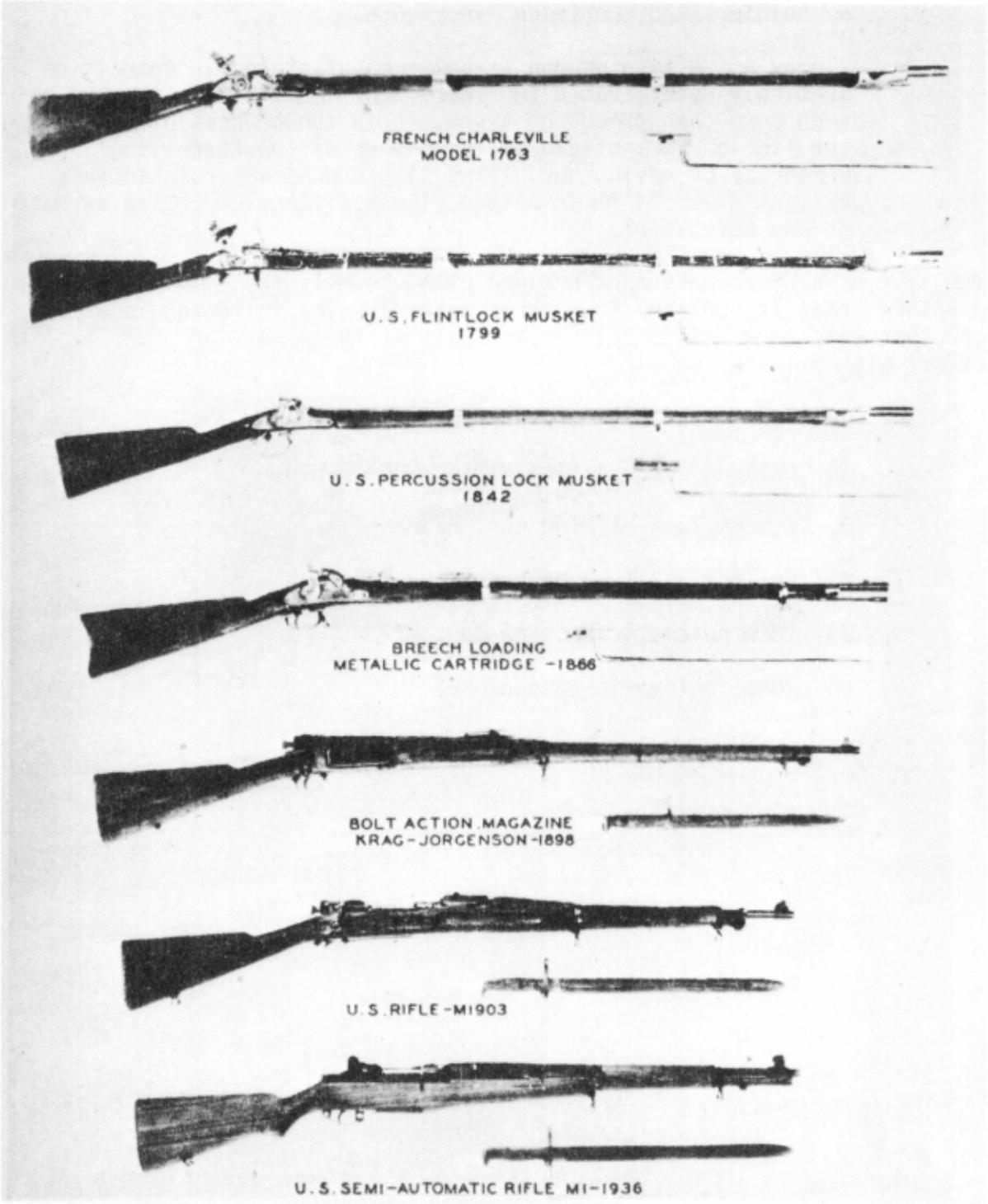
2) Caliber .50 Spotting Rifle, M8C

3) 7.62mm Tank Machine Gun, M73

4) Caliber .50 Tank Machine Gun, M85

5) 20mm Automatic Machine Gun, M39

6) 20mm, Automatic Weapon, M61



PAST TO PRESENT

Seven different types of guns have been manufactured at the Armory during its 160 years of military gun making. They range from the French Charleville Musket to the Garand Rifle. Each has played an important part in the progress and expansion of the United States.

