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(IN TEN VOLUMES)

Volume VI

Report of the

CHIEF OF ORDNANCE



WASHINGTON
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WAR DEPARTMENT.
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OFFICE OF THE CHIEF OF ORDNANCE.

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ARRANGEMENT OF THE ANNUAL REPORTS OF THE WAR DEPARTMENT FOR THE YEAR ENDED JUNE 30, 1907.

Volume I.....	Secretary of War. Chief of Staff. The Adjutant-General. Inspector-General. Judge-Advocate-General.
Volume II.....	Armament, Transportation, and Supply: Quartermaster-General. Commissary-General. Surgeon-General. Paymaster-General. Chief of Engineers, Military Affairs. ^a Chief of Ordnance. ^b Chief Signal Officer. Chief of Artillery. Board of Ordnance and Fortification.
Volume III.....	Division and Department Commanders: Atlantic Division— 1. Department of the East. 2. Department of the Gulf. Northern Division— 1. Department of the Lakes. 2. Department of the Missouri. 3. Department of Dakota. Southwestern Division— 1. Department of Texas. 2. Department of the Colorado. Pacific Division— 1. Department of California. 2. Department of the Columbia. Philippines Division— 1. Department of Luzon. 2. Department of the Visayas. 3. Department of Mindanao. Army of Cuban Pacification.
Volume IV.....	Militia, Military Schools, and Military Parks: The Adjutant-General, Militia. Military Academy— 1. Board of Visitors. 2. Superintendent. Military Schools— 1. Infantry and Cavalry. 2. Staff College. 3. Signal. 4. Cavalry and Field Artillery. 5. Coast Artillery. 6. Engineer. 7. Submarine Defense. 8. Army Medical. Military Parks— 1. Chickamauga and Chattanooga. 2. Gettysburg. 3. Shiloh. 4. Vicksburg.
Volume V.....	Chief of Engineers.
Volume VI.....	Chief of Ordnance.
Volumes VII-X.....	Insular Affairs, and Philippine Commission.

^a Printed in Report of Chief of Engineers, Vol. V.

^b Printed in Report of Chief of Ordnance, Vol. VI.

REPORT OF THE CHIEF OF ORDNANCE.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
Washington, August 3, 1907.

SIR: I have the honor to submit the following report on the principal operations of the Ordnance Department during the past year, together with certain remarks as to its interests and necessities:

PERSONNEL.

The statutory organization of the Ordnance Department comprises 85 officers; the Department now has 72, which is 7 more than it had at the date of my last annual report. The number at the date of the previous report was 65, and in the meantime there had been legislation improving the conditions of detail for service in the Ordnance Department, with the object of stimulating its recruitment. Under the programme adopted after the passage of this legislation it was intended to take in officers at such a rate that the vacancies would all be filled in four years' time; gradual recruitment being necessary in order that the Department should not be deprived suddenly of the services of a large number of officers, due to the simultaneous expiration of detail of those admitted at the same time.

The first examination for detail, after the passage of the legislation referred to, was held in March last, and it was expected then to obtain 14 officers; but in the meantime the passage of the act increasing the artillery had had the effect of entirely removing the most fruitful field from which officers of the Ordnance Department are gathered, namely, the second lieutenants of artillery, by creating vacancies in the higher grades of that arm, to which they were all promoted. Had it not been that the Department had some vacancies in the grade of captain, for which first lieutenants of the line are eligible, it is feared that but a small number of officers would have been obtained at the examinations; but by reason of the inducement thus held out to first lieutenants, and, with the addition of officers

from the infantry and cavalry who successfully passed the examinations, 11 officers were obtained. It is believed that with a return to normal conditions, after the grade of second lieutenant in the line shall have had time to become filled, the existing system will be found adequate for maintaining the strength of the Ordnance Department.

The examining board of last March had, in addition to the duty of selecting officers for the grade of first lieutenant of ordnance, the difficult task of picking out those to be advanced to the grade of captain from among four classes of eligibles, with different kinds of data upon which to base a recommendation for selection, namely: First lieutenants with previous service in the Department who were temporarily out of it; first lieutenants serving in the Department, with several years of service to their credit; first lieutenants serving in the Department, but needing an examination for the grade of captain to supplement their short service therein; and first lieutenants of the line taking the examination for original entry into the Department. This variety of qualification increased the difficulties of the board, but is not likely to occur to as great an extent in the future. All eligible officers for the grade of captain were thus put in competition without discrimination, because of current or previous service in the Ordnance Department. The board was instructed to take into consideration the seniority, character, and ability of all eligible officers; the nature of their service in the Ordnance Department; the length of their remaining service in the Department; the examination which they passed; their efficiency record; the recommendations submitted by their superior officers, and, in general, every element concerning them which was within the knowledge of the board; and to make their recommendations in accordance with the best interests of the service as they presented themselves to the board.

Those officers who had had more than a year's service in the Ordnance Department were not required to pass an examination with reference to their promotion to the grade of captain; but officers who had had less than a year's service were required to take what is known as a captain's examination for the Ordnance Department, i. e., an examination upon those subjects not included in the examination for the detail of officers as first lieutenant in the Department. Each commanding officer under whom any of the eligible officers had served in the Ordnance Department was directed to submit a list of those officers who had at any time served under him, arranged in the order in which he would recommend them for promotion to captaincy, and these lists were submitted to the board for its information.

Twenty-one officers were eligible for the fourteen vacancies in the grade of captain, and of the list arranged in the order of their

seniority in the service the choice fell upon the following, namely, Nos. 1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 16, and 18.

It is interesting to note how officers who were graduates of the Military Academy and those who were not have fared in the recommendations concerning the technical service of the Ordnance Department. Of the 17 men who took the examination for detail 3 were not graduates of the Military Academy, and of these 1 was recommended. Of the 14 graduates 8 were recommended. Of the 21 officers eligible for detail to the grade of captain in the Ordnance Department 17 were graduates and 4 were not. Of the 17 graduates 12 were recommended for captaincies and 5 were not. Of the 4 non-graduates 2 were recommended for captaincies and 2 were not.

The inauguration of the new system, under circumstances of rather exceptional difficulty, the character, intelligence, and attainments of the officers who have been recruited under it, and the stimulating effect of its provisions, are such as to indicate promise of very gratifying success for the effort which the system constitutes to place this branch of the Army upon a competitive basis.

FISCAL AFFAIRS.

As my annual report is required to be submitted earlier this year than usual, I am unable to present with it the usual fiscal statement. This arises from the fact that the accounts of the disbursing officer at the Manila Ordnance Depot for the last month of the fiscal year will not reach this office until about the middle of August, and deposits of funds pertaining to this Department made by other officers stationed outside of the United States will probably not reach this office until the early part of September. It is expected, however, to attach this fiscal statement to the printed copy of my report, accompanied by remarks on the conduct of business of the Department as shown by the transactions appearing on it.

[The statement referred to in the preceding paragraph, giving the receipts and expenditures of the Ordnance Department under general headings for the fiscal year of 1907, with suitable remarks, is interpolated in tabular form, so as to show the data under the various appropriations made for the service of this Department, including those for experiments conducted under the direction of the Board of Ordnance and Fortification and for the purchase of submarine mines, the control of which rests with the Chief of Artillery.

The tables constituting the statement show that on July 1, 1906, there was in the Treasury and in the possession of disbursing officers the sum of \$12,284,198.51 pertaining to Ordnance Department appropriations.

Statement showing receipts of the appropriations under control of the Ordnance Department for the fiscal year ended June 30, 1907.

RECEIPTS.

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REPORT OF THE CHIEF OF ORDNANCE.

Appropriations.	Amount in the Treasury to credit of ordnance appropriations on July 1, 1906.	Amount deposited in the Treasury on account of the Ordnance Department, but not credited to ordnance appropriations, on July 1, 1906.	Amount in the United States depositaries to credit of disbursing officers under ordnance appropriations on July 1, 1906.	Amount of appropriations made for the fiscal year ended June 30, 1907, including the amount of those contained in the act making appropriations for fortifications and other works of defense, etc., approved Mar. 2, 1907, under control of the Ordnance Department.	Amount refunded during the fiscal year ended June 30, 1907, to ordnance appropriations by Treasury settlements on account of transfers of property to the various bureaus and Executive Departments, to the organized militia, etc.	Amount received during the fiscal year ended June 30, 1907, from sales of ordnance and ordnance stores, from collections from troops on account of loss or damage to ordnance stores, from Chicago, Rock Island and Pacific R. R. Co., on account of maintenance of Rock Island Bridge, proceeds arising from tests made by the Government testing machine at Watertown Arsenal, and from other sources not before mentioned.	Total.
Ordnance service, 1907				\$300,000.00	\$37.79	\$9.10	\$300,046.89
Ordnance stores, ammunition, 1907				600,000.00			600,000.00
Ordnance stores and supplies, 1907				1,100,000.00	20.00	18.10	1,100,038.10
Small-arms target practice, 1907				1,000,000.00			1,000,000.00
Replacing ordnance and ordnance stores, 1906 and 1907	\$463,084.72	\$9,794.10	\$63,661.63		146,839.22	41.20	683,420.87
Replacing ordnance and ordnance stores, 1907 and 1908					711,167.85	88,165.13	799,332.98
Manufacture of arms, 1906-1907	1,252,901.37		168,730.21			10.00	1,416,641.58
Manufacture of arms, 1907 and 1908				1,700,000.00	3.60		1,700,003.60
Ordnance material (proceeds of sales)		1,305.04	507.06	75,000.00		215,803.98	292,616.08
Field artillery for organized militia, 1905 and 1906	169,851.05	21.10	33,221.54		13,152.90		216,246.59
Field artillery for organized militia, 1907				550,000.00		2.78	550,002.78
New arms and equipments for organized militia	18,963.66	1.20	6,326.04			.25	25,291.15
National trophy and medals for rifle contests, 1907				5,000.00		6.00	5,006.00
Encampment and maneuvers, organized militia				20,000.00	9,692.90		29,692.90
Repairs of arsenals, 1907				250,000.00	2,135.00		252,135.00
Board of Ordnance and Fortification	199,095.73		8,965.40	25,000.00	137.63		233,198.76
Powder and projectiles (proceeds of sales)						73,536.79	73,536.79
Submarine mines	578,244.75		6,919.55	250,000.00	32.18	80.44	835,276.92

Armament of fortifications	6,242,686.99	1,478.69	879,209.45	1,829,000.00	31,642.45	712.72	8,484,730.30
Fortifications in insular possessions	958,256.21		58,760.08	457,500.00		38.18	1,474,554.42
Torpedoes for harbor defense			11,655.02				11,655.02
Fire control at fortifications				158,579.24			158,579.24
Expenses, National Board for Promotion of Rifle Practice				2,162.00			2,162.00
Augusta Arsenal, Augusta, Ga.	50,000.00						50,000.00
Benicia Arsenal, Benicia, Cal.				50,000.00			50,000.00
Proving ground, Sandy Hook, N. J.	126,977.31		14,787.89	167,768.00			309,483.20
Frankford Arsenal, Philadelphia, Pa.			5,458.02				5,458.02
San Antonio Arsenal, San Antonio, Tex.	16,000.00						16,000.00
Powder depot, Dover, N. J.	11,571.89	11,284.09	2,213.38	67,000.00			92,069.36
Rock Island Bridge, Rock Island, Ill., 1907				16,550.00		1,399.35	17,949.35
Rock Island Arsenal, Rock Island, Ill.			2,809.40	62,692.00			65,501.40
Rock Island power plant, Rock Island, Ill., 1907				12,500.00		2,399.15	14,899.15
Reconstructing Rock Island bridge and via- duct, Illinois				125,000.00			125,000.00
Watertown Arsenal, Watertown, Mass.	23,000.00			30,000.00			53,000.00
Testing machine, 1907				15,000.00	22.78	1,092.22	16,115.00
Watervliet Arsenal, West Troy, N. Y.	20,000.00		11,885.11	10,600.00			42,485.11
Springfield Arsenal, Springfield, Mass.			1,746.41	16,500.00			18,246.41
Ordnance depot, Manila, P. I.			99.74	6,000.00			6,099.74
Isham shell and Tuttle thorite	100,000.00			165,000.00			100,000.00
Army powder factory							165,000.00
Ordnance service, 1905	1,374.54						1,374.54
Ordnance stores, ammunition, 1905	11.84						11.84
Ordnance stores and supplies, 1905	8,762.30		4.17				8,766.47
Replacing ordnance and ordnance stores, 1904 and 1905							
Converting muzzle-loading guns for saluting purposes, 1905	1,463.51						1,463.51
Repairs of arsenals, 1905	715.92						715.92
Artillery targets, 1905	5,564.11						5,564.11
Ammunition for morning and evening gun, 1905	93.65						93.65
Manufacture of arms, 1904 and 1905	99,689.94		17,468.26				117,158.20
National trophy and medals for rifle contests, 1905	8.00						8.00
Testing machine, 1905	746.23						746.23
Field artillery for organized militia, 1904 and 1905	172,817.31		7,308.84		1,225.00		181,351.15
Ordnance service, 1906	2,056.05	708.22	29,093.48		123.43	6.50	31,987.68
Ordnance stores, ammunition, 1906	85,084.41	132.00	122,967.06				208,183.47
Ordnance stores and supplies, 1906	106,628.50	1,790.80	146,825.50				255,244.80
Manufacture of arms, 1905-1906	114,941.00		67,330.44				182,271.44
Converting muzzle-loading guns for saluting purposes, 1906	342.50		3.08				345.58
Repairs of arsenals, 1906	556.46	451.74	20,414.45				21,422.65
Testing machine, 1906	105.63		3,809.70				3,915.33
National trophy and medals for rifle contests, 1906	1,019.23		249.95			.50	1,269.68

Statement showing receipts of the appropriations under control of the Ordnance Department for the fiscal year ended June 30, 1907—Continued.

RECEIPTS—Continued.

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REPORT OF THE CHIEF OF ORDNANCE.

Appropriations.	Amount in the Treasury to credit of ordnance appropriations on July 1, 1906.	Amount deposited in the Treasury on account of the Ordnance Department, but not credited to ordnance appropriations, on July 1, 1906.	Amount in the United States depositaries to credit of disbursing officers under ordnance appropriations on July 1, 1906.	Amount of appropriations made for the fiscal year ended June 30, 1907, including the amount of those contained in the act making appropriations for fortifications and other works of defense, etc., approved Mar. 2, 1907, under control of the Ordnance Department.	Amount refunded during the fiscal year ended June 30, 1907, to ordnance appropriations by Treasury settlements on account of transfers of property to the various bureaus and Executive Departments, to the organized militia, etc.	Amount received during the fiscal year ended June 30, 1907, from sales of ordnance and ordnance stores, from collections from troops on account of loss or damage to ordnance stores, from Chicago, Rock Island and Pacific R. R. Co., on account of maintenance of Rock Island Bridge, proceeds arising from tests made by the Government testing machine at Watertown Arsenal, and from other sources not before mentioned.	Total.
Replacing ordnance and ordnance stores, 1905 and 1906	\$117,319.43	\$2,110.03	\$81,890.71				\$201,320.17
National trophy and prizes for army and militia, 1904	756.00						756.00
Rock Island power plant, Rock Island, Ill., 1906			1,547.96		\$3,758.00		5,306.96
National defense (war)	33,555.58		56.70		1,323.29		33,555.58
Rock Island Bridge, Rock Island, Ill., 1906							1,379.99
Field artillery for organized militia				\$564,377.90			564,377.90
Replacing and repairing ordnance property at Gulf forts				30,878.00			30,878.00
Ordnance service (certified claims)				25.00			25.00
Ordnance stores, manufactures, etc. (certified claims)				150.00			150.00
Ordnance stores, equipments (certified claims)				18.00			18.00
Ordnance stores, repairs (certified claims)				25.00			25.00
Submarine mines in insular possessions				205,440.00			205,440.00
Converting muzzle-loading guns for saluting purposes				5,250.00			5,250.00
Miscellaneous receipts						\$8,461.53	8,461.53
Total	10,984,245.32	29,077.01	1,270,876.18	9,853,015.14	921,309.02	391,783.92	23,450,306.59

Statement showing expenditures of the appropriations under control of the Ordnance Department for the fiscal year ended June 30, 1907.

EXPENDITURES.

Appropriations.	Amount disbursed by disbursing officers from ordnance appropriations during the fiscal year ended June 30, 1907.	Amount paid and transferred by Treasury settlements during the fiscal year ended June 30, 1907, from ordnance appropriations on account of property from other bureaus and Executive Departments to the Ordnance Department, and of payment to contractors for certain purchases, etc.	Amount deposited in the Treasury during the fiscal year ended June 30, 1907, and credited to ordnance material (proceeds of sales).	Amount covered into the Treasury under miscellaneous receipts on account of proceeds of sales Government property during the fiscal year ended June 30, 1907.	Amount covered into surplus fund of the Treasury on June 30, 1907.	Amount in United States depositaries to credit of disbursing officers under ordnance appropriations on June 30, 1907.	Amount deposited in the Treasury on account of Ordnance Department, but not credited to ordnance appropriations on June 30, 1907.	Amount in Treasury to credit of ordnance appropriations on June 30, 1907.	Total.
Ordnance service, 1907	\$259,052.63	\$3,584.75				\$32,893.72	\$2,705.23	\$1,810.56	\$300,046.89
Ordnance stores, ammunition, 1907	348,717.71	54.74				54,289.47		196,988.08	600,000.00
Ordnance stores and supplies, 1907	609,503.38	1,356.40				207,593.40	1,732.52	279,852.40	1,100,038.10
Small-arms target practice, 1907	631,220.65	1,514.89				130,006.86	2,372.03	234,885.57	1,000,000.00
Replacing ordnance and ordnance stores, 1906 and 1907	517,546.75	1,340.49				53,605.42	2,743.21	108,185.00	683,420.87
Replacing ordnance and ordnance stores, 1907 and 1908	130,544.32	535.84				48,445.10	10,610.67	509,197.05	799,332.98
Manufacture of arms, 1906-1907	1,390,865.72	106.55				1,944.68	3.84	23,720.79	1,416,641.58
Manufacture of arms, 1907 and 1908	845,630.08	164.09				271,776.40	3,127.03	579,306.00	1,700,003.60
Ordnance material (proceeds of sales)	913.19		\$215,803.98			75,898.91			292,616.08
Field artillery for organized militia, 1905 and 1906	97,798.95	1.80				26,721.95	.20	91,723.69	216,246.59
Field artillery for organized militia, 1907	253,461.14	61.34				102,851.81		193,628.49	550,002.78
New arms and equipments for organized militia	5,559.05	14,377.90				3,535.08		1,819.12	25,291.15
National trophy and medals for rifle contests, 1907	3,484.57	256.22				610.86		654.35	5,006.00

Statement showing expenditures of the appropriations under control of the Ordnance Department for the fiscal year ended June 30, 1907—Continued.