THE REVOLUTIONARY WAR PERIOD

The Springfield Armory, known as the birthplace of the small arms industry in the United States, was first established as a National Armory by an act of the Third Continental Congress on April 2, 1794. However, the Springfield Armory was also active during the Revolutionary War. In 1777 a barn was rented for the repair of arms. In 1778 buildings were rented on Main and Cypress Streets for the manufacture of paper cartridges for muskets with the powder mill located on the Mill River.

In 1789, George Washington visited Springfield. His great concern over standardization of rifles for the Continental army spurred development of a national armory. Upon recommendation of General Knox, Springfield was chosen as the site for the National Armory. Washington chose Springfield even though the Congress had voted Brookfield, Massachusetts as the ideal site. The reasons for his selection of Springfield were:

1) Far enough inland to prevent attack by sea

2) Excellent quantities of water for power and transportation

3) Presence of considerable number of gunsmiths, blacksmiths and other artisans

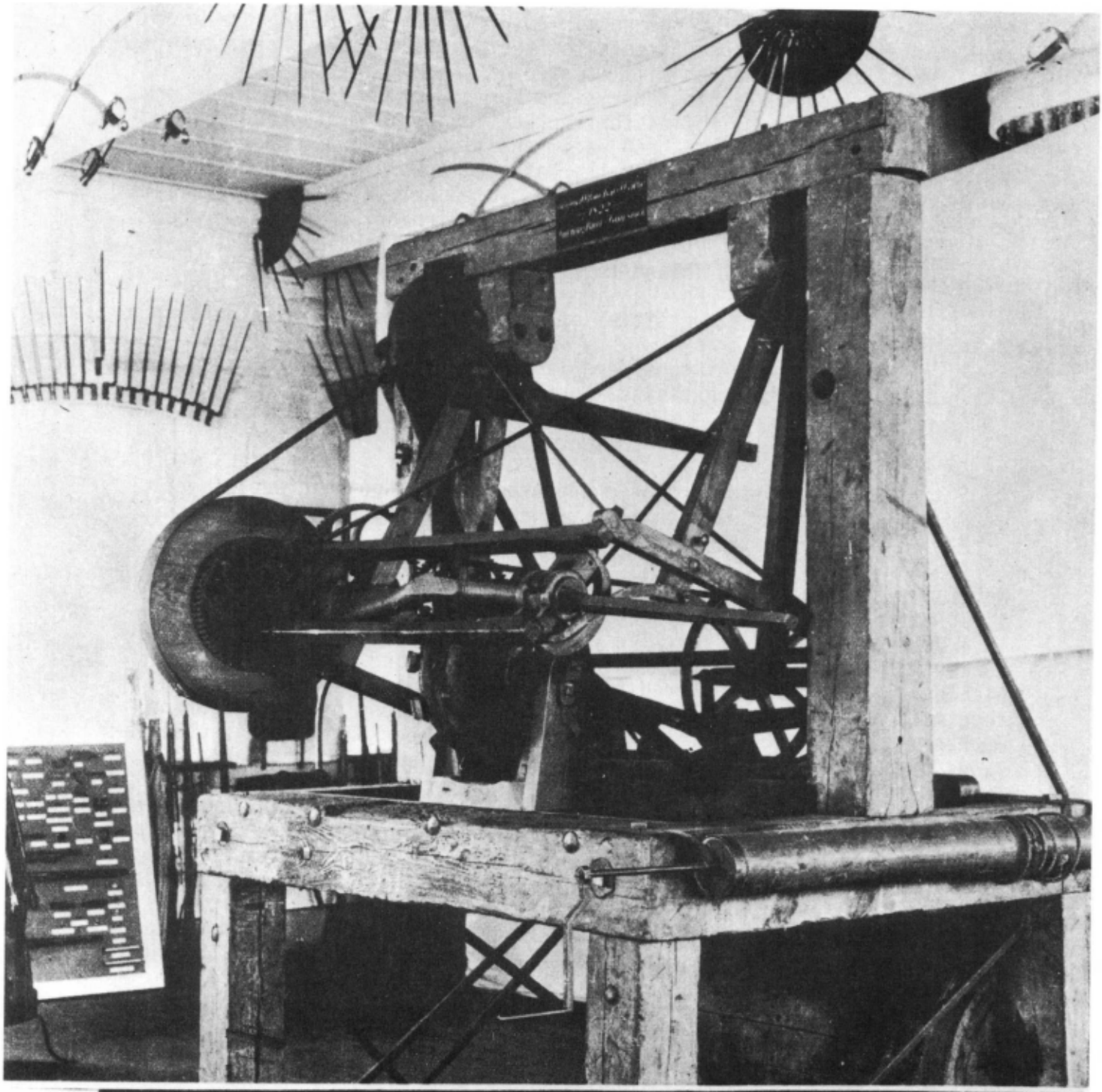
4) Good roads for transportation

5) To provide ordnance support for the Northern Department of the Continental Army headed by General Horatio Gates during the Revolutionary War.

Not many years later the U.S. Model 1795 Musket, a Flint Lock, was the first official U.S. weapon and the first Springfield weapon produced.

During the Armory's earlier years it was noted, as always, for its concentration of fine craftsmen and engineers. Among them was Thomas Blanchard. Blanchard was credited with introducing an astonishing thirteen machines designed especially for the improvement of manufacturing muskets. One of the thirteen was said to have been based on his observations of a borer-worm in an oak log. His major contribution came in 1819, with the invention of a lathe for turning gun-stocks. The Blanchard lathe, as it became known, was said to be one of the ten greatest inventions. The lathe, an example of which is at the Armory Museum, could turn out irregular shapes from patterns. The lathe's basic design principles are still followed today in many machine tools. Its creation later played a great part in the development of interchangeable parts. During the Civil War the machine allowed the production of 450 gun stocks in a ten hour period, previously each stock would take one man ten hours to produce.

When the Springfield Armory was given an order to develop a new model weapon with interchangeable parts, another Armory employee, Thomas Warner, did just that. He is credited with being the first to put into practical operation the mechanical idea of interchangeable parts. Warner



The original Blanchard lathe for turning rifle butt stocks. Invented in 1822 by Thomas Blanchard, U. S. Armory, Springfield.

also designed a set of machinery for finishing bayonets that dispensed with grinding, thereby eliminating the health hazard caused by stone dust.