EXPENDITURES—Continued.

Appropriations.	Amount disbursed by disbursing officers from Ordnance appropriations during the fiscal year ended June 30, 1907.	Amount paid and transferred by Treasury settlements during the fiscal year ended June 30, 1907, from Ordnance appropriations on account of property from other bureaus and Executive Departments to the Ordnance Department, and of payment to contractors for certain purchases, etc.	Amount deposited in the Treasury during the fiscal year ended June 30, 1907, and credited to Ordnance material (proceeds of sales).	Amount covered into the Treasury under miscellaneous receipts on account of proceeds of sales Government property during the fiscal year ended June 30, 1907.	Amount covered into surplus fund of the Treasury on June 30, 1907.	Amount in United States to credit of disbursing officers under Ordnance appropriations on June 30, 1907.	Amount deposited in the Treasury on account of Ordnance Department, but not credited to Ordnance appropriations on June 30, 1907.	Amount in Treasury to credit of Ordnance appropriations on June 30, 1907.	Total.
Encampment and maneuvers, organized militia.....	\$7.50	\$20,000.00				\$942.50		\$8,742.90	\$29,692.90
Repairs of arsenals, 1907.....	132,777.87	618.32				71,234.74	\$632.84	46,871.23	252,135.00
Board of Ordnance and Fortification.....	26,318.11	49,546.74				6,266.72	137.63	150,929.56	233,198.76
Powder and projectiles (proceeds of sales).....							141.35	73,395.44	73,395.44
Submarine mines.....	217,189.61	1,773.30				69,719.65		546,594.36	835,276.92
Armament of fortifications.....	2,779,467.97	20,295.80			\$146.14	443,943.44	1,755.04	5,239,121.91	8,484,730.30
Fortifications in insular possessions.....	284,148.11	20.25				52,948.88		1,137,437.18	1,474,554.42
Torpedoes for harbor defense.....	11,655.02								11,655.02
Fire control at fortifications.....	5,571.08								
Expenses, National Board for Promotion of Rifle Practice.....	2,112.00				50.00		698.50	152,246.75	158,579.24
Augusta Arsenal, Augusta, Ga.....								50,000.00	50,000.00
Benicia Arsenal, Benicia, Cal.....	3,988.74					3,566.76		42,444.50	50,000.00
Proving ground, Sandy Hook, N. J.....	87,464.10					51,910.43		170,108.67	309,483.20
Frankford Arsenal, Philadelphia, Pa.....	4,228.22					1,229.80			5,458.02
San Antonio Arsenal, San Antonio, Tex.....								16,000.00	16,000.00
Powder depot, Dover, N. J.....	35,821.91					14,857.50		41,389.95	92,069.36

Rock Island Bridge, Rock Island, Ill., 1907	15,703.41				2,245.94		17,949.35
Rock Island Arsenal, Rock Island, Ill.	53,284.00				12,217.40		65,501.40
Rock Island power plant, Rock Island, Ill., 1907	9,281.52				2,017.63	3,600.00	14,899.15
Reconstructing Rock Island bridge and viaduct, Illinois	32,732.94				50,267.06	42,000.00	125,000.00
Watertown Arsenal, Watertown, Mass.	12,055.67				17,060.92	3,883.41	33,000.00
Testing machine, 1907	12,299.93				2,784.17	1,030.90	16,115.00
Watervliet Arsenal, West Troy, N. Y.	33,940.49			600.00	6,444.62	1,500.00	42,485.11
Springfield Arsenal, Springfield, Mass.	13,247.18				1,999.23	3,000.00	18,246.41
Ordnance depot, Manila, P. I.	332.51				817.23	4,950.00	6,099.74
Isham shell and Tuttle thorite.						100,000.00	100,000.00
Army powder factory	22,705.82				19,558.90	122,735.28	165,000.00
Ordnance service, 1905		98.53		1,276.01			1,374.54
Ordnance stores, ammunition, 1905				11.34			11.34
Ordnance stores and supplies, 1905		260.31		8,506.16			8,766.47
Replacing ordnance and ordnance stores, 1904 and 1905							
Converting muzzle-loading guns for saluting purposes, 1905				1,463.51			1,463.51
Repairs of arsenals, 1905		6.03		709.89			715.92
Artillery targets, 1905				5,564.11			5,564.11
Ammunition for morning and evening gun, 1905				93.65			93.65
Manufacture of arms, 1904 and 1905	99,063.95	1.15		16,806.30	1,286.80		117,158.20
National trophy and medals for rifle contests, 1905				8.00			8.00
Testing machine, 1905				746.23			746.23
Field artillery for organized militia, 1904 and 1905							
Ordnance service, 1906	88,190.12	11.24			23,975.04	69,174.75	181,351.15
Ordnance stores, ammunition, 1906	29,049.40	883.87			3.04	2,051.37	31,987.68
Ordnance stores and supplies, 1906	206,746.25					1,437.22	208,183.47
Manufacture of arms, 1905-1906	244,617.76	60.35			9,999.00	192.10	255,244.80
Converting muzzle-loading guns for saluting purposes, 1906	100,988.08	12.00				81,271.36	182,271.44
Repairs of arsenals, 1906						345.58	345.58
Testing machine, 1906	19,914.05					1,508.60	21,422.65
National trophy and medals for rifle contests, 1906	3,816.46					98.87	3,915.33
Replacing ordnance and ordnance stores, 1905 and 1906	510.50				11.70	747.48	1,269.68
National trophy and prizes for army and militia, 1904						6,946.10	201,320.17
Rock Island power plant, Rock Island, Ill., 1906	194,374.07						
National defense (war)		756.00					756.00
Rock Island Bridge, Rock Island, Ill., 1906	2,441.23					2,859.73	5,300.96
Field artillery for organized militia	9,898.28				99.23	23,558.07	33,556.58
Replacing and repairing ordnance property at Gulf forts	1,379.99						1,379.99
Ordnance service (certified claims)	543.92				1,972.75	561,861.23	564,377.90
		*					
		25.00				30,878.00	30,878.00
							25.00

Statement showing expenditures of the appropriations under control of the Ordnance Department for the fiscal year ended June 30, 1907—Continued.

EXPENDITURES—Continued.

Appropriations.	Amount disbursed by disbursing officers from ordnance appropriations during the fiscal year ended June 30 1907.	Amount paid and transferred by Treasury settlements during the fiscal year ended June 30, 1907, from ordnance appropriations on account of property from other bureaus and Executive Departments to the Ordnance Department, and of payment to contractors for certain purchases, etc.	Amount deposited in the Treasury during the fiscal year ended June 30, 1907, and credited to ordnance material (proceeds of sales).	Amount covered into the Treasury under miscellaneous receipts on account of proceeds of sales Government property during the fiscal year ended June 30, 1907.	Amount covered into surplus fund of the Treasury on June 30, 1907.	Amount in United States depositaries to credit of disbursing officers under ordnance appropriations on June 30, 1907.	Amount deposited in the Treasury on account of Ordnance Department, but not credited to ordnance appropriations on June 30, 1907.	Amount in Treasury to credit of ordnance appropriations on June 30, 1907.	Total.
Ordnance stores, manufactures, etc. (certified claims).....		\$150.00							\$150.00
Ordnance stores, equipments (certified claims).....		18.00							18.00
Ordnance stores, repairs (certified claims).....		25.00							25.00
Submarine mines in insular possessions.....								\$205,440.00	205,440.00
Converting muzzle-loading guns for saluting purposes.....								5,250.00	5,250.00
Miscellaneous receipts.....				\$8,461.53				8,461.53	8,461.53
Total	\$9,892,165.91	117,916.90	\$215,803.98	8,461.53	\$35,981.34	\$1,879,617.65	\$26,852.19	11,273,507.09	23,450,306.59

The total amount of the appropriations for the fiscal year 1907, including those contained in the act making appropriations for fortifications and other works of defense approved March 2, 1907, amounted to \$9,853,015.14. The total amount with which the appropriations were credited in accordance with authority of law from sales, transfers, etc., was \$1,313,092.94. The total of the payments made by disbursing officers and by Treasury settlements during the year amounted to \$10,010,082.81. The total sales of condemned stores during the year amounted to \$215,803.98, all of which was credited on the books of the Treasury Department to "Ordnance material (proceeds of sales)." The total sales to colleges and other parties, covered into the Treasury Department to the credit of the fund "Miscellaneous receipts," was \$8,461.53. The total amount to the credit of disbursing officers on June 30, 1907, was \$1,879,617.65, and the total amount in the Treasury on the same date amounted to \$11,300,359.28.

FUNDS ON HAND AT THE BEGINNING AND CLOSE OF THE FISCAL YEAR.

The principal amounts on hand at the beginning of the year pertained to the following appropriations:

Manufacture of arms, 1906-1907.....	\$1, 416, 631. 58
Field artillery for organized militia, 1907.....	550, 000. 00
Board of Ordnance and Fortification.....	208, 061. 13
Armament of fortifications.....	8, 452, 375. 13
Fortifications in insular possessions.....	1, 474, 516. 24

The status of these appropriations at the close of the fiscal year will be seen by reference to the tabular statement, and will be discussed later under the above heading.

The principal amounts on hand at the close of the fiscal year pertained to the following appropriations:

Ordnance stores, ammunition, 1907.....	\$251, 227. 55
Replacing ordnance and ordnance stores, 1907-1908.....	668, 252. 82
Manufacture of arms, 1907-1908.....	854, 209. 43
Armament of fortifications.....	5, 684, 820. 39
Fortifications in insular possessions.....	1, 190, 386. 06
Field artillery for organized militia, 1907.....	296, 480. 30

The above amounts under the appropriations "Armament of fortifications" and "Fortifications in insular possessions" include the sums of \$1,829,000 and \$457,500, which had been appropriated at the last session of Congress under these appropriations, respectively. Under the law these appropriations are available on the approval of the act making them and until used.

The balances under the fund "Replacing ordnance and ordnance stores, 1907 and 1908," and the appropriation "Manufacture of arms, 1907-1908," are available for the fiscal year 1908.

Of the above amounts reported on hand at the close of the fiscal year the greater portion, in nearly every case, has been allotted to meet outstanding obligations. The available balances under the above-named appropriations at the close of the fiscal year are as follows:

Ordnance stores, ammunition, 1907.....	\$442. 62
Replacing ordnance and ordnance stores, 1907 and 1908.....	380, 005. 89
Manufacture of arms, 1907-1908.....	537. 50
Armament of fortifications.....	1, 879, 597. 64
Fortifications in insular possessions.....	653, 094. 42

It will be seen, therefore, in case of the above-named appropriations, that they were largely obligated at the close of the fiscal year, except in case of the appropriations which had been made and increased at the preceding session of Congress.

The large amount available under the appropriation "Replacing ordnance and ordnance stores, 1907 and 1908," is due to the fact that this appropriation is also available for the present fiscal year.

TRANSFERS AND SALES OF ORDNANCE STORES.

The value of ordnance stores transferred to the Executive Departments is refunded to ordnance appropriations by Treasury settlements, and the funds received become available upon receipt and remain so during that and the following fiscal year for replacing the stores so transferred. The total value of the stores thus transferred amounted to \$819,397.96. Of this amount \$301,669.19 were on account of transfers to the Navy Department, \$89,406.37 on account of transfers to the Marine Corps, \$38,609.11 on account of transfers to other Executive Departments, and \$428,322.40 on account of transfers to the organized militia. In conducting experiments for the Board of Ordnance and Fortification the value of the ordnance stores which were used in them amounted to \$49,546.74, which was transferred from the appropriations for the Board to the ordnance appropriations proper.

The total amount of sales made to the organized militia, to the Philippine government, to officers of the Army, to American designers engaged in the development of military inventions, etc., amounted to \$391,783.92, all of which was refunded to ordnance appropriations.

The total of the transfers and sales amounted to \$1,313,092.94, which is 13.3 per cent of the total amount appropriated for the use of this Department in arming, equipping, and supplying the Regular Army.

PAYMENTS.

The total amount of payments made by disbursing officers amounted to \$9,892,165.91 and by Treasury settlements to \$117,916.90, a total of \$10,010,082.81. The appropriations proper for the year amounted

to \$9,853,015.14. By reason of the procurement of ordnance and ordnance stores to replace articles transferred or sold to other departments, etc., the disbursements were about 2.5 per cent in excess of the appropriations.

The amounts of disbursements made at the principal arsenals and in the Ordnance Office during the fiscal year are as follows:

Frankford Arsenal	\$2,030,432.20
Rock Island Arsenal	2,155,567.28
Sandy Hook Proving Ground	153,327.22
Springfield Armory	1,704,227.74
United States Powder Depot	87,278.31
Watervliet Arsenal	340,084.48
Watertown Arsenal	541,962.29
Ordnance Office	2,338,818.61

AMOUNTS COVERED INTO THE SURPLUS FUND.

The principal amounts covered into the surplus fund of the Treasury were:

Manufacture of arms, 1904 and 1905	\$16,806.30
Ordnance stores and supplies, 1905	8,506.16
Artillery targets, 1905	5,564.11
Converting muzzle-loading guns for saluting purposes, 1905	1,463.51
Ordnance service, 1905	1,276.01

COMPARISON OF THE FISCAL STATEMENT WITH THAT OF THE PRECEDING YEAR.

Comparing the fiscal statement with that of the preceding year, it will be found that the amount of the appropriations was increased from \$8,126,418.57 to \$9,853,015.14, an increase of \$1,726,596.57; the amount of the disbursements decreased from \$11,389,835.09 to \$10,010,082.81, a decrease of 12.1 per cent. The amount received from transfers to the Executive Departments and the organized militia decreased from \$998,173.82 to \$819,397.96. The amount available for disbursement at the close of the fiscal year decreased from \$12,284,198.51 to \$11,300,359.28, a decrease of \$983,839.23.】

SYSTEM OF MONEY ACCOUNTS.

It has been the object of this office to continually improve the system of accounts established therein and at the various ordnance establishments, as experience developed defects and pointed out better methods to be prescribed.

In my last report I referred specifically to the difficulties involved in accounting for public funds expended on account of the indirect expenses arising from manufacturing operations at the various arsenals. It has been held by the accounting officers of the Treasury Department that every item of expenditure constituting part of the

indirect expenses of manufacture should be charged pro rata against each and every appropriation authorizing manufacturing or similar operations. This gave rise to expensive methods in the preparation of vouchers covering the disbursement of funds arising on account of such indirect expenses. In order to reach a simpler method of accounting for such funds, the matter was submitted to Congress, and the necessary legislation was enacted which enables this Department to charge such indirect expenses in such a manner as is most economical and efficient, provided that each and every appropriation authorizing manufacturing or similar operations shall eventually bear its ratable share of such expenses.

In determining the costs of articles manufactured, repaired, or altered at ordnance establishments, this Department has been for several years considering not only the costs which arise on account of expenditures from the appropriations authorizing the work and charged thereto, but also the costs which arise from depreciation of plants and equipments, interest on capital invested, pay of officers and enlisted men, charges on account of fire, and general administrative expenses required in the maintenance of the several establishments and not charged against the manufacturing appropriations. The various percentages by which these costs constitute part of the total cost have been determined for the five larger arsenals on account of operations during the fiscal year of 1906.

During the past year a system of cost keeping was prescribed and introduced at Watertown Arsenal. At this arsenal it had been customary for the workmen to report, on blanks furnished them for the purpose, the number of hours of work performed by each on the various jobs given them. It was not believed to be in the interest of good administration that the interested party keep account of his own services which would be the basis of his compensation. The system introduced, therefore, provides that the compensation of employees and the charges for labor on the various orders be based on entries made on time and job cards by registering time clocks. The charges for material entering into the manufacture of articles are based on the accomplished receipts of the foremen showing the delivery of the material for that purpose.

The several costs are obtained from these vouchers semimonthly and transferred to a monthly expenditure card for each and every order. These records are transferred monthly to a consolidated card until the completion of the order, when the record is completed and the card filed.

In the introduction of this system at Watertown Arsenal an innovation was made in treating the several machines as direct machines and charging the time they were engaged in accordance with the

hourly rate prescribed for them. The treating of each direct machine as if it were a machinist requires that when it is idle the value thereof shall be charged pro rata as a general expense over the entire work in the shops. Provision is made for determining at the end of each year the additional cost arising from administration, idle machinery, depreciation, interest on the capital, and fire charges. This additional cost will be prorated over the orders of the subsequent fiscal year in proportion to the direct and machine labor performed thereon. It is expected to introduce later an additional cost card which will take into consideration the costs of the several components of and of the principal operations on the larger articles of ordnance property manufactured at that arsenal. This Watertown Arsenal system constitutes the Department's latest refinement of the difficult subject of cost keeping.

The cost-keeping systems now in operation at the various arsenals are considered reliable and furnish the actual costs of articles within reasonable limits of error. It may also be added that through the efficient management of the several commanding officers the costs of articles manufactured have, generally speaking, been much less than the price at which these articles could have been procured elsewhere. In my last annual report I referred to specific instances where the costs were much lower at manufacturing arsenals than the prices of the same articles procured by purchase. As this report is required to be rendered much earlier this year than last, I am unable to furnish a similar lengthy list, but can only refer to one specific instance, namely, the manufacture of 3-inch field guns. Thirty-six of these guns have just been completed under contract dated November 21, 1905, at a price of \$2,177.90 each, exclusive of the costs of inspection; 36 of these guns have also just been completed at Watervliet Arsenal, under an order given the commanding officer thereof under date of October 13, 1905, at a total cost of \$1,273.92 each, which includes the charges for administration, fire, interest on capital invested, and depreciation of plant.

SYSTEM OF PROPERTY ACCOUNTS.

In my last annual report I referred to the introduction of a new classification of ordnance property at the various arsenals which had been inaugurated at that time. During the year this classification has been extended to include the ordnance property located elsewhere. No criticisms whatever have been received of this new classification, and it is believed that it has fulfilled all the requirements that it was intended to meet.

The accounting for ordnance property at the various arsenals requires that property in which the transactions are rare shall be

accounted for on permanent record cards which are not changed unless the quantity or condition of the article thus accounted for is changed. The saving in clerical work by the use of these record cards is shown by the following table, giving approximately the number of articles thus accounted for:

Received from—	Number of cards in return.
Augusta Arsenal	800
Benicia Arsenal	1,300
Frankford Arsenal	2,900
New York Arsenal	1,400
Rock Island Arsenal	3,600
San Antonio Arsenal	1,300
Sandy Hook Proving Ground	5,200
Springfield Armory	2,400
United States Powder Depot	1,100
Watertown Arsenal	2,300
Watervliet Arsenal	2,500
Total	24,800

The adoption of this system of accountability means that the accountable officers are no longer required each six months to rewrite headings and footings and make corresponding entries of approximately 25,000 articles of ordnance property. It may be stated here that all the cards received from the various arsenals have been examined and settled.

The articles of ordnance property at the various arsenals in which the transactions are not rare are required to be accounted for on a semiannual return wherein columns are provided for the entry of the receipts and issues under the several headings provided for these articles. Blank forms with appropriate printed headings have been prepared for nearly all the regular articles of issue required to be accounted for on this return.

The introduction of this new system of property accountability led to considerable delay in the rendition of the first returns by the commanding officers of the various arsenals. In some cases the character of the returns received showed that the instructions furnished for their preparation had not been carefully followed. However, where new clerks, previously not familiar with the rendition of property accounts, had charge of the preparation of the new returns the results accomplished have been exceedingly satisfactory. A marked exception, however, to the delay in the rendition of the semiannual return was in the case of that rendered by the commanding officer of the Watervliet Arsenal, which was not only received within the prescribed time but the number of errors found in this return of about 700 pages amounted to only thirteen. It was a very creditable piece of work and shows that the new system of property accountability can be made a success.

The form of semiannual return used by the commanding officers of arsenals is also now being used by artillery district ordnance officers. These officers are required to account for large quantities of ordnance property in which the transactions are numerous; this form of return was therefore deemed advisable for them to use.

The form of return prescribed for the remaining custodians of ordnance property, comprising governors of States and Territories, commanding officers of organizations, post ordnance officers, educational institutions, etc., has been prepared, and these accountable officers are now rendering returns on this new form. This form of return is similar in principle to that used by the commanding officers of arsenals. It is, however, slightly smaller and can be folded to the indorsement size and therefore easily packed for field service with the other records. The marked advantage of the present forms of returns over the old ones consists in their being composed of a number of separate blanks for the various articles usually found together in service. Officers are not required, therefore, to use any sheets in the rendition of a return covering articles for which they are not accountable. As voluminous abstracts of receipts and issues are not required with the new forms of returns the saving in filing space is even greater than the saving in clerical work. In the case of certain returns from arsenals the space occupied by the new form is one-fifteenth of that formerly occupied by the same return and its accompanying abstracts. The new form also facilitates the examination of transactions about which a question may arise, since the entries thereof will be found directly on the return under the appropriate heading, thus saving the time heretofore required to consult many abstracts under the same heading.

In the preparation of the various blanks of the new forms of returns care has been taken to establish a standard nomenclature, by which the property can be transferred, inventoried, etc., throughout the service. The fact that it has been the practice to give different names to the same article has led to endless confusion in the auditing of property returns. Advantage has also been taken in the preparation of price lists to not only arrange all articles according to the new classification, but to properly describe such articles according to the standard nomenclature.

It has also been the experience of this Department that there is no better method of furnishing instructions in regard to the preparation of papers than to have such instructions printed on the back of the blank forms furnished for the purpose. Not only is the semiannual return and form of return now used by the governors of States and Territories and the commanding officers of organizations furnished with these instructions, but the statement of charges, certi-

ificate of expenditures, etc, have had printed on them detailed instructions required for their proper preparation. In the case of volunteer officers called into service it is believed that these instructions will be invaluable in performing the duties which will devolve on them.

Maj. George Montgomery, in charge of the finance and property divisions of this office, has, in conjunction with the commanding officers of the large manufacturing arsenals, given great attention to the subject of the improvement of the system of accounting and cost keeping. There have been introduced, first at one arsenal and then at another, improvements and refinements of the method of keeping track of expenditures for manufacturing purposes, which have been in part described above. In working out this process economy of clerical labor has been carefully kept in mind, and consideration has been given as to whether each additional bit of information was worth the expense of procuring it. At all of the arsenals the strength of the clerical force is less in proportion to the business done than before the introduction of the changes.

Accountability for property offers greater difficulties than that for money. Money is carefully kept in depositories and is disbursed only for purposes which are closely scrutinized. Property is widely scattered; it is in the possession of a great number of people, some of them of little responsibility, and when not in present use is apt to pass out of mind in a manner not shared by money. In addition, persons accountable for property are often so placed and have such other duties that the clerical work of giving an account of it is oftentimes onerous and perhaps annoying. And yet the investment of the Government in property is enormous, and there must be continual effort to provide reasonable accountability for it without interfering with the effective prosecution of the purposes for which it is provided. The efforts of Major Montgomery have effected very considerable improvements in the method of accounting for the property of this Department, both that at the arsenals and that in the hands of organizations of the active army. The clerical labor has been much reduced and at the same time the accountability has been made more strict.

EXAMINATION AND SETTLEMENT OF ORDNANCE PROPERTY RETURNS.

STATUS OF THE WORK.

The work of the examination and settlement of property returns during the past fiscal year is set forth in the following table:

Returns.	On hand July 1, 1906.		Received during year.	Examined during year.	Settled during year.	On hand June 30, 1907.	
	Unexamined.	Examined and not settled.				Unexamined.	Examined and not settled.
Arsenals and inspectors.....		4	89	88	61	1	31
Artillery, coast and field.....		22	611	410	395	201	37
Cavalry.....		52	751	437	427	314	62
Infantry.....		133	1,484	1,074	1,064	410	143
Surgeons.....		30	611	610	609	1	31
Philippine Scouts.....		36	176	176	171		41
Artillery districts.....		4	43	28	28	15	4
Forts and posts.....		13	399	268	262	131	19
Submarine mine property.....		7	109	109	100		16
Militia (States, etc.).....		26	53	10	24	43	12
Colleges.....		23	190	136	139	54	20
Miscellaneous.....		24	346	346	331		39
Total.....		374	4,862	3,692	3,611	1,170	455

This table shows that at the beginning of the fiscal year all returns had been examined, but 374 remained to be settled on account of errors and other reasons.

At the close of the fiscal year 1,170 returns remained to be examined, and 455 were examined and not settled. The reason that the work of auditing returns was not up to date at the close of the year is the extra work involved in the introduction of a new classification of ordnance property and of new methods in accounting for it and the loss by death and resignation of valuable clerks in the property division of this office.

It may be stated here that it was expected during the last fiscal year that the present force in the property division could not undertake to audit all the property returns, in view of the difficulties stated above, and since March 1 these clerks have been working overtime, with a view to accomplishing as much as it was practicable to accomplish within the closing period of the fiscal year. I can not speak too highly of their faithfulness, energy, and the excellent character of the work performed by them at a time when such qualities have been so necessary in order to accomplish the desired result.

As the cause of the delay in the settlement of returns during the last fiscal year will not obtain during the present one, there is no reason to doubt but that the work will sometime in the course of the year be up to date, and it should then go on more satisfactorily because of the introduction of the new system.

The examination of ordnance property returns during the past year shows that the sum of \$1,797.11 was paid to the United States

by officers to cover the value of ordnance property not properly accounted for by them, that the sum of \$9,221.67 was charged against enlisted men to cover the value of stores lost or destroyed by them, and that the sum of \$3,222.19 was charged against deserters for similar reasons. The returns examined further show that ordnance property to the value of \$118,183.42 was dropped from the property returns without having been paid for or charged, it having been lost, due to unavoidable causes or destroyed in the interests of the service.

The examination of returns in prior fiscal years showed a great loss of small arms, particularly revolvers. Since the publication of Circulars Nos. 27 and 40, War Department, series of 1905, informing officers that they would be held pecuniarily responsible for all losses of small arms unless every possible precaution should be taken for their safe-keeping, and that the Ordnance Department issues for the safe-keeping of small arms arm chests provided with locks and hinges, this office has rigidly enforced the requirements of these circulars in the examination of returns showing losses of revolvers. The result has been that, as shown by the returns examined during the last fiscal year, the loss of revolvers has been very largely reduced throughout the service. Many of these losses occurred at maneuver camps, where it was not practicable to use the same precautions for the safe-keeping of small arms, as in garrison.

Section 1661 of the Revised Statutes, as amended by the act approved June 22, 1906, authorizes the charging of the loss of public property issued to the States, Territories, or the District of Columbia, for the purpose of arming and equipping their organized militia, when such losses arise through neglect, carelessness, or could have been avoided by the exercise of reasonable care, against the allotment of the State made from the appropriation contained in this section. This authority has resulted in the settlement of all the returns of ordnance property from the various States except that of one State, wherein the loss was so great that the Secretary of War is now considering the means to be followed in making the charge without seriously affecting the amount of future issues to be made this State.

EXPENDITURES OF ORDNANCE PROPERTY.

It has been frequently the practice of officers accountable for ordnance property to drop from their returns expendable supplies upon their receipt, without there having been an actual expenditure or consumption of such supplies. This practice has led to these officers having on hand surplus ordnance property not accounted for as required by law and regulations. Whenever such property is on hand in an organization there can not be the same degree of care exercised over it as when the property is regularly accounted for. It

appears also that in many cases articles have been dropped from the returns as expended which were not authorized to be so dropped. After correspondence it was found that in most cases such property had not been expended and was again taken up on returns by the accountable officers. This Department in the preparation of price lists has indicated the articles which are properly expendable, and when officers consult these price lists freely considerable correspondence required now in the examination and settling of returns will be obviated.

The most flagrant cases of expenditure of articles of public property, when there had been no real expenditure, have been in the case of small-arms ammunition. It appeared to have been the practice to drop from the property returns the authorized allowance of small-arms ammunition irrespective of whether or not such allowance had been entirely expended or fired in target practice or other instruction. On recommendation of this office, Circular No. 16, War Department, series of 1906, was published, requiring officers to furnish with their returns a certificate that they had made a careful inventory of the various quantities of small-arms ammunition, for which they were accountable, and had taken up all surplus ammunition on hand. The beneficial effect of this circular is shown by the fact that the returns examined during the last fiscal year show that 1,063,475 rounds of rifle ball cartridges, 274,589 rifle blank cartridges, 78,653 rounds of revolver ball cartridges, and 48,075 rounds of revolver blank cartridges were taken up and accounted for by the various accountable officers. The value of the small-arms ammunition so taken up and accounted for is approximately \$38,000. A similar certificate is now required from officers accountable for artillery ammunition, but the object in this case is not so much to prevent the dropping of ammunition not actually expended as to require such officers, twice a year, to make a careful inventory of artillery ammunition, so that in case steel projectiles are fired in lieu of cast-iron ones at target practice the responsibility can be readily fixed.

AVOIDABLE DELAYS IN THE SETTLEMENT OF RETURNS.

It has been found in the examination of returns that one of the most frequent causes of delay in their settlement has arisen from the failure of officers to comply with existing instructions in reporting charges made on pay rolls against enlisted men on account of the loss or damage of ordnance property for which they were accountable, and in failing to comply with Army Regulation 1564, as amended, requiring that when detached soldiers are transferred from one station to another, accompanied by their equipments, such equipments shall be invoiced and receipted for as provided for in that regulation.

It having been found that the practice of sending the "Statement of charges" to the Paymaster-General for verification led to considerable delay in the settlement of returns, on account of the numerous pay rolls which had to be consulted in the verification of such charges, General Orders, No. 180, War Department, series of 1905, was published, requiring that a monthly report of all charges on each pay roll should be transmitted to the Chief of Ordnance, through the paymaster who pays the men on the roll on which the charges appear, for verification. This general order would have accomplished a much desired result if officers had in all cases furnished the desired report for verification by the paymaster without this office having to call on them by correspondence to do so.

In regard to the requirement of Army Regulation 1564, relative to the accounting for equipments in the possession of enlisted men sent from one station to another, compliance with this regulation would not only result in the prompt settlement of the returns of the invoicing officer, since he is authorized to drop the property on the receipt of the detached soldier, but would also lead to an equally prompt settlement of the returns of the receiving officer, when the receipt required by him is transmitted to the Chief of Ordnance. The difficulties which have been met with have arisen from officers dropping property in the possession of detached soldiers as charged on descriptive lists or descriptive assignment cards in case of recruits, which are not in any sense property vouchers, and frequently, even when the invoices are prepared in accordance with Army Regulation 1564, receiving officers fail to complete the receipt for the property and forward it to the Chief of Ordnance. These difficulties have increased the correspondence of the office to a great extent, all of which could be obviated by compliance with the regulation in question. It is hoped that the difficulties mentioned above will be largely obviated by reason of the instructions published in General Orders, No. 59, War Department, series of 1907, which furnishes detailed instructions in regard to reporting charges against enlisted men on pay rolls, and prohibits the practice of dropping property by virtue of charges appearing on descriptive lists or descriptive and assignment cards.

Another difficulty met with in the settlement of accounts has arisen from officers failing to render prompt returns in case of complete transfer of accountability to another officer. On the recommendation of this office Army Regulation 705 was amended, requiring that in cases in which complete transfer of property from one officer to another occurred within an accounting period the closing return should be forwarded by the officer making the transfer within twenty days after the date thereof. A practice also arose of continuing account-

ability for property which was either not on hand or retained for some purpose, when a complete change of accountability should have occurred. Such property was accounted for by officers as "Stores in charge." This practice has been broken up by requiring that officers who were so accounting for property should either turn it over to an officer properly responsible for such property or, in case it was not on hand, to furnish proper evidence to show that the loss occurred without fault or neglect on their part. Army Regulation 716, as amended, requires that all returns of officers shall show the actual quantities of stores on hand and that in case vouchers can not be furnished to account for any shortages, reference thereto must be made on the return to show that such vouchers will be submitted as early as practicable. It is expected that these regulations, as amended, will accomplish the settlement of returns with the minimum delay and correspondence.

COST OF MAINTENANCE OF ORGANIZATIONS.

In my last annual report I referred to the introduction of certain records in this office whereby the relative values of ordnance property disposed of by the different organizations would be ascertained, not including supplies which are expended in the preservation of the arms and equipments issued to the several organizations. As all the returns for the calendar year 1906 have not been examined, it has not been practicable to furnish the desired information for the entire calendar year, and the following tables furnish it only for the six months ended June 30, 1906:

CAVALRY.

Regiment.	Station.	Maximum.		Minimum.		Total (Regt.).
		Troop.	Amount.	Troop.	Amount.	
1.....	United States.....	G	\$681.09	H	\$330.18	\$1,782.21
2.....	do.....	B	307.30	K	9.35	432.26
3.....	Philippine Islands.....	H	325.96	M	44.81	494.09
4.....	do.....	E	796.64	B	552.51	1,349.15
5.....	United States.....	F	436.50	I	7.45	1,002.84
6.....	do.....	I	289.38	F	7.87	414.45
7.....	Philippine Islands.....	K	385.79	B	1.65	394.60
8.....	do.....	C	642.02	C	642.02	642.02
9.....	United States.....	B	626.26	K	34.80	2,416.84
10.....	do.....	B	381.12	A	38.35	1,052.92
11.....	do.....	D	421.79	I	78.08	1,962.96
12.....	do.....	G	589.55	K	40.09	2,167.81
13.....	do.....	F	517.64	K	11.60	2,337.65
14.....	do.....	D	307.17	L	281.83	589.00
15.....	do.....	D	394.34	B	1.74	1,779.29

INFANTRY.

Regiment.	Station.	Maximum.		Minimum.		Total (Regt.).
		Com- pany.	Amount.	Com- pany.	Amount.	
1.....	Philippine Islands.....	I	\$39.71	I	\$39.71	\$39.71
2.....	do.....	A	291.13	H	4.15	796.14
3.....	United States.....	I	61.34	F	.96	123.62
4.....	do.....	B	124.52	L	.84	215.73
5.....	do.....	A	113.75	I	2.09	165.63
6.....	Philippine Islands.....	I	220.46	G	13.44	1,297.11
7.....	United States.....	D	219.65	C	89.23	624.36
8.....	Philippine Islands.....	A	200.17	G	2.27	398.04
9.....	do.....	B	244.76	K	.56	390.45
10.....	Alaska and Hawaii.....	G	27.57	C	.82	43.15
11.....	United States.....	D	143.28	L	18.11	161.39
12.....	do.....	F	1.19	F	1.19	1.19
13.....	Philippine Islands.....	K	33.58	A	1.96	127.40
14.....	United States.....	L	56.91	M	5.63	87.84
15.....	Philippine Islands.....	C	32.64	K	4.12	116.89
16.....	do.....	F	111.71	G	5.29	397.32
17.....	United States.....	K	251.41	A	16.23	1,089.09
18.....	do.....	H	131.47	D	11.29	364.45
19.....	Philippine Islands.....	F	265.36	K	2.51	1,075.68
20.....	United States.....	D	98.47	A	10.48	328.67
21.....	Philippine Islands.....	E	245.24	L	26.13	1,116.65
22.....	United States.....	H	218.70	F	14.90	824.28
23.....	do.....	M	287.84	D	21.35	735.69
24.....	Philippine Islands.....	I	45.42	L	.59	55.64
25.....	United States.....	B	172.06	M	11.00	223.54
26.....	do.....	G	322.52	I	15.12	796.86
27.....	do.....	D	13.40	D	13.40	13.40
28.....	do.....	A	43.06	M	1.43	141.51
29.....	do.....	I	188.08	K	41.51	229.59
30.....	do.....	M	12.75	M	12.75	12.75
Porto Rico.	Porto Rico.....	F	423.06	G	58.39	1,662.34

FIELD ARTILLERY.