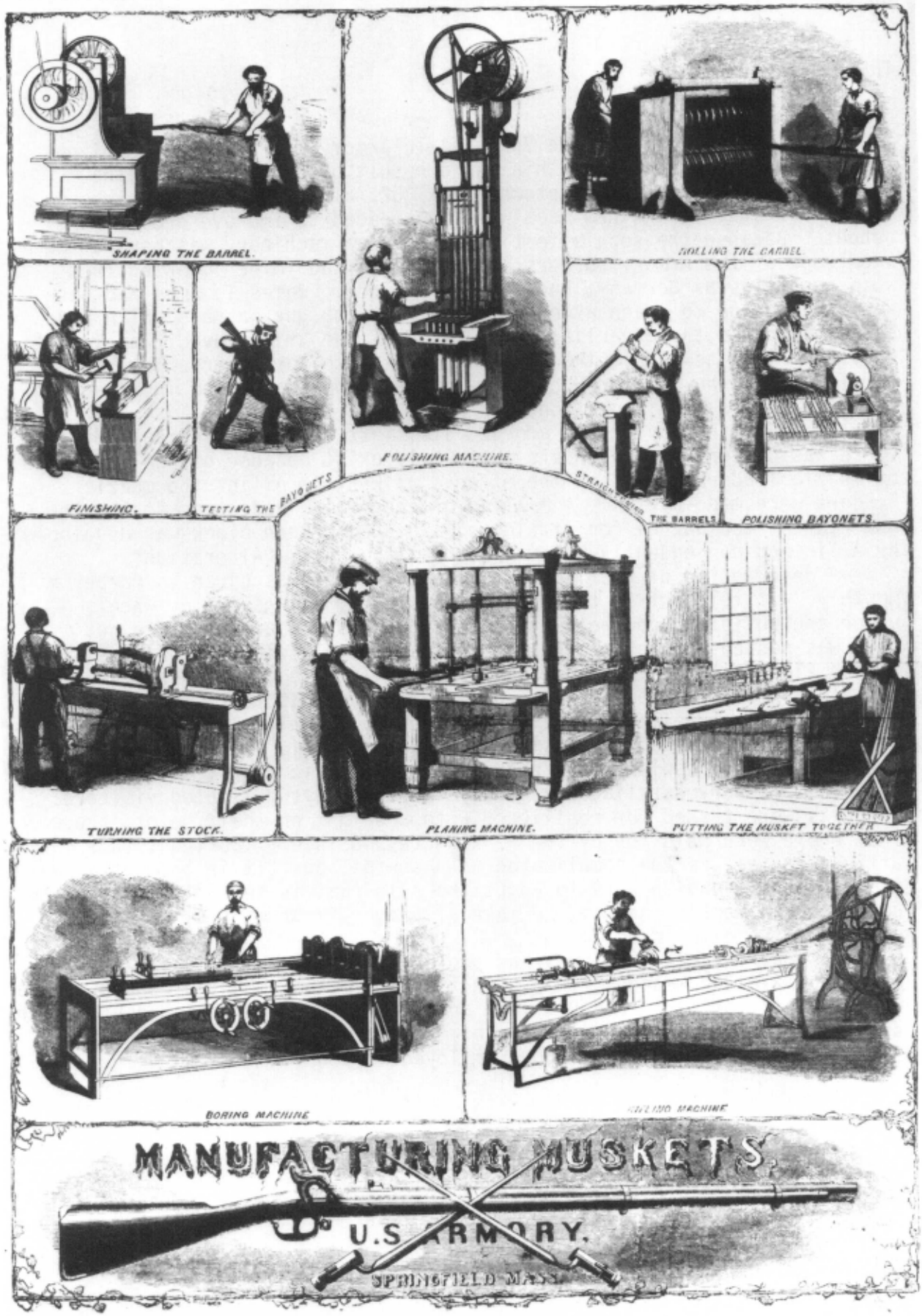
THE CIVIL WAR PERIOD

During the Civil War the Springfield Armory was alone in suppling arms to the Union soldiers; this was a result of the capture of the Harper's Ferry Arsenal in September of 1862. In 1861, steam engines had been installed and new machinery introduced to improve production output. Because the sophistication of the new machinery was beyond the knowledge of the Armory workers, many workers had to be imported from such countries as Germany, England, and Sweden. James T. Ames had been sent to England to learn a new system for making gun barrels which had been introduced there earlier. The value of the trip proved twofold not only for Ames' newly acquired knowledge but also for an Irishman by the name of Onion who Ames brought back with him and who proved invaluable to the system's implimentation.

In 1865, the government adopted its first official breech loader. There was concern for the waste that would exist because of the stockpile of muzzle loaders. Through the efforts of Erskine Allin, the muzzle loaders were made useful. A milling process which made room at the top and rear of the barrel for fitting on a hinged breech block was developed by Allin and consequently became known as the "Allin Alteration".

A description of the manufacturing processes was given in Harper's Monthly. It tells of 18 tilt-hammers driven by immense water wheels under the building, for welding the gun barrels. When the white hot iron was passed from the forges in the center to these tilt-hammers all working at once, the "incessant and intolerable clangor and din" plus the showers of sparks was a powerful experience to visitors! In another room, reflecting mirrors were used to help the workman check on the straightness of the inside of the gun barrel. What the layman sees is "a very resplendent congeries of concentric rings, forming a spectacle of very dazzling brilliancy" which always delighted visitors. Bayonets were tested for resiliency with a weight on their point; those that broke were paid for by the workman responsible. "Boring", this article states, is too complicated to describe, but “It is the custom with all machinists and turners to adopt the rule that is so indispensable and excellent in morals, namely, to make all right first within, and then to attend to the exterior."

By 1864 the new machinery had proven itself worthwhile with an output of 276,200 weapons, this being ten times the amount produced at the beginning of the war. Between 1862 and 1864 alone, production doubled, an specilization increased the number of occupations from 113 in 1860 to 390 in 1865 with a total of 3,000 employed in 1865.


SHAPING THE BARREL.
ROLLING THE BARREL.
POLISHING MACHINE.
FINISHING.
TESTING THE BAYONETS.
STRAIGHTENING THE BARREL.
POLISHING BAYONETS.
TURNING THE STOCK.
PLANING MACHINE.
PUTTING THE MUSKET TOGETHER.
BORING MACHINE.
MANUFACTURING MUSKETS.
U.S. ARMORY.
SPRINGFIELD MASS.