Battery.	Station.	Total.	Battery.	Station.	Total.
1.....	United States.....	\$425.03	16.....	United States.....	.....
2.....	do.....	258.49	17.....	do.....	.....
3.....	do.....	307.31	18.....	do.....	.....
4.....	do.....	1,103.51	19.....	do.....	\$935.09
5.....	Philippine Islands.....	1,103.51	20.....	do.....	.....
6.....	United States.....	967.15	21.....	do.....	13.50
7.....	do.....	1,043.70	22.....	do.....	616.68
8.....	Philippine Islands.....	1,402.60	23.....	do.....	.....
9.....	United States.....	994.26	24.....	do.....	8.40
10.....	do.....	376.65	25.....	do.....	495.99
11.....	do.....	369.03	26.....	Philippine Islands.....	.....
12.....	do.....	.....	27.....	United States.....	435.63
13.....	Philippine Islands.....	476.94	28.....	Philippine Islands.....	.....
14.....	United States.....	.....	29.....	United States.....	17.00
15.....	do.....	191.70	30.....	do.....	405.81

An examination of the preceding tables furnishes an idea of the cost of maintaining the several organizations and the several articles of ordnance equipments which are not expendable. On account of the brief period covered by the tables it is not desired at this time to invite attention to the excessive expenditures, as they probably arose from the unusual conditions of field service of the organizations against which these amounts are charged. These tables are therefore furnished solely for the purpose of showing the results that can be accomplished when the system is in working order.

In the primer on cost keeping published by the Committee on Department Methods (Keep Commission) and approved by the

President the advantages of obtaining costs, not only of the manufacture of articles at Government establishments but also of certain definite objects, such as the maintenance of organizations, etc., were pointed out. The expenditure of supplies required in the maintenance of ordnance, small arms, and equipments in the possession of troops is a part of the cost of the maintenance of the several organizations of the Army to which they are issued, and the question of whether or not accountable officers shall report on the proper form the values of the *expendable* supplies consumed by their organizations is now under consideration by the War Department. It may be considered impracticable to furnish this information, but if it can be done, undoubtedly a very desirable result would be accomplished. It is believed that when commanding officers of organizations realize that an account is kept of the cost of maintaining their commands efforts will be made by them to reduce the cost as much as it is practicable combined with the required efficiency of their respective organizations. It is understood that comparison in any case should only be made of organizations serving under like conditions.

SMALL ARMS.

United States magazine rifle, model of 1903.—A new musket, with knife bayonet and model of 1905 rear sight, has been issued to all the regular troops in service. It has, on the whole, proved most satisfactory. The minor defects mentioned in my report of a year since have been overcome, and, with the exception of the weapons in the hands of the troops, the greater part have been rechambered for the model of 1906 ammunition. As soon as a sufficient quantity of this ammunition shall have been manufactured the modified rifle will be issued and the rifles recalled will also be converted. On this account the reserve supply of ammunition, model of 1903, has been reduced to the lowest amount possible, in order that, concurrently with the issue of the altered rifle, the new ammunition will be available and the model of 1903 ammunition exhausted.

Telescopic sight for the musket.—Paragraph 235, Small Arms Firing Regulations for 1906, prescribed a telescopic sight for the use of expert riflemen. Such a sight was perfected and received a favorable report from the Infantry Board, but as the cost (about \$80) was almost prohibitive, the same general lines have been followed in the development of a new model, the cost of which will not be much more than half that of the earlier form. All the essential features have been retained, the reduction in cost having been effected mainly by simplification of the mechanical details. It is hoped that a supply of these sights may be obtained before the close of the calendar year.

Thong and brush for United States magazine rifle, caliber .30, model of 1903.—The design has been improved so as to do away with the abrasion of the string at the point where it is connected with the metal part, and the string has been largely increased in strength, it having been found in service that such change was desirable.

Self-loading magazine rifles.—The test of the Schuboe automatic magazine rifle has been continued during the year. Experiments are continuing with this class of gun at Springfield Armory.

Muzzle rest for magazine rifle.—One of these devices has been manufactured, in general accord with the design of Lieut. W. L. Guthrie, Corps of Engineers, and has been attached to a magazine rifle, model of 1903. It is intended for steadying the rifle during firing in the prone position, and when not in use folds under the barrel, the two prongs being held in this position by a band designed to slip over them. The rifle to which this rest was assembled has been sent to the School of Musketry for experimental trial.

Revolvers and automatic pistols.—Upon the request of this Department a board was convened for the test of revolvers and automatic pistols, with a view of determining the most desirable weapon, and whether it was sufficiently superior to the service revolver to justify adoption.

The tests consisted of velocity and accuracy firings, endurance, rust and dust tests, examination of the arms, consideration of the number of parts, etc.

The automatic pistols submitted were the Colt, Luger, Savage, Knoble single action, Knoble double action, Bergmann, and White-Merrill.

The double-action revolvers submitted were the Colt and Smith & Wesson. The Webley-Fosbery automatic revolver was also tested.

All of the above weapons were caliber .45, firing ammunition having a muzzle velocity of approximately 800 feet per second and a weight of bullet of 230 grains.

As a result of the tests the Board stated its belief to be that the advantages of the automatic pistol and the disadvantages of the double-action revolver are such as to require the adoption of an automatic pistol if practical certainty of action is attained. None of the weapons tested were entirely satisfactory to the Board in this respect, but favorable mention was made of the Colt, the Savage, and the Luger.

The Board recommended that the troops in the Philippines be armed as soon as practicable with Colt double-action revolvers, caliber .45; that three troops of cavalry be completely armed with Colt automatic pistols and three troops with Savage automatic pistols for a service test of one year; that these arms be used during the test to the exclusion of the service revolver; and that one troop of cavalry at

each of the posts supplied with automatic pistols be equipped with Colt revolvers, caliber .45, for purposes of comparison.

The recommendation that three troops of cavalry in the United States be armed with Colt automatic pistols and three troops with Savage automatic pistols was approved; but it was decided not to purchase any revolvers at the present time, although both revolvers tested were found to be excellent weapons of their kind. It is expected that the use of automatic pistols in the service for a year will furnish such information as will enable those interested in furnishing this type of pistol to make such improvements as will meet the objections which the Board has found to the final adoption of any one of the models presented.

Two hundred Colt automatic pistols, with certain modifications recommended by the Board, are under manufacture, and it now seems probable that a like number of Savage automatic pistols may be obtained, at first some consideration having been necessary for the supply of this limited number of pistols of a new caliber. Luger pistols may also receive further trial in the service.

The Board was of the opinion that the pistol finally adopted should be of the caliber .45 because of the greater stopping power of the projectile than that of the present caliber .38. Special means of increasing the stopping power of the caliber .38 bullet have been devised (proposed by Capt. Samuel Hof, Ordnance Department), but it has been deemed better to endure the slight increase of weight involved with the pistol and ammunition of caliber .45 than to adopt a cruel form of bullet of smaller caliber.

During the year an automatic pistol, caliber .45, designed by Maj. W. S. Peirce, Ordnance Department, and Capt. Wilford J. Hawkins, also of the Ordnance Department, has been manufactured and given an armory test. While not entirely successful, the pistol gave so much promise that another one of the same design, but with such improvements as the test of the first one would seem to make necessary, will be manufactured and tested.

Gallery practice rifles, caliber .22.—A number of gallery practice rifles, caliber .22, model of 1898, have been completed and issued to the militia. The model of 1903 gallery practice rifle has been perfected during the year, and as it proved to be quite as accurate as that of the model of 1898, and has the advantage of permitting the use of the clip and rapid firing, if desired, the earlier model gallery practice rifle has been recalled and that of the model of 1903 will be issued both to regular troops and to the militia.

The cartridge holder as finally adopted is of the design of Maj. Jay E. Hoffer, Ordnance Department, U. S. Army, with modifications suggested by Maj. John T. Thompson, also of this Department.

This holder is in shape similar to the service cartridge, but is bored and chambered to receive the .22 caliber short cartridge. The holder is so shaped that it can not by chance be inserted in the service rifle. The chamber of the gallery practice rifle will not receive the service cartridge.

Automatic machine gun.—During the year cavalry and infantry regiments in service have been equipped with the Maxim automatic machine gun, caliber .30. Pack outfits of both American and English design were issued to each platoon for the purpose of a comparative trial. The reports received are so much at variance that no definite conclusion can be drawn. As far as possible the pack outfits will be reassigned, giving to each platoon the type desired. The more desirable of the two types will be adopted when greater experience shall have been had. In the meantime there is a fair supply of each.

SMALL-ARMS AMMUNITION, CALIBER .30, MODEL OF 1898.

The National Board for the Promotion of Rifle Practice recommended for use in the National Match machine-loaded ammunition, whether of Government or private manufacture. This recommendation was made after consultation with this Department and with its entire approval. The adjutants-general of the various States were requested to submit requisitions for such ammunition of private manufacture as might be needed on or before March 15, 1907. The requisitions were for ammunition to be manufactured by the Union Metallic Cartridge Company, the Winchester Repeating Arms Company, the Peters Cartridge Company, and the United States Cartridge Company, and the aggregate requisitioned was 911,600 rounds. Inquiry was made of the various companies for the amounts requisitioned, but the Peters Cartridge Company declined an order because of press of private orders and the fact that their plant had been for some time submerged in water, due to floods in that vicinity. The States which had made requisition for the Peters ammunition were again communicated with and were asked to advise what ammunition would be accepted as a substitute. After the revised estimates were received, contracts were placed with each of the three remaining manufacturers and every effort has been made to expedite the manufacture.

The specifications under which ammunition had been formerly procured were revised to such an extent that the cartridge manufacturers were permitted to furnish any ammunition which would properly gauge, pass the Government test for waterproofing, and which would give the required initial velocity. The requirement for non-fulminate primer was waived, provided the ammunition to be furnished would satisfactorily pass the reloading test, and this require-

ment was later waived, provided a price of \$2.50 less per 1,000 were accepted. The necessity for the use of a nonfulminate primer arises from the fact that the fulminate primer causes the metal of the case to deteriorate so rapidly that reloading can not be resorted to. Such cartridges are consequently of less value to the Government than are those which may be reloaded a number of times. Delivery of ammunition by the Winchester Company will begin about the middle of July, while the Union Metallic Cartridge Company and the United States Cartridge Company began deliveries the latter part of June. The United States Cartridge Company objected to the presence of an officer in their works. The affidavit of the vice-president of the company that hand loading had not been resorted to was accepted by this Department after having received the indorsement of the two other private concerns furnishing ammunition.

MODEL OF 1906 BALL CARTRIDGE.

In my last report mention was made of the proposed adoption of a new .30-caliber cartridge having a bullet of improved form of head and weighing 150 grains. During the past year experiments with this cartridge were continued, and by October, 1906, such satisfactory progress had been made that its adoption for service was recommended to the honorable the Secretary of War, and received his approval October 15, 1906.

The principal difficulty encountered in the development of this cartridge lay in obtaining a satisfactory length of accuracy-life for the musket barrel. In the early stages of the development the accuracy-life of the musket was less than 1,000 rounds. This condition was due to the high rate of erosion attending the use of the new cartridge and to the short cylindrical bearing of the bullet. Erosion was of course greatest in the rear portion of the barrel, and owing to the enlargement at this point it was ascertained that the longitudinal axis of the bullet was not constrained into parallelism with the axis of the bore as the bullet seated itself on the rifling. Such a condition naturally manifested itself in considerable inaccuracy. In a new or uneroded barrel, however, the accuracy of the new form of bullet was good, and it was therefore apparent that the rate of erosion must be decreased or the length of cylindrical bearing increased, or both, in order to arrive at a satisfactory accuracy-life of the musket.

To this end efforts were made to develop a powder which should give less erosion, and experiments were made to ascertain how much flatness of the trajectory would be sacrificed for increments in length of cylindrical bearing, increase of this bearing involving, for a bullet of the same total length, a blunter point. Efforts were also made to

find a grade of steel which would offer more resistance to the erosive effect of the powder gases. The efforts to improve the powder have been rewarded by the production of powder the erosive action of which on the bore of the musket is so much less than that formerly used that an unimpaired accuracy-life of 4,500 rounds, and a considerable life of fair accuracy beyond that point, have been obtained with the new cartridge.

The following tabulation shows the varying degrees of flatness of trajectory attained using bullets having different weights, forms, and muzzle velocities:

Bullet.	Point.	Length of cylindrical bearing.		Weight.	Muzzle velocity.	Muzzle energy.	Ballistic coefficient C.	Coefficient of Form c.	Maximum ordinate of 500 yards trajectory.	Remaining energy at 500 yards.	Maximum ordinate of 1,000 yards trajectory.	Remaining energy at 1,000 yards.
		<i>Ins.</i>	<i>Grs.</i>	<i>Ft. per sec.</i>	<i>Ft. lbs.</i>				<i>Feet.</i>	<i>Ft. lbs.</i>	<i>Feet.</i>	<i>Ft. lbs.</i>
Model of 1903.....	Blunt.....	0.625	220	2,200	2,365	0.39408	0.88614	$\left\{ \begin{smallmatrix} 3.25 \\ \alpha 3.20 \end{smallmatrix} \right\}$	879	$\left\{ \begin{smallmatrix} 22.18 \\ \alpha 21.40 \end{smallmatrix} \right\}$	451	
Experimental.....	Sharp.....	.643	220	2,190	2,344	.56314	.62010	$\alpha 2.51$	1,177	$\alpha 15.57$	619	
Do.....	do.....	.255	150	2,700	2,429	.4620	.55863	2.02	966	$\alpha 12.753$	400	
Do.....	Same as model of 1903.	b.30	150	2,700	2,429	.25783	.88359	2.75	555	21.66	240	
Do.....	Sharp.....	.36	150	2,700	2,429	.39982	.59550	$\alpha 2.00$	952	$\alpha 14.06$	392	
Do.....	do.....	.50	150	2,700	2,429	.39470	.60323	$\alpha 2.02$	940	$\alpha 14.25$	386	
Model of 1906.....	do.....	.33	150	2,700	2,429	b.40204	b.59222	$\alpha 1.11$	957	$\alpha 13.96$	395	

^a Calculated values.

^b Estimated values.

Comparing the trajectory of the model of 1906 bullet with that of the bullet of the old weight, 220 grains, but also with the sharp point, it is seen that the maximum ordinate of the former, for 500-yard range, is less than half that of the latter, while for 1,000-yard range the difference is 1.61 feet.

The penetrations obtained in various substances with model of 1903 and the model of 1906 cartridges, respectively, are shown in the following table:

Material.	50 feet.		100 yards.		500 yards.		1,000 yards.	
	Model of 1903.	Model of 1906.	Model of 1903.	Model of 1906.	Model of 1903.	Model of 1906.	Model of 1903.	Model of 1906.
White pine.....	<i>In.</i> 41.5	<i>In.</i> 33.5	<i>In.</i> 43.5	<i>In.</i> 46.7	<i>In.</i> 18.8	<i>In.</i> 24.3	<i>In.</i> 13.4	<i>In.</i> 12.8
Moist sand.....	9.0	8.7	.....	.....	15.6	13.4	13.5	12.5
Dry sand.....	6.0	4.0	.....	.....	13.4	9.2	11.7	7.5
Loam practically free of sand.....	14.2	14.0	.....	.....	22.4	18.8	21.8	18.6
Low steel plate, ".493 thick.....	.177	.446	.085	.259	.....	.....	.....	.....
Low steel plate, ".3843 thick.....	Through.	Through.	.374	Through.	.....	.....	.....	.....
Low steel plate, ".3062 thick.....	Through.	Through.	Through.	Through.	.....	.....	.....	.....
High steel plate, ".3848 thick.....	.065	Through.	.021	.241	.....	.....	.....	.....
High steel plate, ".1962 thick.....	Through.	Through.	Through.	Through.	.....	.....	.....	.....
Seasoned oak, cross grain.....	27.6	12.2	26.3	33.6	.....	.....	.....	.....
Brick wall.....	.....	.....	8.0	5.0	.....	.....	.....	.....

The accuracy obtained with the new cartridge compares favorably with that obtained with the model of 1903 ammunition.

The new cartridge is now being manufactured in quantity at Frankford Arsenal and adaptation of the musket to the new bullet is practically completed, except of the guns in the hands of troops, which will be called in.

THE MODEL OF 1906 GUARD CARTRIDGE.

The rechambering of the musket entailed a change in the existing or model of 1903 guard cartridge. This cartridge has therefore been modified to suit it to the modified chamber of the musket. The new guard cartridge is known as the model of 1906, and differs from the superseded cartridge in having a jacketed pointed bullet entirely similar to that of the model of 1906 cartridge. The use of a jacketed bullet in this cartridge permits the firm crimping of the bullet in the case, thus overcoming the looseness which was found to exist with the nonjacketed bullet in the model of 1903 guard cartridge.

The new guard cartridge gives a muzzle velocity of 1,200 feet per second and a mean absolute deviation at 100 yards of about $1\frac{1}{2}$ inches.

GALLERY-PRACTICE AMMUNITION, CALIBER .22.

Contracts for 5,000,000 rounds of caliber .22 short ammunition were placed with each of three firms, viz, the Peters Cartridge Company, the Union Metallic Cartridge Company, and the United States Cartridge Company. All this ammunition has been delivered and a considerable portion of it issued to the Regular Army and to the militia. The Peters ammunition is loaded with semismokeless powder, while each of the other manufacturers used smokeless powder.

BENCH RELOADING TOOLS.

During the year this Department manufactured for issue to the troops the necessary bench reloading tools to permit the reloading at the posts of fired cartridge cases. The target-practice order was revised on the basis of a monetary allowance for each man participating in target practice. As the components for reloaded ammunition are furnished at cost price it will be possible under the new order and with the reloading tools furnished to obtain from two to three times the allowance of ammunition formerly used, provided a large enough proportion of the reloaded ammunition be made use of. The issue of this material has just begun, and although sufficient time has not elapsed for reports as to the success of the new method it is thought reasonably certain that the change will be welcomed by the Army at large.

SMALL-ARMS TARGET PRACTICE.

In addition to the experiments made with the Williams target, to which reference was made in last year's report, this Department has been furnishing for the use of the militia the Aiken target. It has recently examined and recommended for purchase by the militia a target submitted by the National Rifle Supply Company. The recommendation for the issue of this target for militia use having received the approval of the honorable the Secretary of War, such issues will be made.

Both the targets above referred to have been sent to the School of Musketry for further trial and for recommendation.

There have been sent to twelve different posts in this country for use during the target season and to the School of Musketry for report the following articles, viz, Williams targets, Aiken targets, book-binder's board silhouette targets, and olive-drab silhouette targets, and to the School of Musketry a number of marking disks. These disks are provided with a spring-wire pin which permits the disk to be placed over the shot hole until a subsequent shot is fired. It is then removed, the hole pasted over, and the disk placed over the last shot. The disk is sufficiently large to be seen with a good pair of field glasses at the ranges used.

To the School of Musketry has also been sent a telescopic sight and a muzzle rest for the musket. Reference has been made to each of these earlier in this report.

EQUIPMENTS.

All equipments made of duck or of woven web are now being manufactured or procured in olive-drab color instead of khaki, as was formerly the case.

Experiments are being made to procure a satisfactory enameling or coloring material for use on the cup so as to prevent the reflection of sunlight when carried by the soldier. Samples have been forwarded to the Cavalry Board for an experimental trial and report. During the year a number of canteens were manufactured, with a change suggested by Maj. E. P. Pendleton, Twenty-ninth Infantry. The change suggested was the substitution of a strip of webbing sewed to the rear face of the canteen, in lieu of the ears and the detachable strip formerly used. This modification has received favorable action on the part of the Infantry Board, and it is probable that a number of these canteens will be given a service trial.

Gun slings.—One of the experimental forms of gun sling, to which I made reference in my last report, has since been adopted. The sling as now issued utilizes the short sling formerly used, and has for its primary object the support of the gun in firing and as a second-

any object the carrying of the musket. The design adopted follows very closely that suggested by Colonel Wright, of the Ohio National Guard.

Intrenching tools.—In the procurement of intrenching tools a great deal of difficulty has been experienced in obtaining satisfactory wood for handles for the pick mattocks and shovels. The Department has finally been compelled to obtain intrenching tools without handles and will provide handles for these articles at the Rock Island Arsenal.

Reports on the experimental carriers have been received, and as the result of these experiments duck carriers have been adopted.

BROWNSVILLE INVESTIGATION.

TECHNICAL INVESTIGATION IN CONNECTION WITH THE BROWNSVILLE AFFRAY.

With a view to developing the full value of the circumstantial evidence adduced in the investigation of the Brownsville affray, in so far as this evidence comprised ordnance material, the Department undertook an investigation, the object of which was to identify the rifles from which the bullets and cartridge cases, received in evidence, had been fired.

With this end in view a trial was made at Springfield Armory to determine the possibility of ascertaining from a microscopical examination of the gun marks on a fired cartridge case the rifle from which it had been fired. This trial developed the fact that such an identification was possible by virtue of the characteristic markings on the various external surfaces of the cartridge case, produced by the similar complementary markings in the chamber and on the breech mechanism of the rifle.

The possibility of such an identification having been established by actual trial, all of the cartridge cases received in evidence and all of the rifles which had been at Brownsville in the hands of troops, at such times as would render it possible for the cartridge cases to have been fired from them, were sent to the Springfield Armory for comparative microscopical examination. As a result, it was found that of the 39 cartridge cases in question, 11 had been fired from the same rifle, 8 from another rifle, 11 from another rifle, and 3 from a fourth rifle, the remaining 6 having insufficient gun marks to classify them. The markings on the cartridge cases of each group were then compared with the markings produced by all of the above-mentioned rifles, through the medium of auxiliary cartridges fired at Springfield in each of the rifles. In this way it was found that the cartridge cases comprising groups one, two, and three had been fired in three rifles belonging to Company B, Twenty-fifth Infantry, and that the cartridge cases of group four had probably also been fired from another of the rifles in the same company.

A somewhat similar investigation was made in regard to the bullets recovered from Brownsville and received in evidence before the investigating committees. As the bullets bore no distinctive gun markings, as did the cartridge cases, it was necessary to base their identification upon their design and dimensions and upon the dimensions of the rifle bore. Proceeding along this line by the method of elimination, it was finally established that the bullets were United States model of 1898 or United States model of 1903 bullets, and that they had been fired from either the United States model of 1898 rifle or from the United States model of 1903 rifle, and from no other.

The bearing of these facts upon the identity of the persons doing the firing and upon the time when the cases and bullets were fired in the guns is not a concern of this Department.

GUNS AND MORTARS.

The guns and mortars in our seacoast fortifications have been maintained in a satisfactory state of efficiency during the past year, and reports received from armament officers, post ordnance officers, and battery commanders indicate a greater interest in the care, preservation, and efficient use of this expensive material.

In my last annual report and Appendix I thereof, the influence of erosion in limiting the accuracy-life of guns, especially heavy guns, was discussed at considerable length, and attention was invited to the necessity of lowering the muzzle velocities of the guns in service to prolong their accuracy-life, and of securing in guns of future manufacture the desired offensive power and prolonged life by an increase in caliber and a reduction in muzzle velocity.

The later models of 5, 6, 10, and 12 inch guns, with their high muzzle velocities, obtained by the use of large powder charges, giving high maximum pressures, were the guns that were being most rapidly eroded, and, as a result of the discussion referred to above, their prescribed muzzle velocities have been reduced, for both practice and service charges, to those of the earlier models, and the data available at present indicate that the accuracy-life of these guns will, as a result, be trebled. The actual reductions made in the muzzle velocities of these guns are as follows:

Guns.	Reductions.
5-inch rapid fire, model of 1900	From 3,000 to 2,600 feet per second.
6-inch rapid fire, models of 1900, 1903, and 1905..	From 2,900 to 2,600 feet per second.
10 inch and 12 inch, model of 1900	From 2,500 to 2,250 feet per second.

Of the 14-inch guns recommended by the Taft Board to be used in place of the 12-inch guns in situations where the highest power is required, the necessary funds for three were appropriated by Congress at its last session, two to be mounted in the Philippines and one

in this country. Upon the recommendation of the Board of Ordnance and Fortification, approved by the honorable the Secretary of War, it was decided that two of these guns should be built up of concentric cylinders, assembled with shrinkages in accordance with the system heretofore used, and one with the outer cylinders replaced by wire, wound under tension, or the type known as the "wire gun." The designs of these guns have been completed and contracts placed for the forgings, upon delivery of which the actual manufacture of the guns will commence.

This Department has been conducting experiments during the past year with the object of obtaining data which would determine the relative effect of the different causes producing erosion. In prosecuting these investigations an effort has been made to separate the effect of erosion of the bore due to the action of highly heated powder gases from the simple wear of the bore due to friction of the rotating band of the projectile and at the same time to arrive at some conclusion as to the grade of steel most suitable for the manufacture of gun tubes. The erosion test consisted in allowing all the gas from a charge of smokeless powder fired in a closed chamber and giving pressures of about 31,000 pounds per square inch to escape through tubes of different metals about 1 foot in length, the interior diameters of which were bored to 0.157 inch. Specimens of five grades of steel were used in this test, as follows: .30-caliber rifle-barrel steel, a special amorphous steel, simple carbon steel, nickel steel, and a special grade of steel known as Monel metal. The tubes were carefully weighed both before and after the firing of the charge, for the purpose of determining accurately the loss in weight due to erosion.

In the friction test bars of steel of the same grade as those used in the erosion test were moved to and fro between strips of copper of the same quality as is used for the rifling bands of projectiles. While the bars were being moved pressure was applied to the holders of the copper strips, causing a normal pressure of 40,000 pounds per square inch to be imposed upon the surface of contact of the steel and the copper strips.

The results of both the erosion and friction tests lead to the conclusion that the metal used at present in the manufacture of gun tubes is as satisfactory as any that can be obtained, which confirms the results of previous tests made with barrels for the United States magazine rifle, model of 1903.

The tests have been further extended to include the investigation of the relative erosion in guns of the same caliber and model, in which the same muzzle velocity was secured by varying the charge and quickness of the powder, and therefore the maximum pressure. In this test two 6-pounder (2.24-inch) rapid-fire guns were used. In one a relatively quick burning powder and in the other a larger

charge of relatively slow burning powder was used, and to secure the same muzzle velocity of 2,350 feet per second the charges were as 4 to 5 and the maximum pressures 37,000 and 32,000 pounds per square inch, respectively. One thousand rounds were fired from each gun, and the erosion determined by star gauging the bore and taking rubber impressions thereof. The results show that the wear or erosion of the bore is not great in either gun, and that the limit of accuracy has not been reached; that the uniformity in the muzzle velocity for the two powders is about equal; that the slow powder gave greater heating effect in the chase of the gun, while there was little difference in the temperature taken at the seat of the projectile after a series of firings, and that the quicker powder produced more rapid erosion near the rear portion of the rifled bore.

The results of this test, while not clearly fixing the relative effect of pressure and weight of charge upon the erosion, do indicate that for the same muzzle velocity and under the same conditions of this test, the reduction in the charge of one-fifth, which would alone have the effect of reducing the rate of erosion, is not sufficient to overcome the increase in erosion due to the increase in pressure from 32,000 to 37,000 pounds per square inch.

These investigations are to be continued by corresponding firings in a 6-pounder gun of a different model, whose chamber capacity is two and one-half times that of the 6-pounder guns used in the test referred to above. With this gun the same muzzle velocity of 2,350 feet per second will be obtained with a still slower powder and lower maximum pressure.

Various explanations have been advanced for the erosion of guns. That most generally given is that it is due to the escape of small streams of gas past the projectile; but this does not cover all the phenomena observed. For instance, it fails to take into account the extremely tight sealing of the bores of cannon by the copper bands of the projectiles, which are made to seat upon the smooth portion of the bore in rear of the starting point of the rifling, and having a projecting lip at the rear edge slightly larger in diameter than the seat, thus forming a most efficient gas check. Also, this explanation does not account for the smooth and even wearing of the rear portion of the rifled bore of the gun into a smoothbore instead of the guttering which would result from the really erosive action of jets of gas; in addition, it does not explain why the wear should take place so much faster in larger than in smaller guns. The most reasonable explanation appears to be that the effects are due to the softening and washing away of a thin skin of metal at the surface subjected to the highest temperature and pressure, at each round, by the extremely hot gases in contact with it. This explanation covers all the points which have been raised.

Referring to the more pronounced action in larger guns, Mr. J. F. Meigs, of the Bethlehem Steel Company, has very serviceably drawn attention to the fact that the hot gases are in contact with the surface of the bore for a greater length of time in large than in small guns, and has stated a very striking law about as follows: "In similar guns similarly loaded the duration of equal pressures and temperatures, and hence of equal erosive effects, is directly proportional to the caliber." Under this law, if large guns are to be given a reasonable accuracy-life, they can not be made similar to small guns (that is, with dimensions proportional to the caliber) and similarly loaded. It is necessary to reduce the time of action of erosive pressures and temperatures, either by using smaller charges of quicker powder, thus reducing the time of action, or less reduced charges of powder not so much quickened; either method being accompanied by a reduction of velocity for a given length of bore.

While the causes of erosion may be known, the data at present available are not thus sufficient to clearly define their relative values or ability to produce erosion, and the experiments which are in progress and those which will be made have such definition for their object. When the relative values of the causes producing erosion shall have been accurately determined, guns can be designed which, for a given caliber and muzzle velocity, will have the powder, weight of charge, chamber capacity, and other conditions involved so adjusted as to insure the longest possible accuracy-life.

HAND GRENADE.

This Department has been experimenting during the year with a view of developing a satisfactory hand grenade. The last one tried weighs little more than a pound, but contains a relatively large charge of high explosive, and can be thrown by hand a distance of from 100 to 125 feet over an obstacle 50 to 60 feet high. There is also under consideration a design of mortar for throwing these projectiles a much greater distance, this mortar to be light enough to be carried about by hand. Such an instrument of warfare would find its principal place in the attack of fortified positions when the besiegers by trenches or other means had been able to come close to the besieged and when the fire of the small-arms rifle had become ineffective owing to its flat trajectory.

GAS-CHECK PADS.

Experiments have continued during the year to determine the best form and composition of the gas-check pad for seacoast guns of large caliber. This pad is a very important part of the breech mechanism, and the efficiency of the gun is dependent largely on the manner in which it performs its functions.

The pad hitherto used is a composition of asbestos and tallow. It was the best that could be obtained and has performed its functions in a satisfactory manner in service, except that the composition is subject to objectionable chemical and physical changes, due to the action of the heat, powder gases, etc., especially under rapid-fire conditions. Several new pad compositions have been subjected to extended tests during the year, covering all conditions that could arise in service. Two of these have given such promising results that one of them will probably be adopted in the near future, eliminating the objectionable features of the old composition.

POWDER.

The Joint Army and Navy Board, consisting of officers of the Navy Bureau of Ordnance and of this Department, which was convened March 12, 1906, and mentioned in my last annual report, has continued its work during the past year.

As a result of the investigations of this Board, the specifications for the manufacture and test of smokeless powder have been modified and improved, and the War and Navy Departments are now procuring their powder under the same specifications. In the revision of these specifications the most careful consideration was given to those conditions affecting the stability of the powder or its ability to resist deterioration in storage. The importance of securing powders of a satisfactory stability results from the time required for the actual process of manufacturing and drying smokeless powder, which for the powders used in the largest seacoast guns is six months. This necessitates the accumulation of a reserve supply of powder sufficient to carry our fortifications through a period of that length after the outbreak of a war, and large quantities of this reserve supply will necessarily remain on hand for years. With the steady improvement that has been made in the manufacture of smokeless powder for cannon, from the year it was adopted, and the thoroughness of the inspection and test of the powders prescribed by the present specifications, it is believed that the powders now being manufactured will be safe for many years.

Tests have been made during the year to determine the effect of comparatively large amounts of aldehyde in the alcohol used in the manufacture of smokeless powder. The powder specifications formerly required that the alcohol should contain no more than a trace of aldehyde, or about 1 part in 2,000,000, since it was thought that the presence of this impurity in greater quantity might have a deleterious effect upon the powder. Laboratory and firing tests made up to the present time indicate that no appreciable effect on the stability or action of the powder is produced, even when aldehyde is present in the alcohol to the extent of 5 per cent. As a result of the above investigations, the powder specifications have been revised to

omit the aldehyde test of the alcohol used in the manufacture of smokeless powder.

Charcoal powder, known as saluting powder, has heretofore been used for maneuver and saluting purposes, owing to the inability of the manufacturers to produce a smokeless powder for this purpose which would give a satisfactory report without danger of excessive pressures. The Department has tested several experimental samples of smokeless powder designed for this purpose, and one has been found which appears to fill all the requirements. Before its adoption, however, it has been decided to subject it to more extensive tests in the field.

HIGH-EXPLOSIVE SHELL.

In view of the use of high-explosive shell in both field and sea-coast guns, it was deemed advisable to determine the effect upon a gun of the premature burst of such a shell in the bore. The gun selected was a 3-inch field gun. Two high-explosive shell were fired under normal conditions, except that short delay primers were utilized to insure premature burst in the bore. These two shots were followed by the detonation (at rest) of a third shell in the bore of the gun near the muzzle.

The first shell detonated about 8 inches from its seat. It enlarged the bore about 0.05 of an inch at the place of burst and bulged the outside of the jacket, rendering the gun unfit for service, but not producing fragments to endanger the cannoneers. The maximum chamber pressure was increased from about 26,500 to 40,500 pounds per square inch.

The second shell detonated about 4 inches from its seat, or about 4 inches in rear of the point of burst of the first shell, producing a maximum pressure of 51,800 pounds. The greater portion of the jacket was thrown off in one piece; the tube was split under the jacket and the breechblock thrown to the rear.

The third shell, detonated (at rest) in the chase of the gun, carried away the walls opposite the place of burst and threw the fragments in a direction perpendicular to the axis of the gun. Some of these fragments penetrated a box of fixed ammunition, containing high-explosive shell, placed in position for the purpose. Two of the charges were considerably damaged, but none was exploded.

These tests indicate:

First, that if a high-explosive shell be prematurely detonated in the bore near the breech, there is little probability of the gun bursting, and

Second, that if the detonation occur in the bore, near the muzzle, that portion of the gun will yield explosively, but the fragments will be thrown in such a direction as not to greatly endanger the gun detachment.

PRIMERS.

The combination electric and friction primer, the use of which has been extended to all seacoast guns of 5-inch caliber and over, having separate loading ammunition, has given excellent satisfaction during the year. Failures of this primer have become very infrequent. Early difficulties were no doubt due to the inexperience of the personnel in their use.

MOUNTAIN ARTILLERY.

The alteration of the Vickers-Maxim 75-mm. mountain-gun carriage into a long-recoil carriage has received consideration by the Department, but as the changes necessary involve almost every part of both gun and carriage, it was thought wiser to abandon the idea. A design for a long-recoil mountain-gun carriage is well along, and the manufacture of a pilot gun and carriage will be undertaken upon its completion.

PACK OUTFITS FOR 2.95-INCH VICKERS-MAXIM MOUNTAIN GUN AND CARRIAGE.

During the past year particular attention has been given to the design and manufacture of pack outfits, for pioneer tools, blacksmith and harness maker's tools, and supplies of saddler's and cleaning materials. The designs have been completed and manufacture is well advanced. The total weight on each mule will be approximately 275 pounds. Considerable difficulty has been experienced in designing suitable outfits to carry all the material and keep within the weight given above.

3-inch field artillery material.—The manufacture of this material has progressed satisfactorily during the year. Standard fuze setters as well as hand fuze setters have been supplied.

All batteries of the increased regular service and 22 batteries of the organized militia have been equipped.

Progress is being made toward the equipment of the remaining militia batteries and the establishment of a reserve.