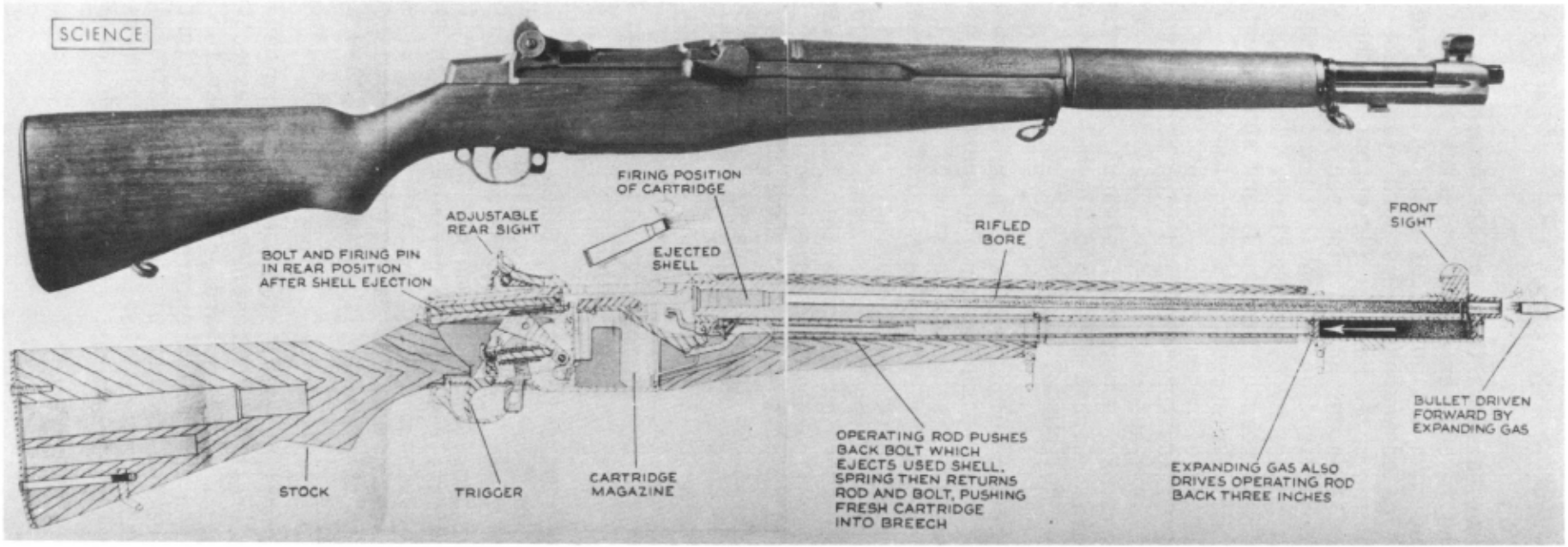
WORLD WARS I AND II

In 1891, the experimental department of the Armory was formed, this department being the forerunner of the research and development division which would play such a significant role in the development of more and more sophisticated weapons. One such weapon was the "03 Springfield" produced during World War I. The output of the "03" reached over a quarter of a million during the nineteen months of the war.

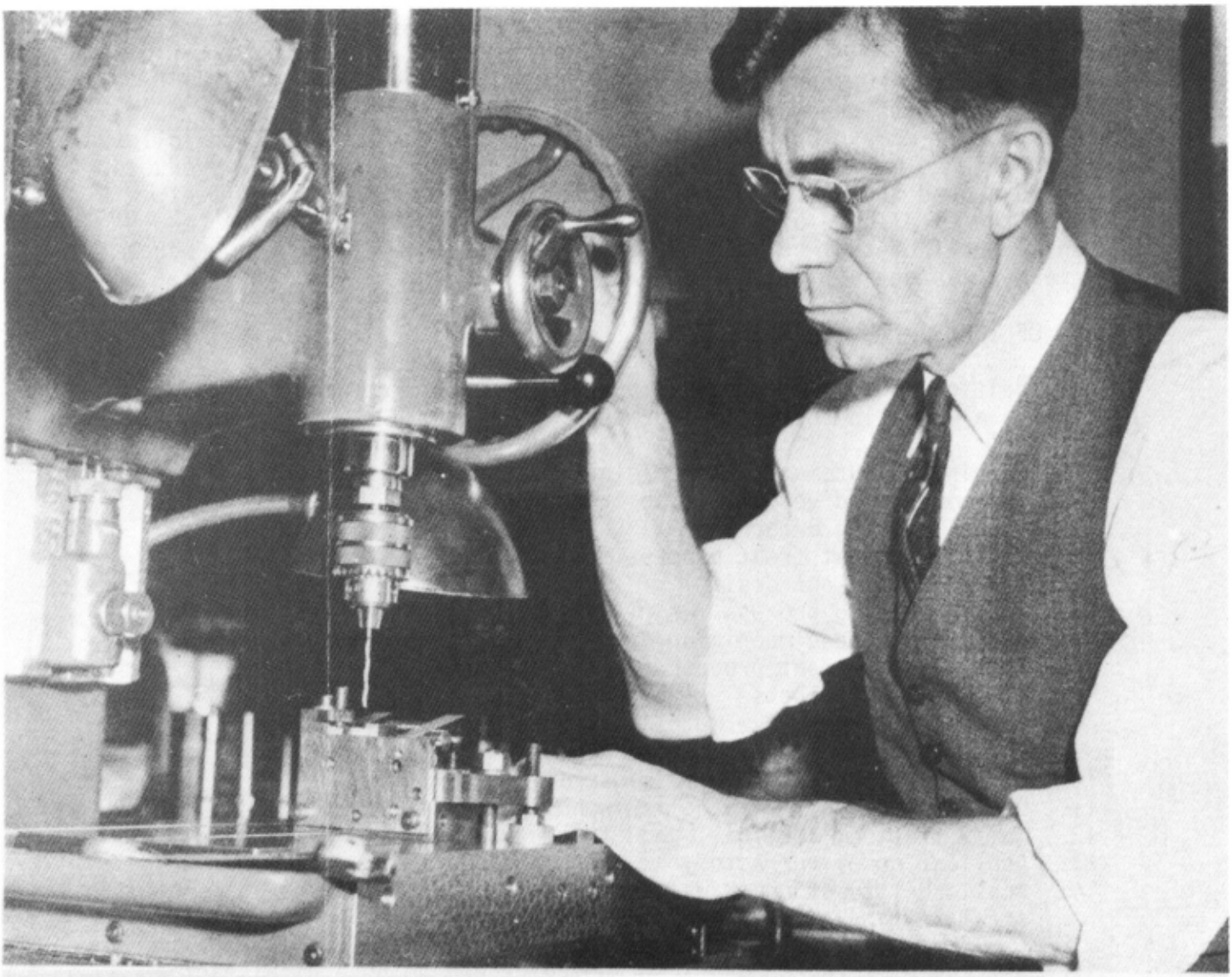
A most significant contribution to manufacturing was the development of a precise set of gauges by Cyrus Buckland. The high quality of these gauges attracted the Bureau of Standards and subsequently Buckland was asked to assist in the development of their standards.

Probably the most noted of recent employees of the Armory was John C. Garand. In 1936 Garand submitted a design accepted by the Government for the first semi-automatic rifle. His design came after approximately twenty years of successful research, experimentation and testing across the country. Garand described his M-1 before a meeting of the Rotarians in 1943 as follows:

> "Foreign and previous models of American service rifles required the manual, time-consuming operations of unlocking, withdrawing, closing and locking of the bolt between each shot that was fired. The M-1 rifle, however, is designed to fire standard service ammunition just as rapidly as a man can pull the trigger. When the cartridge is fired terrific pressure builds up within the barrel to expel the bullet. Considerable pressure remains for a fraction of a second after the bullet leaves the muzzle, and this pressure is tapped into the gas cylinder. Here it operates a piston which automatically unlocks a light mechanism and opens the bolt, ejects the fired cartridge case, loads a new round into the chamber, closes and locks the bolt, and cocks the hammer in preparation in firing the next round.
>
> "The process of ejection and reloading takes place so rapidly that if a man were capable of pulling the trigger at the rate of 1500 times per minute, the automatic action would keep ahead of him. Actually men can fire this rifle at a rate of approximately 400 shots per minute which means that every soldier equipped with an M-1 rifle is in effect carrying a light machine gun. So far as fire power is concerned, one man with this weapon is equivalent to five with the conventional type rifle.
>
> "The strongest and most suitable steels were determined for each part and heat treated to accentuate their respective qualities. Some parts are very hard on the surface for bearings but soft and tough at the core to permit slight flexing without breakage. Other pieces must be extremely tough throughout and relatively hard without brittleness in order to withstand high pressures. Some parts are corrosion