It is believed that the difficulties in regard to the strength of this material mentioned in my last annual report have been satisfactorily overcome. The stronger wheels referred to therein have been supplied to many batteries and the entire service will shortly be thus equipped. A caisson and a limber with the heavier design wheels and with the side rails reenforced in accordance with the design prepared by this Department were given a road test extending over a period of about six months. The distance traveled was approximately a thousand miles over all kinds of roads, especially prepared to strain the material. The vehicles were overturned, maneuvered at rapid gaits over obstacles, etc. At the termination of the test the

wheels were in excellent condition and no signs of weakness in the side rails were shown. A large number of vehicles in service have already been strengthened and orders have been given for the remainder. During the year new material has been made in accordance with changes in design that are expected to give ample strength.

Suit for infringement brought by the Fried Krupp Aktiengesellschaft.—The Fried Krupp Aktiengesellschaft brought suit against the Ordnance Department, alleging infringement of certain patents owned by the Krupp Corporation. The patents in question were granted by the United States Patent Office to Otto Lauber, a German citizen, who assigned them to the Krupp Company. These patents cover certain devices of the general type used in long-recoil gun carriages, and the suit alleges that three of the Lauber patents are infringed by the Ordnance Department in its 3-inch field gun carriage, model of 1902.

The three Lauber patents involved are as follows:

One covering a bayonet joint method of attaching the piston rod to the cradle-closing cap and of preventing rotation of the piston rod. This patent also covers a form of one-piece cradle-closing cap.

A second patent covering a form of dust-proof packing and retaining ring for the same; the object of the packing being to prevent dust and foreign material from entering the cradle through the piston-rod orifice in the end of the cradle.

A third patent, covering a form of recoil spring of such flat section that the radial dimension of the section is greater than the longitudinal dimension of the same.

The defense of the Ordnance Department in the above-mentioned suit will be as follows:

Priority of invention on the first two and common use on the third of these patents. All the features resembling those covered by the first two of the Lauber patents were known and laid down in sketches or drawings in the Ordnance Office prior to the date of application for the Lauber patents.

In addition, in the case of the first patent, the Department's designs of piston attachment and of cradle-closing cap are quite different from the Lauber designs.

In the case of the second patent, the designs are also different, the Lauber packing being intended to act only when the gun is in battery, and also being intended to act as a counter-recoil buffer. In the Ordnance Department design, the packing acts to exclude dust at all points of the stroke, and not at all as a buffer.

The flat spring covered in the third patent is not novel and, as stated above, its use in combination with the recoil-brake system was known and in common use earlier than the date of the application for the Lauber patent.

2.38-inch field gun on long-recoil carriage.—This material, of which mention was made in my last report, has been given an exhaustive test at the Sandy Hook Proving Ground, and the design has been found entirely satisfactory. It is, however, something of a question whether a projectile of the weight used with it, 7 pounds, is necessary. The adoption of a rifle of this caliber is not, therefore, certain.

3.8-inch field artillery material.—The pilot 3.8-inch field material has successfully passed all tests at the proving ground, and a second battery of 4 guns is now under construction. The place of this material in the system of field artillery was alluded to in my last annual report.

Field howitzer material.—A satisfactory design for a 4.7-inch howitzer carriage has been finished and the pilot carriage is now nearing completion. The design of a 3.8-inch field howitzer carriage, on practically the same lines as the 4.7, is practically complete and a pilot carriage should be finished early in the next calendar year.

SIEGE MATERIAL.

4.7-inch siege rifle and carriage.—A second battery of this material is under construction.

6-inch siege howitzer and carriage.—The pilot 6-inch siege howitzer carriage is completed and the pilot howitzer will be finished as soon as possible. The test of this material will be hastened as much as possible, and it is hoped that work on a battery can be started within the year.

The system of mobile artillery, as built or under construction, comprises:

First. Mountain artillery, a 3-inch mountain gun firing a projectile of 15 pounds' weight with a muzzle velocity of 900 feet per second, to be carried on pack mules.

Second. Standard field artillery, consisting of a 3-inch field gun firing a 15-pound projectile with a velocity of 1,700 feet per second, and a 3.8-inch howitzer firing a 30-pound projectile with a velocity of 900 feet per second. These to be hauled by teams of 6 horses.

Third. Heavy field artillery, consisting of a 3.8-inch field gun firing a 30-pound projectile with a velocity of 1,700 feet per second, and a 4.7-inch howitzer firing a 60-pound projectile with a velocity of 900 feet per second; to be hauled by teams of 6 horses.

Fourth. Light siege artillery, consisting of a 4.7-inch gun firing a 60-pound projectile with a velocity of 1,700 feet per second, and a 6-inch howitzer firing a 120-pound projectile with a velocity of 900 feet per second; to be hauled by teams of 8 horses.

ARTILLERY PRACTICE.

Reports received during the year indicate general satisfaction with the material issued for this purpose. The use of capped projectiles for target practice has been extended during the year to include 12-inch mortars as well as the seacoast guns of 5-inch caliber and upward. All projectiles hereafter procured for target practice will have the same exterior dimensions as the service projectiles and the same position of the center of gravity, thus permitting, without corrections, the use of the range tables corresponding to and prepared for the service projectiles.

Reports and opinions of post ordnance officers and battery commanders as to the action of the drill primers and drill primer outfits indicate that as more experience and skill in the handling, preparation, and care of these primers is acquired, much less difficulty is encountered, and that on the whole this primer is serving the purpose for which it was designed in permitting a large number of rounds of subcaliber ammunition to be fired at a relatively low cost for primers. The use of these outfits reduces the cost of primers used in subcaliber practice to about one-fifth that of the service primers. A resizing die, for use with the hand press for priming cartridge cases, has been furnished with the drill primer outfit for the purpose of reforming primer cases that have been enlarged by the firings or dented or deformed by rough usage.

Tests of an explosive smoke-producing compound in 18-pounder subcaliber shell, to increase the visibility of splash of this projectile on water impact, have indicated that no material advantage would be secured in practice from its use. It has been found impracticable to construct a fuse that will burst these shell on water impact with high angles of fall and low striking velocities with sufficient promptness to increase the visibility of splash over that which obtains when no explosive is used.

In order to increase the volume and intensity of the report of the primer alone or blank subcaliber ammunition, and more nearly simulate service conditions, charges of saluting powder are being used in seacoast guns this year in the joint exercises of the Militia and Coast Artillery. Reports thus far received indicate that, owing to the low pressure produced by these charges, the primers in guns using nonmetallic ammunition frequently fail to obturate, and the powder gases escaping to the rear in such cases injure and sometimes disable the firing mechanisms which have been found so satisfactory under service conditions. There is also danger of the gas-check pads and rings failing to obturate properly under this low pressure, with resultant injury to gas-check pads. With black powder there is

always more or less residue, and unless the greatest care is exercised in sponging out the chamber after each round, there is danger of premature ignition of the succeeding charge. The advisability of discontinuing the firing of saluting charges in seacoast guns not having the charge in a metallic case is therefore receiving serious consideration.

For the purpose of eliminating as far as practicable the effect upon the muzzle velocity of variations in powder charges, resulting from storage under different conditions, etc., battery commanders have been authorized to reblend, reweigh, and remake charges of the same lot of powder for the same gun, if they so desire, immediately before target practice. It is expected that these provisions, if carefully followed out, will still further improve the target practice with seacoast guns. In fact they have already done so.

TRANSPORTATION OF EXPLOSIVES.

With a view to reconciling the differences which existed between the regulations of the American Railway Association and those of the Ordnance Department as to the preparation of explosives for transportation, Maj. Beverly W. Dunn, Ordnance Department, was directed to represent the Department at a meeting of a committee of the American Railway Association in New York City, August 29, 1906, convened for the purpose of considering this question. As a result of this meeting the regulations of this Department governing the preparation of explosives for transportation have been revised to the satisfaction of the American Railway Association and this Department.

This railway association has recently established a "bureau for the safe transportation of explosives and other dangerous articles," having for its object the determination of the particular explosives and other dangerous articles that can be safely transported by its lines, and their proper preparation for shipment. At the request of the American Railway Association, Major Dunn has been detailed by direction of the honorable the Secretary of War to assist the association in the organization of this bureau.

ARMY POWDER FACTORY.

In my last annual report I referred to the establishment of an army powder factory, for which Congress had made an appropriation of \$165,000. On August 26, 1906, a board of officers of this Department was convened for the purpose of determining a suitable location for the erection of the factory. The funds appropriated by Congress were based on estimates of the cost of the plant alone, which limited the selection of a site to a military reservation, and the following four

were considered as possible sites by the board and visited for the purpose of determining their relative advantages:

Rock Island Arsenal, Rock Island, Ill.

Jefferson Barracks, Mo.

West Point, N. Y.

The United States Powder Depot, Dover, N. J.

In arriving at its conclusion the board was governed by a consideration of the following requirements for a smokeless-powder factory:

- (a) A plentiful supply of pure water, with a natural head.
- (b) Good drainage facilities.
- (c) Good transportation facilities.
- (d) Facilities for proving powder.
- (e) Isolation of the factory.
- (f) Facilities for natural defense.
- (g) Labor supply.
- (h) Climate.
- (i) Area and topography.

Of the four military reservations considered, the United States Powder Depot, at Dover, N. J., was deemed most suitable from all points of view for the location of the powder factory, and this location was definitely determined upon.

During the winter the plans of the necessary buildings for the powder factory were made, the ground cleared, and contracts awarded for the machinery. As soon as the weather permitted, actual work on the buildings was begun. While the appropriation contemplated a powder factory with an output of 1,000 pounds of smokeless powder per day of eight hours, the plans and buildings have been so arranged as to permit of a convenient and symmetrical enlargement to one of a capacity of 5,000 pounds per day of eight hours.

The work of construction of the buildings and the installation of the machinery has progressed satisfactorily, though considerable difficulty is experienced in obtaining sufficient labor. It is expected that the manufacture of smokeless powder in small quantities will begin this year.

ORDNANCE REPAIR SHOPS.

These shops, which are located at the more important fortifications and which are used by resident machinists employed by this Department, were originally intended for a very limited class of work. It has, however, developed that they can be advantageously used for more than was originally intended, and the equipment has consequently been considerably increased during the past year. The design of the shop has been changed and increased in size for new construction, and in a limited number of the most important cases recommendation has been made that the present shops be increased by an addition to the building.

2-INCH AND 3-INCH TELESCOPIC SIGHTS.

On the recommendation of the Chief of Artillery these sights will hereafter be made without range drums or elevation scales, retaining the deflection scales and allowing enough movement in elevation and depression to insure keeping the target within the field of view.

PLOTTING BOARD FOR MOBILE ARTILLERY.

The Dillard relocater for mobile artillery, which quite radically differs from the plotting board previously used, has been manufactured and submitted to the Field Artillery Board for test. Upon its recommendation it will, after some minor changes, be adopted for service.

SELF-CONTAINED, HORIZONTAL BASE RANGE FINDERS FOR SEACOAST ARTILLERY.

Several of these instruments have been subjected to test, notably a Barr & Stroud range finder with a 9-foot base, and a Warner and Swasey, with an 8-foot base. The results obtained were such as to justify further trial and, consequently, four additional instruments, two each of the above-mentioned designs, will be obtained for service use to determine the desirability of supplying them for emergency purposes.

BATTERY COMMANDER'S TELESCOPES.

Experience with these instruments since the original trials and their adoption has shown certain changes in the carrying case and the instrument itself to be desirable. One of those under manufacture was altered in accordance with suggestions of the Field Artillery Board and sent to it for trial; all instruments in service and those under manufacture will be changed in accordance with recommendations of the Board. The carrying case will also be strengthened.

Observation telescope for the field artillery.—The design for an observation telescope for the field artillery has been completed and a type instrument will be manufactured and sent to the Field Artillery Board for criticism. It is hoped that before the close of the calendar year a sufficient number of these instruments may be obtained for supplying each battalion.

EXPERIMENTAL GUNS.

10-inch Brown segmental-tube wire gun.—On October 28, 1903, the locking device of this gun was disabled and firings were discontinued. Since that date no progress has been made in the test of it.

In October, 1904, the gun was returned to the company for repairs to the breech mechanism.

6-inch Brown segmental-tube wire gun and 6-inch wire-wound gun, Crozier design.—The tests have been completed and these guns are now under consideration by a board of army and navy officers especially appointed for the purpose.

Semiautomatic 3-inch 15-pounder rapid-fire gun.—The test of this gun has been continued during the past year. The results indicate that the gun and mount will be suitable for use in the military service when the minor defects developed during the long series of firings have been eliminated. The semiautomatic attachment was found as efficient as any known, and is considered applicable to the breech mechanism of 15-pounder rapid-fire guns. Certain minor changes found desirable are being made, and further tests of the semiautomatic attachment will be made prior to its adoption in service. The tests of this gun have been with ammunition giving a muzzle velocity of 3,000 feet per second. Owing to the excessive erosion developed, a material reduction in the muzzle velocity will be necessary to insure a satisfactory accuracy-life.

Semiautomatic 6-pounder guns and mounts.—Of the four guns procured under allotments made by the Board of Ordnance and Fortification, the tests of three have been completed. The general type consists of a 6-pounder gun, 58 calibers length of bore, giving 3,000 feet per second muzzle velocity, mounted on a central pivot with hydraulic recoil check and spring return. The semiautomatic breech action permitted firing at the rate of 51 rounds a minute. While the tests of these guns have shown that a satisfactory semiautomatic 6-pounder gun and mount can be obtained, it is doubtful if any will ever be procured, as a gun of this caliber is not now considered as having a proper place among the rapid-fire guns necessary for sea-coast defenses.

SEACOAST CARRIAGES.

Funds were appropriated by the last Congress for a type 14-inch gun and carriage and the designs of both are nearing completion. The drafting-room work on the 16-inch carriage has been delayed by the necessity for the completion of the design of the 14-inch, which is similar to that of the larger carriage.

In addition to carriage work being prosecuted at arsenals, contracts exist with the following private manufacturers, viz:

15-pounder rapid-fire carriages, model of 1903, with the American and British Manufacturing Company;

4.5-inch shields for 5-inch and 6-inch barbette carriages, with The Midvale Steel Company and the Bethlehem Steel Company;

6-inch disappearing carriages, L. F., model of 1905, with the Bethlehem Steel Company.

Of the contracts mentioned in my last report, the Bethlehem Steel Company has completed deliveries of all 6-inch carriages, model of 1903, and nearly all of the model of 1905.

The type 6-inch carriage, model of 1905, was delivered at the proving ground in January and has since that time been given an exhaustive test. The design has proved satisfactory, and the 14 and 16 inch carriages will be on the same lines. The principal departure from the designs previously followed is in the position of the hydraulic-recoil brake, which is placed vertically in the axis of the counterweight instead of horizontally upon the top of the chassis rails, as heretofore. The object of the change was to produce greater uniformity of recoil under varying ballistic conditions, and the test shows that the object has been satisfactorily attained. It was suggested by Maj. Lawson M. Fuller, of this Department, in charge of the carriage division of the office, and the many details and varied computations have been worked out by him or under his direction.

10-INCH EMERY DISAPPEARING CARRIAGE.

Mr. Emery has continued work during the year on the 10-inch disappearing carriage of his design being made under a contract in accordance with the provisions of the fortifications act approved April 21, 1904, in such manner as he has deemed best. Additional material for its construction has been obtained.

IMPROVEMENTS IN INSTALLED SEACOAST CARRIAGES.

Electric firing and lighting of seacoast guns.—This work is in progress and is in satisfactory condition.

Loading platforms for subcaliber practice.—One hundred and seven have been completed and issued during the year, and work is being prosecuted on the remainder.

Range disks and scales.—The graduation of range disks and scales is proceeding in accordance with range tables furnished by the Chief of Artillery. In cases where elevation disks only were on carriages, these have been altered to range disks. For guns of less than 5-inch caliber the carriages were provided with range drums geared to the sights and were designed for direct pointing. On the recommendation of the Chief of Artillery, designs are nearly completed for range drums or racks geared to the cradle of the carriage and designed for use without water lining the target by the sight.

12-inch mortar carriages.—The addition to these carriages of 360° electrical contacts, safety-firing switch cables, conduits, cast-steel beams between the racer and hydraulic recoil cylinder, a break to prevent accidental rotation of the racer, improved counter-recoil buffers, and the substitution of continuous grooves for the five throttling holes in the cylinder have been continued. Eighty complete

sets of the parts required have been issued to armament officers for assembling; 16 more sets are nearing completion and 56 sets are under way.

10-inch disappearing carriage, L. F., model of 1894.—The designs for alteration of these carriages are practically completed and work will be started during the ensuing year. The changes include improved traversing and elevating mechanisms, counter balance device, electric retracting gear, slow-motion traversing, elevating, and depressing gearing, and high sighting platform on the left side with 3-inch telescopic sight.

3-inch Driggs-Seabury carriage.—Designs are completed for applying to these carriages traversing, elevating, and depressing gearing, new range drum geared to carriage cradle, and telescopic sights, model of 1898. Alteration on the first carriage is in progress and when this has been tested the changes will be applied to the remainder as fast as funds will permit.

Slow-motion gearing.—These mechanisms are to be applied to all disappearing carriages for 8-inch, 10-inch, and 12-inch rifles. Designs are completed for the 12-inch, models of 1897 and 1901, and are in progress for the other models. The traversing handwheel will be operated from the sighting platform and the elevating and depressing from the working platform. Both mechanisms will be so constructed that they may be engaged or disengaged as desired.

Shot trays for ammunition trucks.—These have been constructed and attached to all shot trucks for guns in service. They render the separate loading trays unnecessary.

Ammunition trucks for 12-inch barbette carriages, model of 1892.—New trucks were required with these carriages for use with the Taylor-Raymond ammunition hoists, and all carriages in service have been supplied.

Counterbalance devices for 12-inch disappearing carriages, model of 1896.—All carriages in service have been supplied with this improvement.

Pit ladders.—Because of the installation of electric firing and lighting cables and the consequent added necessity of working in the counterweight well, the addition of these parts to carriages not previously equipped has become very desirable. They are being supplied for 8-inch and 10-inch disappearing carriages, L. F., model of 1896.

RANGE-FINDING INSTRUMENTS.

Range finders for infantry and cavalry.—The Weldon range finders have been completed and issued to all troops. The results of manufacture at Frankford Arsenal, instead of by contract, have been very satisfactory both as to cost and quality.