OPERATIONAL DRAWING OF M-1 RIFLE



John C. Garand, 51, inventor of the Army's new rifle, is a French-Canadian whose family moved to Connecticut before he was 12. He worked in machine shops, spent nights in shooting galleries run by his father and brothers. He developed his rifle at Springfield Armory, where he has worked for 20 years, now earns about $5,000 a year. When told last fortnight that in his rifle's first National Guard test, twelve marksmen had scored 402 hits in one minute on a target 200 yards away, Inventor Garand remarked: "They should have done better. But the rifle was new to them."

resistant to hot gases and all parts must, of course, be as nearly as possible, rust proof. There are 19 different steels used in the rifle which are heat treated to 30 different degrees of hardness."

Garand was not the only one talking about his rifle. General MacArthur said of the M-1 rifle, "...outstanding performance," and General Patton said, "I consider the M-1 the greatest weapon ever made." Two truly strong testimonials to the genius of Garand and the abilities of Springfield Armory technology.

As a result of Garand's success with the design of the M-1 rifle, the most modern mass production machinery was installed in the Armory. Such machines as modern broaches and on-machine gauges set a pattern followed by other ordnance manufacturers. Over 5.5 million M-1 rifles were produced and served around the world during World War II and the Korean conflict. A sign of the excellence of the manufacturing ability of the Armory can be seen in the fact that between 1939 and 1945 the time it took to produce a single M-1 was cut by 75%.

SUMMARY OF INDUSTRIAL ACHIEVEMENTS

In addition to its weapons development the Armory contributed to industry as a whole in the following ways:

1. Continuous automatic parkerizing process
2. Horizontal and verticle slab broaching
3. Barrel rifling broaching
4. Continuous heat treat process for rifle barrels (including special equipment design)
5. Chrome plating process for rifle barrel bores and chambers
6. Ultra high speed machining of wood using carbine tools
7. Special heat treat process for increasing working life of drop forge dieblocks
8. Salt bath process for metal heat treating
9. China wood oil process for wood preservation
10. Dichromate process for stainless steel
11. Blanchard eccentric lathe for wood turning
12. Multi-station, vertical, wood turning lathe
13. Application of refractory or exotic metals
14. Applicability of numerical controlled machine tools to small lot and pilot production

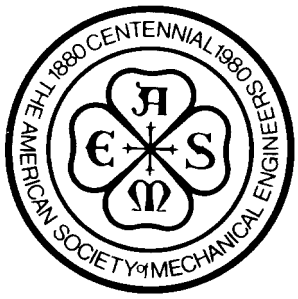
The existance of the Springfield Armory proved to be a vital part in the growth of the United States. Its contributions, not only to arms sophistication, but also to industry and the improvement of productivity should prove to be significant for many years to come.

The present Springfield Armory Museum displays many of the weapons and machines described previously. Some of these are listed below:

- The Armory Museum has the original Blanchard Lathe which is the oldest lathe of its type in existance.
- There are approximately 20,000 rifles in the museum, which makes it one of the largest small arms collections in the world.
- The first of each of the weapons manufactured at the Springfield Armory is in this collection.
- Many of John Garrand's prototypes are there.
- Also many of Erskine Allin's prototypes are there.

The museum is open free of charge to the public, and a visit there should be a memorable occasion for the individual interested in small firearms and/or their manufacturing techniques.

In addition to the Armory Museum which salutes the illustrious past of the Springfield Armory, the former Armory site and many of the former Armory buildings house Springfield Technical Community College. The College continues to carry on the technological tradition of the Armory by educating individuals in Engineering Technology, including Mechanical Engineering. Thus, the dedication of the Springfield Armory as the 39th National Historical Mechanical Engineering Landmark and the first in the American Society of Mechanical Engineer's Centennial Year is certainly appropriate both from its past history, and its present use.



United State Armorg Springfield, Mass., U.S.A.-Museum.

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Geneology and Local History Department of City Library, Springfield, MA. Amy Spratlin, Mrs. Arline Mortin, and Ellen Coty.