Swasey depression position finder.—The illumination device is to be altered to give such a variation in the amount of light on the cross wires as may be desired by the operator, to connect the lamps in parallel so that the failure of one lamp will not extinguish all, and to give a better view of the scales. For present manufacture instruments will be supplied with an automatic correction for the curvature of the earth applying to any height from 40 to 400 feet at which the instrument may be used.

Material for fire control and direction system at seacoast fortifications.—Work has progressed well so far as funds would permit. The supply of instruments is up to present requirements, except that the best type of observation telescope has not been decided upon and that a larger number of position finders is desirable. Fifty position finders will be obtained during the coming year and it is anticipated that tests of observation telescopes that have been in progress will be completed and that such instruments as funds on hand will cover will be obtained in the near future. A test of simpler range finders will be made in the autumn.

MAINTENANCE OF THE ARMAMENT OF FORTIFICATIONS.

The division of the seacoast and field armament, for the purpose of maintenance and improvement, into districts continues to operate very satisfactorily, and the service guns and mortars have been maintained in a good state of efficiency during the year. Visits of armament officers to fortifications for the purpose of semiannual inspection during the target-practice season have been continued with good results.

The reserve supply of infantry and cavalry rifles is very fair and is increasing at a satisfactory rate. For some years to come, however, an army of war size would have to be armed with rifles of two models, namely, that of 1903 and that of 1898, the last generally known as the Krag-Jørgensen, with which the militia is now armed. The reserve ammunition for the latter rifle is sufficient, and only such additional supplies need be currently procured as to meet the annual expenditures. The reserve supply for the rifle of the model of 1903 is not sufficient.

There is a moderate supply of revolvers of caliber .38 and of caliber .45; but the commencement of the accumulation of a proper reserve for the contingency of war is delayed by the effort to develop the automatic pistol to a satisfactory stage.

There is a very good reserve of infantry and cavalry and horse equipments.

The armament of the seacoast fortifications of the United States is in a very forward condition of effectiveness. The coast defense is

not entirely complete, but it is believed to be such as to preclude the occurrence of great disaster of a class to be prevented by this kind of preparation. There is some reserve supply of ammunition, but it is not what it should be. The fortification of the insular possessions is proceeding at a rate which should be considered reasonable. It was slow in commencement, but as thus far provided for will give a very good degree of protection to the harbors to which it is being applied.

The reserve supply of mobile artillery is in a less satisfactory state than that of any other class of fighting material. We have a sufficient number of mountain guns, but the model is not completely up to date. The standard field gun is believed to be of as good model as any in existence, but the supply should be much greater and should be increasing at a more rapid rate than current appropriations permit. The model of the heavy field gun has just been decided upon, but there are not sufficient funds to proceed with their manufacture in any considerable quantity. The model of the light siege gun has been established and a small number are under construction; the rate of production should be considerably increased. Models of light and heavy field howitzers and of light siege howitzers have not yet been adopted; but experimental pieces and carriages are under construction and will soon be ready for test.

INSPECTOR OF ORDNANCE, RICHMOND, VA.

Maj. Odus C. Horney, Ordnance Department, U. S. Army, performed the duties of inspector of ordnance in Richmond from July 1, 1906, until August 26, 1906, and Maj. Jay E. Hoffer, Ordnance Department, U. S. Army, from August 27, 1906, until June 30, 1907, in addition to their duties in the office of the Chief of Ordnance, Washington, D. C.

The material covered by the following contracts was under inspection in Richmond, Va., during the year:

The Tredegar Company.—Contract of July 2, 1906, for 300 cast-iron projectiles for 6-inch howitzer; contract of November 30, 1906, for 10 experimental 6-inch cast-iron shell.

The Richmond Iron Works.—Contract of July 2, 1906, for 10 caps for projectiles for 12-inch rifle; 125 caps for 800-pound projectile for 12-inch mortar; 80 caps for 1,000-pound projectile for 12-inch mortar; contract of November 10, 1906, for 10,000 18-pound cast-iron shell for subcaliber tube; contract of April 3, 1907, for 2,000 6-pounder common steel shell.

Of the material covered by the above contracts, all was delivered during the year except 6,000 18-pound cast-iron shell for subcaliber tube and the 2,000 6-pounder common steel shell.

THE HAVANA ORDNANCE DEPOT.

This depot was established in October, 1906. It was commanded from October 16, 1906, to May 13, 1907, by Capt. W. H. Tschappat, Ordnance Department, U. S. Army, and from May 14, 1907, to June 30, 1907, by Capt. J. C. Nicholls, Ordnance Department, U. S. Army.

The commanding officer, Havana Ordnance Depot, is also the chief ordnance officer, Army of Cuban Pacification.

The office, enlisted men's barracks, storerooms, and issue room are all in one building, at the corner of Compostela and Fundicion streets, Havana. The available storage space is about 3,300 square feet, and 15 feet high.

This depot is without facilities for manufacturing or for making other than the simplest repairs. Its operations are confined to those of receiving and issuing ordnance stores and supplies to the troops in Cuba. During the period, October 1, 1906, to June 30, 1907, 374 shipments of miscellaneous stores were received and 757 issues made.

The force of employees and enlisted men consists of 1 clerk, 8 laborers, 1 post ordnance sergeant, 1 corporal, and 5 privates.

BETHLEHEM STEEL WORKS.

Capt. W. H. Tschappat, Ordnance Department, U. S. Army, performed the duties of inspector of ordnance at the Bethlehem Steel Works from July 1, 1906, to September 14, 1906, and Maj. C. C. Williams, Ordnance Department, U. S. Army, from September 15, 1906, to June 30, 1907.

During the year work was in progress on 30 contracts, comprising steel forgings for cannon, steel projectiles, disappearing carriage for the seacoast, field guns, field-gun carriages and caissons, shields for field artillery, and parts of ammunition.

Besides the above, work was in progress on shields with supports and bolts for 15-pounder barbette carriage, model of 1903; shield for 6-pounder pedestal mount; miscellaneous forgings; miscellaneous castings; finished hubs for 3-inch field material; flange steel parts, and steel bars ordered by ordnance establishments and other manufacturers.

The following was completed during the year:

- 240 4-inch armor-piercing shell.
- 157 3-inch field caissons, model of 1902.
- 402 6-inch armor-piercing steel shell.
- 9 6-inch disappearing carriages, model of 1903.
- 7 6-inch disappearing carriages, model of 1905.
- 4,600 3-inch common steel shell (field).
- 15,000 15-pounder (3-inch) common steel shell (seacoast).
- 20 sets hardened protective shields for 3-inch field caisson.
- 44 sets hardened protective shields for 3-inch field-gun carriage.

- 20 3-inch field guns, model of 1905.
- 25 sets of forgings for 3-inch rapid-fire gun, model of 1903.
- 13 sets of forgings for 6-inch rapid-fire gun, model of 1905.
- 3 16-inch armor-piercing shot.
- 3 16-inch armor-piercing shell.
- 4 forgings for 5-inch rapid-fire gun, model of 1900.
- 1 set forgings for 6-inch siege howitzer, model of 1906.
- 1 tube for 6-inch rifle, Bofors.
- 27 sets hardened protective shields for wheeled mount for Maxim automatic machine gun.

Besides the above there were completed 56 shields with supports and bolts for 15-pounder barbette carriage, model of 1903; 1 shield for 6-pounder pedestal mount; 309 miscellaneous forgings; 2,681 miscellaneous castings; 1,290 finished hubs for 3-inch field material; pressing of 18 flange steel parts; 346 bars; 1,356 feet of bars, and 386,760 pounds of steel bars.

The total amount of money paid to this company during the fiscal year by this office and other establishments of the Department was \$578,347.42.

INSPECTOR OF ORDNANCE, SHARON, PA.

The inspection work pertaining to this office has been under the charge of Capt. Edwin D. Bricker, Ordnance Department, U. S. Army, and included material manufactured at Sharon, Pa.; Pittsburg, Pa.; Cleveland, Ohio; Shelby, Ohio; Kings Mills, Ohio; Aurora, Ind., and contiguous localities.

The Driggs-Seabury Ordnance Corporation, Sharon, Pa.—This company has had during the year contracts for 164 3-inch field caissons, model of 1902; 368 3-inch field limbers, model of 1902; 70 3-inch field caissons, model of 1902; 64 3-inch field limbers, model of 1902; 40 3-inch field limbers, model of 1902; 1 set of forgings for 1-pounder subcaliber gun; 1 set of forgings for 3.2-inch field rifle, converted, model of 1907, and 1 set of forgings for 4.7-inch field howitzer, model of 1907.

The set of forgings for 1-pounder subcaliber gun was delivered in December, 1906.

During the year 54 3-inch field caissons, model of 1902, have been delivered, and 117 caissons and 247 limbers finished, except for wheels.

The difficulties experienced by the company in obtaining wheels of the modified design has delayed the delivery of the otherwise completed vehicles. There has been, however, considerable delay in finishing the material without the wheels, due to the methods of this company and the lack of thoroughly competent workmen.

The Warner & Swasey Company, Cleveland, Ohio.—During the fiscal year this company completed 45 2-inch objective telescopic

sights, model of 1906, and made some minor repairs and alterations to Swasey depression position finders.

The Peters Cartridge Company, Cincinnati, Ohio.—This company completed a contract for 5,000,000 gallery practice cartridges, caliber .22 short. The ammunition was presented for inspection before the expiration of the contract, and was of satisfactory quality.

The Royer Wheel Company, Cincinnati, Ohio.—This company is engaged in the manufacture of 1,248 wheels for 3-inch field material under a contract with the Driggs-Seabury Ordnance Corporation.

Crucible Steel Company of America, Pittsburg, Pa.—This company has a contract for 120 sets of protective shields for 3-inch field caissons, model of 1902. Satisfactory progress is being made with the work, and it is anticipated that the material will be delivered prior to the expiration of the contract. This company has also filled orders for 75,000 pounds of steel of various grades.

In addition to the above, the office has had under inspection much miscellaneous material for contractors and ordnance establishments.

The total value of all contracts and orders under inspection during the year was \$722,332.74. The total value of material delivered and finished awaiting delivery was \$344,639.37.

MIDVALE STEEL WORKS.

The work of the inspecting officer at the Midvale Steel Works included not only the inspection of material manufactured at these works, but also that manufactured by other contractors in Philadelphia and vicinity, and has included the manufacture of powder at the works of the E. I. Du Pont Company, Wilmington, Del. This inspection has been performed during the year by Capt. Samuel Hof, Ordnance Department, U. S. Army, in addition to his duties as assistant to the commanding officer at Frankford Arsenal, as, owing to the continued shortage of officers in the Department it has not yet been found practicable to assign one officer to this duty exclusively.

The work comprised 178 different orders or contracts, manufactured at 18 different establishments. The total value of the material under inspection was \$685,137.63, of which that to the value of \$533,385.63 was completed. The principal articles inspected were gun forgings, tire steel, flange steel, steel castings, bronze castings, miscellaneous steel forgings, shields for 5-inch gun carriages, steel springs, wood for wheels, spokes and neck yokes for 3-inch field material, telescopic sights, smokeless powder, and alcohol.

The total quantity of material inspected and shipped was 1,830,167 pounds.

INSPECTOR OF ORDNANCE, BRIDGEPORT, CONN.

Maj. W. S. Peirce, Ordnance Department, U. S. Army, performed the inspection duties at this place from July 1, 1906, until April 20, 1907, in addition to his duties as assistant to the commanding officer, Springfield Armory. Maj. Kenneth Morton, Ordnance Department, U. S. Army, performed these duties from April 21, 1907, until June 30, 1907, with station at Bridgeport, Conn.

These duties have comprised the inspection of material under manufacture at the works of the following companies:

United States Rapid Fire Gun and Power Company.....	Derby, Conn.
American and British Manufacturing Company.....	Bridgeport, Conn.
Scovill Manufacturing Company.....	Waterbury, Conn.
United States Cartridge Company.....	Lowell, Mass.
Winchester Repeating Arms Company.....	New Haven, Conn.
Union Metallic Cartridge Company.....	Bridgeport, Conn.
Colt's Patent Fire Arms Company.....	Hartford, Conn.

United States Rapid Fire Gun and Power Company.—At the beginning of the fiscal year this company had 3,000 rounds of 15-pounder steel shell ammunition yet to deliver under the original contract of April 15, 1898. Of these rounds, 2,000 shell failed to pass the ballistic test, and this Department was forced to act under the terms of the contract and procure these shell elsewhere in the manner prescribed by law. During the year the company completed contracts for 10,000 front plugs and 10,000 rear plugs for the base detonating fuze, major caliber, and have the work well advanced on the contracts for 136 cartridge cases for 15-pounder rapid-fire gun and 2,000 15-pounder common steel shell.

The American and British Manufacturing Company.—This company has completed the following material during the year: 20 3-inch field carriages, 70 3-inch field caissons; also considerable quantities of ammunition and parts thereof.

The following new contracts have been made: For 37 3-inch field carriages, model of 1902; for 23 15-pounder barbette carriages, model of 1903; for 16 3-inch field guns, model of 1905; for 10,000 stocks for major caliber base detonating fuze; for 1,000 6-pounder common steel shell, and for 2,500 6-inch armor piercing shell.

The contract of October 16, 1906, for 1,000 6-pounder common steel shell has been completed and satisfactory progress has been made under the remaining contracts.

Scovill Manufacturing Company.—The contract for the preceding year for 5,000 shrapnel, 3-inch, and 5,000 21-second fuzes, was delayed pending certain changes in both the fuze and the shrapnel, which necessitated suspension of the work on the part of the company. These changes having been fixed, work has been resumed and the early delivery of this material is expected.

United States Cartridge Company.—This company has a contract for the manufacture of 5,000,000 caliber .22 gallery practice cartridges, and 208,500 caliber .30 ball cartridges. Deliveries of this material have been delayed on account of rejections, but the manufacture of the cartridges is now progressing satisfactorily.

Winchester Repeating Arms Company.—This company has a contract for the manufacture of 350,000 caliber .30 cartridges, model of 1898, the completion of which is expected early in the present fiscal year.

Union Metallic Cartridge Company.—This company has completed and delivered during the year the caliber .22 ball cartridges under their contract for 5,000,000 caliber .22 ball cartridges, and 354,000 caliber .30 ball cartridges. Satisfactory progress has been made in the manufacture of the caliber .30 ball cartridges.

Colt's Patent Fire Arms Company.—This company has under manufacture 137 automatic machine guns, caliber .30, model of 1904, with spare parts, under a subcontract with the Vickers, Sons & Maxim Company (Limited). One gun has been submitted for inspection and found satisfactory, and it is expected that the remaining guns will be completed within the time allowed by the contract.

THE ARCHIBALD WHEEL COMPANY.

The work of inspection at the works of this company was conducted during the year by Lieut. (later Capt.) Glen F. Jenks, Ordnance Department, U. S. Army.

The manufacture of wheels on Government orders was carried on intermittently during the whole year, and since about the 1st of March the assembling presses have been operated nights on Government orders. Improvements in design of the wheels delayed work for a considerable period.

The total number of wheels manufactured during the past year was as follows: For 3-inch field material, manufactured 2,696, repaired 121; for siege material, manufactured 8.

At these works a large stock of material for spokes and felloes is carried on hand in all stages of seasoning. Thus the wheels have been manufactured without delay after the receipt of metal parts.

At the present time orders are on hand for repairing and manufacturing a considerable number of wheels.

SANDY HOOK PROVING GROUND.

The proving ground was commanded during the year by Col. Charles S. Smith, Ordnance Department, U. S. Army, who is also president of the Ordnance Board, president of the Board for Testing Rifled Cannon, and armament officer of the Sandy Hook armament district.

Firings for experimental and proof purposes have been conducted daily, weather permitting.

The following material, received at the proving ground, has been subjected to ballistic test:

- 49 lots of projectiles.
- 29 lots of shrapnel.
- 7 guns.
- 2 shields.
- 63 lots of powder.
- 39 lots of fuses.

The firings during the year have involved the expenditure of 58,542 pounds of powder, 2,135 pounds of high explosives, 5,996 projectiles, and 158 rounds of fixed ammunition, a total of 6,366 rounds having been fired, while 134 fragmentation and miscellaneous tests were made. These firings necessitated the preparation of 320 reports and the plotting of 160 targets.

The railroad connecting the proving ground with the Central Railroad of New Jersey at Highland Beach has been maintained in first-class condition throughout the year, and has proven a source of convenience and economy in the transportation of men and material. The total amount of freight shipped over this railroad during the year amounted to 26,049,618 pounds, requiring a total car movement of 701 cars. The total number of passengers carried during the year was about 140,000.

The U. S. S. *Ordnance* has been in operation between new Pier 12 East River, foot of Wall street, New York City, and Sandy Hook, daily throughout the year except Sundays and holidays. No accidents of any kind have occurred during the year, and the boat has been maintained in good order and condition and in a high degree of efficiency. The total number of passengers carried was 22,033; freight carried, 1,102,902 pounds; distance run, 10,698 nautical miles; annual coal consumption, 1,063 tons.

New construction.—The construction of one machine and smith shop, carpenter and plumbing shop, power house and paint shop, authorized by the sundry civil act approved June 30, 1906, is well underway.

The foundations have all been completed and the brick walls about one-fourth erected. Contracts have been entered into for the machinery necessary for the equipment of the shops, and several deliveries have been made. It is expected that the new shops will be ready for occupancy early in January next.

Shops.—The shops which were temporarily installed in vacant buildings have been fully occupied during the year by the experimental work of the proving ground and with work in connection with armament installed in the Sandy Hook district.

Proof battery.—To enable the large number of ballistic lots of shrapnel and fuzes sent here for test to be promptly completed a field-gun platform has been made, and two screens erected at sufficient height to permit the taking of velocities at the highest elevation required.

The butts for armor-plate tests are now located on a line parallel to and about 140 feet in front of the guns in the proof battery. It is proposed to move these butts about 450 feet as soon as more pressing work will permit.

Careful study has been made of methods by which accuracy of taking range data may be increased, and the extreme variations in the ranges obtained from the three observations taken on each round have been reduced to practically a negligible quantity.