Springfield Armory Museum Personnel, W.E. Meuse, Curator; Thomas Wallace, former Director

NATIONAL HISTORIC MECHANICAL ENGINEERING LANDMARK PROGRAM

In September 1971 the ASME Council reactivated the Society's History and Heritage program with the formation of a National History and Heritage Committee. The overall objective of the Committee is to promote a general awareness of our technical heritage among both engineers and the general public. A charge given the Committee is to gather data on all works and artifacts with a mechanical engineering connection which are historically significant to the profession - an ambitious goal, and one achieved largely through the volunteer efforts of the Section and Division History and Heritage Committees and interested ASME members.

Accordingly, two major programs are carried out by the Sections and Divisions under the direction of the National Committee: 1) a listing of industrial operations and related mechanical engineering artifacts in local Historic Engineering Records; and 2) a National Historic Mechanical Engineering Landmark program. The former is a record of detailed studies of sites in each local area; the latter is a demarcation of local sites which are of national significance - people or events which have contributed to the general development of civilization.

In addition, the Society cooperates with the Smithsonian Institution in a joint project which provides contributions of historical material to the National Museum of History and Technology in Washington, D.C. The Institutions's permanent exhibition of mechanical engineering memorabilia is under the direction of a curator, who also serves as an ex officio member of the ASME National History and Heritage Committee.

The Springfield Armory, Springfield, MA is the thirty-ninth landmark to be designated since the program began in 1973. The others are:

Ferries and Cliff House Cable Railway Power House, San Francisco, CA
Leavitt Pumping Engine, Chestnut Hill Pumping Station, Brookline, MA
A.B. Wood Low-Head High-Volume Screw Pump, New Orleans, LA
Portsmouth-Kittery Naval Shipbuilding Activity, Portsmouth, NH
102-inch Boyden Hydraulic Turbines, Cohoes, NY
5000 KW Vertical Curtis Steam Turbine-Generator, Schenectady, NY
Saugus Iron Works, Saugus, MA
Pioneer Oil Refinery, Newhall, CA
Chesapeake & Delaware Canal, Scoop Wheel and Engines, Chesapeake City, MD
U.S.S. Texas, Reciprocating Steam Engines, Houston, TX
Childs-Irving Hydro Plant, Irving, AZ
Hanford B-Nuclear Reactor, Hanford, WA
First Air Conditioning, Magma Copper Mine, Superior, AZ
Manitou and Pike's Peak Cog Railway, Colorado Springs, CO
Edgar Steam-Electric Station, Weymouth, MA
Mt. Washington Cog Railway, Mt. Washington, NH
Folsom Power House #1, Folsom, CA
Crawler Transporters of Launch Complex 39, J.F.K. Space Center, FL
Fairmont Water Works, Philadelphia, PA
U.S.S. Olympia, Vertical Reciprocating Steam Engines, Philadelphia, PA
5 Ton "Pit-Cast" Jib Crane, Birmingham, AL
State Line Generating Unit #1, Hammond, IN
Pratt Institute Power Generating Plant, Brooklyn, NY
Monongahela Incline, Pittsburgh, PA
Duquesne Incline, Pittsburgh, PA

Great Falls Raceway and Power System, Paterson, NJ
Vulcan Street Power Plant, Appleton, WI
Wilkinson Mill, Pawtucket, RI
New York City Subway System, New York, NY
Baltimore & Ohio Railroad, Baltimore, MD
Ringwood Manor Iron Complex, Ringwood, NJ
Joshua Hendy Iron Works, Sunnyvale, CA
Hacienda La Esperanza Sugar Mill Steam Engine, Manati, PR
RL-10 Liquid-Hydrogen Rocket Engine, West Palm Beach, FL
A.O. Smith Automated Chassis Frame Factory, Milwaukee, WI
Reaction-Type Hydrulic Turbine, Morris Canal, Stewartsville, NJ
Experimental Breeder Reactor 1 (EBR-l), Idaho Falls, Idaho
Drake Oil Well, Titusville, PA

ACKNOWLEDGEMENTS

The Western Massachusetts Section of the American Society of Mechanical Engineers gratefully acknowledges the efforts of all who cooperated on the landmark dedication of the Springfield Armory, Springfield, Massachusetts.

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