Instruction of officers.—The class during the year consisted of nine officers, and instruction was given in the chemistry of explosives, electrical engineering, machine-shop practice, ordnance engineering, and differential equations.

Two new courses of study were added during the year, viz, ordnance engineering and differential equations.

The former consisted of 31 problems applying to service material, some of the principal calculations involved in the designing of guns, coast and mobile gun carriages, projectiles, and fuzes.

The experience gained in the practical application of the principles illustrated by these problems should enable the officers who have completed the course to undertake their use with confidence.

It is believed the benefits derived by student officers during the course of instruction have on the whole been more material than since the establishment of the course. It takes time to get a new course of instruction arranged on a satisfactory basis; especially when all concerned have other pressing duties.

Machine-shop work.—The course in machine-tool work has been prosecuted to the extent permitted by the limited machines available for the purpose. To enable this course to be taken up, a small addition was made to the temporary machine shop, and new lathe apparatus installed, but with these provisions the facilities were limited, usually not providing machines for more than two officers at one time.

Chemical laboratory work.—Practical instruction of officers in the chemistry of explosives was taken up July 16 and continued until September, 1906. No change was made in the course of former years, but to provide work for those who made the most rapid progress several exercises were added covering tests of oils and quantitative analysis.

Visit to Parlin.—Through the courtesy of Mr. H. F. Brown, of the International Smokeless Powder and Chemical Company, the officers

were given an opportunity to witness the manufacture at Parlin, N. J., of smokeless powder on a large scale.

Electrical engineering.—This course was taken up March 11 and continued until June 1, 1907, the work being classified under three heads, as follows:

1. Practical exercises.
2. Theoretical course of study.
3. Problems relating to practical exercises.

The nine officers taking this work were divided into three groups of three each for the practical laboratory work. Satisfactory progress was made during time available, several completing the work outlined.

ROCK ISLAND ARSENAL.

This arsenal was commanded during the year by Col. Stanhope E. Blunt, Ordnance Department, U. S. Army.

Artillery store shed.—The 3.2-inch field artillery material in service in the Army has been replaced with the 3-inch, and that for the militia is being exchanged as fast as the new material is completed. The 3.2-inch material may possibly be altered to embody some of the nonrecoil features of the new 3-inch, but in any case must be stored as a reserve supply. As no building is available for this purpose a design has been prepared and estimate for its construction submitted.

Quartermaster-sergeant's quarters.—There are now no quarters at this arsenal for the post quartermaster-sergeant, who has to live in a neighboring city and be paid commutation of quarters. This method besides involving unnecessary expense removes the sergeant from the arsenal at all except regular work hours, and his services are not available if an emergency requiring immediate shipment of stores should arise. An estimate for quarters for this noncommissioned officer is submitted.

Hospital and stables.—Under appropriations that became available July 1, 1906, a building 42 by 37 feet was constructed of yellow brick to provide quarters for the hospital steward and with necessary accommodations for dispensary, emergency hospital treatment, and surgeon's office, and has been in use since February 1, 1907.

A stable, constructed from funds allotted for that purpose, has been erected and is now in use.

Rock Island Arsenal wagon bridge.—Under an appropriation of \$125,000, for reconstruction of the bridge and viaduct between this arsenal and the city of Rock Island, plans and specifications were prepared, proposals received, and contract finally let to Messrs. Bayne & Hewitt, of Minneapolis, Minn. The new structure is to use the piers of the old bridge and also additional piers, to be placed

midway between those now in position. The superstructure will consist of plate girder spans, and an extension of the present masonry approach by concrete retaining walls with earth filling. Over the railroad tracks in the city of Rock Island the bridge and viaduct will be constructed on a curve, avoiding the dangerous sharp angle of the former bridge. Over the tracks the bridge is to have a permanent floor of reinforced concrete, protected from the action of gases of engines passing below by a fireproof coating of concrete on all exposed parts. The roadway is to be 20 feet in width between curbs, and in addition there are to be two sidewalks 7 feet in width. There will be two street-car tracks on the bridge, the tracks and the paving between curbs being provided and laid by the Tri-City Railway Company as one of the conditions of extending their license authorizing them to operate electric instead of horse cars on the Government bridges. The contract requires that the bridge shall be completed by November 1, 1907, and that it shall not be closed to traffic for more than three months during the construction.

The bridge from this arsenal to the city of Moline was constructed about thirty-four years ago at a cost of \$121,118. Eleven years ago the wood floor was renewed and the ironwork painted, but with this exception no appropriations have been made for repairs of any nature to this bridge. The timber stringers are now in exceedingly bad condition, so much so that the bridge is dangerous for the traffic which it has to bear, and it has been considered necessary to exclude the heaviest teams. It is recommended that the timbers and stringers of this bridge be replaced and the ironwork cleaned and painted. An estimate for this purpose has been submitted.

Water supply and fire protection.—At a previous session Congress made provision for an increase of water supply for fire protection at this arsenal, and with the funds available the present pump house has been enlarged and extra machinery purchased. The new pumps consist of three 8-inch horizontal centrifugal pumps, each directly driven by a 75-horsepower induction motor. The capacity is 1,400 gallons per minute for a single pump with a discharge pressure of 60 pounds per square inch or for two pumps operated in series with a discharge pressure of 120 pounds per square inch. The former pressure is for ordinary service, and is sufficient for the delivery of water to any floor of any arsenal building. The higher pressure is for fire service and is sufficient to force six streams through the usual 1-inch fire-hose nozzles and over the roof of the highest arsenal building. For ordinary service a single pump will be operated at 60 pounds pressure, but the installation is so arranged that either one of the idle pumps can be quickly started in series with the operating pump to give fire pressure. The feed lines for the electrical current required to operate these pumps are entirely separate from

the power feed lines of the arsenal shops, in order that any interruption of the latter lines through fires, etc., may not effect the pumping service.

Power plant.—To the motors previously installed have been added during the year two 3-horsepower, one $\frac{1}{2}$ -horsepower, and one 25-horsepower. In addition three 75-horsepower motors are under contract for use in the new pumping station, which will be delivered at an early date, making a total of 114 motors, aggregating 3,795 horsepower.

Additional machinery in shops of the arsenal and armory rows.—Fifty-five machines of various kinds have been added during the year, and 28 others are under contract, for the purchase of which funds have already been provided. These include a complete plant for the manufacture and repair of the wooden parts of artillery wheels and a number of additions to the machinery in the armory shops required to provide for a maximum output of 250 rifles per day. A special machine has also been designed and built at this arsenal for the manufacture of pasters used in target practice. This machine takes the roll of paper, places the glue on one side, dries the glue, punches out the pasters, counting them off in lots of 1,000, and places them in pasteboard boxes in which they are issued at the rate of 750,000 per day of eight hours, the only attendance required being to place the covers on the pasteboard boxes.

Arsenal shops.—For the convenient and economical prosecution of work these shops are divided into machine, foundry, and forge shops, polishing, plating, equipment, and tin shops, and the harness shops. In the first group, in addition to the usual repair work and to the manufacture of many of the metallic parts of articles of issue fabricated at this arsenal during the year, the principal operations of these shops have included work upon field and siege howitzer carriages and field and siege rifle carriages, with their limbers and caissons; wheeled mounts, model of 1905, for Vickers-Maxim automatic machine gun, caliber .30; reel and cart for carrying field artillery battalion and regimental commander's fire-control equipment; conversion of 3.2-inch field carriage to permit of long recoil; the manufacture of miscellaneous sets of test tools and gauges; the construction of wheel-assembling machine for the manufacture of artillery wheels, and the alteration and maintenance of field-artillery material in the hands of troops.

Among the miscellaneous work of the machine shop should be included the fabrication of special parts of field-artillery material for use by contractors upon vehicles they are manufacturing for the Government, and of many parts for addition to or repair of 3-inch field-artillery material in store or in service in this and other mobile armament districts.

The principal new work in the polishing, plating, and allied shops has been the manufacture of the metal parts of the new bayonet scabbard. In these shops have also been made, during the year, forks and spoons, aluminum cups, meat cans, canteens, knives, and cartridge storage cases of various sizes, in addition to a large amount of metal parts for other fabrications in the harness and carpenter shops.

The principal new work undertaken in the harness shop during the year has been the manufacture of carriers for intrenching tools and the alteration of gun slings of former pattern to the new model of 1907. Thirty Harris packs (which is a modification of the Merriam pack) have also been manufactured and issued for trial. There have also been made and issued for trial a number of Coolidge rifle carriers for carrying the rifle on the soldier's back instead of the rifle scabbard now used in the cavalry service. Adapters for use with the leather waist belt and bayonet scabbard have been manufactured and issued.

As the reserve supply of cavalry and horse equipments had previously been practically completed, the manufacture of these articles during the past year has not been much in excess of that required for current issues, and the force of harness makers has therefore remained during the year at an average of about 100.

Armory shops.—During the fiscal year ending June 30, 1907, there were manufactured in the armory shops at this arsenal 33,465 United States magazine rifles, model of 1903, adapted for model of 1906 ammunition, complete, except rear-sight leaf; 89,936 bayonets, model of 1905, and the reserve parts for issue in time of war for 33,465 rifles and bayonets.

Proving ground.—The proving-ground work for the year has included the firing of a total of 391 rounds and the proof test of 34 3-inch field guns, models of 1904 and 1905, of 36 3-inch field carriages, model of 1902, and of one 3.2-inch field carriage converted to long-gun recoil. All of the guns proved were of Watervliet Arsenal manufacture, while sixteen of the carriages were made by the American and British Manufacturing Company.

Drafting room.—The principal work in this department during the year, in addition to the routine work in connection with current manufactures, has been as follows:

Design and detailed drawings of test tools; design and detailed drawings of 2.38-inch field caisson and 3.8-inch field caisson; design and detailed drawings of engineer's pack outfit; design and detailed drawings of reel and cart for the transportation of battalion and regimental commander's fire-control equipment; 275 sheets of tracings have been forwarded to the Office of the Chief of Ordnance for approval; 22,600 blueprints and 1,480 brown prints have been made and issued for shop use; 300 photographic negatives have been made, and many prints have been taken from these negatives.

Licenses granted.—Extensions and modifications were made during the year in a number of revocable licenses affording privileges at this arsenal which have from time to time been granted by the Secretary of War, the principal changes being as follows:

The license granted to the Davenport and Rock Island Street Railway Company to substitute electric cars for horse cars on the bridges from the arsenal to the cities of Davenport and Rock Island and upon the connecting arsenal street was on May 15, 1907, extended in favor of the Tri-City Railway Company, under conditions regarding construction of the new bridge which have been previously stated.

License was granted to the People's Power Company on May 29, 1907, to construct, operate, and maintain a line of electric-light wires and electric-power wires across the Government bridges and their connecting street under condition that they light by electricity and maintain all the necessary poles, fixtures, reflectors, wires, and lamps for this lighting on the bridges and the connecting street.

License which had been granted to the Rock Island and Eastern Railway Company to construct, maintain, and operate its tracks through the tailrace south of the old Moline dam wall of the power pool at this arsenal was on May 22, 1907, extended in favor of the Davenport, Rock Island and Northwestern Railway.

The revocable license which had been granted June 2, 1902, to the city of Moline to construct and maintain a water main and settling basin at this arsenal was revoked by the Secretary of War November 6, 1906, no advantage having been taken of this privilege and in the meantime the proposed site having become necessary for the uses of the United States and having been transferred to the Engineer Department of the Army.

The sum of \$2,399.13 was received as proceeds of the rent of electricity to private parties during the year, and \$3,797.16 was left for returning to the Treasury from the \$12,500 appropriated for the maintenance and operation of the power plant.

The average number of employees during the year was 1,671, and the total disbursement for wages during that time was \$1,218,288.23.

There has been a gratifying increase in the celerity of manufacture of experimental gun carriages during the year. There is always the pressure of haste with experimental material.

SPRINGFIELD ARMORY.

The armory has been commanded during the year by Col. Frank H. Phipps, Ordnance Department, U. S. Army.

An automatic sprinkler for better protection against fire will be introduced in the carpenter and stocking shops during the coming fiscal year.

Owing to the continued complaints made by the citizens living in the neighborhood of the targetting house in reference to the constant

noise made by the firing, a site for a new house has been selected and work in connection with targeting rifles on this site has begun. This change of location will add considerably to the expense of targeting, because of the longer haul for the rifles.

Pearl street has been resurfaced and is now in excellent condition.

The present method of furnishing power to the different shops at this armory, with its long line of shafting running through the machine shop, with a quarter turn each for the carpenter and milling shops, and still another quarter turn from the shafting running through the milling shop under Federal street to the bayonet shop, is very wasteful and unsatisfactory. Electric power will be substituted in this plant.

Principal stores manufactured during fiscal year ended June 30, 1907.—United States magazine rifles, caliber .30, model of 1903; gallery-practice rifles, caliber .22, model of 1898; gallery-practice rifles, caliber .22, model of 1903; holders for gallery-practice rifles, caliber .22, model of 1903; bayonets, model of 1905; officers' sabers, fencing muskets, fencing bayonets, hospital corps knives, Belgian aiming devices (Pieper), repair kits, model of 1898, and barrels for drill cartridges, calibers .30 and .45. Sabers of the Ames Sword Company manufacture were also procured under contract.

The usual repairs and alterations of ordnance material have been made, miscellaneous articles fabricated, and slight improvements in design and methods of manufacture adopted.

Until the latter part of April last the manufacture of Vickers-Maxim automatic machine guns and ammunition under contract was inspected by an officer detailed from this armory; since that time this work has been under the supervision of an inspector resident elsewhere.

The Department having decided to issue to the troops and militia a gallery-practice rifle, using .22 caliber cartridge, a series of experiments was undertaken as to the best form of rifling and chamber. The result of these experiments is the adoption of the model of 1903 rifle using the Hoffer-Thompson holder. Three thousand rifles and a supply of holders have been completed.

The change from the rod to the knife bayonet and the turning in of the model of 1898 rifles have added greatly to the work of the storekeepers' department. This has put much of the paper work of that department behindhand, but with the extra assistance given it will soon be brought up to date.

In order to provide a more satisfactory system of accountability and inspection, the inspecting and store rooms at the water shops have been partitioned off, by means of which a much clearer knowledge of the work in the shops at all times is possible.

The usual tests, experiments, and reports on inventions and ordnance material presented have been made during the year.

FRANKFORD ARSENAL.

This arsenal has been commanded during the year by Col. Frank Heath, Ordnance Department, U. S. Army, who is also a member of the Board for Testing Rifled Cannon. Its product includes cartridges of all classes for small arms, time and percussion fuzes, including those for detonating high explosives, primers for all services, sights, quadrants, telescopes, range and deflection boards, and other instruments for the control of seacoast and field artillery fire, tools for reloading small arms and fixed ammunition, the equipment for loading projectiles with high explosives at artillery posts, inspection gauges, and other spare parts and accessories.

In the cartridge factory much needed additional space has been gained by the removal of the wall separating the annealing department from the old and unused double-acting press room. In this space has been installed three revolving annealing furnaces of a new and greatly improved type. In the cellar under this space has been erected an ice-making plant, by means of which all employees are now furnished a full supply of ice for use during working hours. The fuel oil supply to the annealing room has been increased by an additional oil storage house and tank, thus avoiding all danger of a short supply of fuel for this department.

Fuze and primer department.—The manufacture of the 21-second time and percussion fuze has proceeded steadily throughout the fiscal year, the firing test of this fuze having been on the whole very satisfactory. Greater uniformity in the time of burning has been noted as a result of the experience gained in manufacturing the fuze in quantities, and it is now believed that the time fuze as issued to the service is the equal of any of the kind that can be procured abroad. Very good results have been had with the modification of the present design, in which the gases of the burning time train, instead of escaping directly into the air, are conducted by properly arranged internal channels through a natural course protected by a hood. By this means impingement of the air is prevented, thus causing the fuze to burn in flight under conditions approaching more nearly at rest.

Experiments made during the past year have resulted in the development of a larger combination fuze, of about 31 seconds total time of burning, for the new 3.8-inch, 4.7-inch, and 6-inch siege shrapnel. The Department will be in a position to furnish this fuze to the service in quantities as soon as they may be required.

Several designs of centrifugal fuzes have been submitted for test by private manufacturers during the year. None have been sufficiently satisfactory to warrant their adoption for the service.

The manufacture of detonating fuzes has progressed in a satisfactory manner, and this Department is now in a position to supply this

material to the service in any reasonable quantity. Fuzes of this kind have to be made strong enough to withstand the stresses due to impact of the projectiles in which inserted against armor plate. Considerable difficulty has been experienced in obtaining material possessing the required physical qualities to meet the above condition.

High-explosive ammunition.—The preparation of high-explosive ammunition has continued throughout the year. The safety appliances which were developed during the past year have been in constant use with very satisfactory results. The Department is now in a position to furnish ammunition of this class in any reasonable quantity.

Shrapnel.—After considerable difficulty, the high grade of material required for the 3-inch shrapnel case has been secured, and the manufacture of these projectiles is progressing satisfactorily. A great increase in the strength of the case has been secured by requiring it to be drawn hot and omitting subsequent annealing operations. This leaves the metal of the case somewhat harder and increases the cost of machining, which, however, is amply repaid with the increased efficiency of the shrapnel. Experiments are now in progress having for their object the development of a method of oil tempering of shrapnel cases, which, if successful, will enable the weight of the case to be considerably reduced.

In addition to the regular work on 3-inch shrapnel, experimental lots of 2.38-inch, 3.8-inch, and 4.7-inch shrapnel have been completed, and the manufacture of a 3.2-inch shrapnel of new design has been undertaken. The 3.8-inch and 4.7-inch shrapnel are for the new siege material. The 3.2-inch shrapnel is for use with fixed ammunition for the 3.2-inch field gun, mounted on the long-recoil carriage.

Shrapnel, the most useful field projectile, is the most difficult to produce. There is always conflict between its efficiency, represented by the ratio of the weight of the bullets to its total weight, and the thickness of the case, which concerns safety, while there is constant straining to increase the regularity of burning of the fuze. It is hoped that improvement is not yet at an end.

Fuze setters.—The fuze setter is an instrument for accurately and rapidly setting time fuzes for the range desired. Two designs have been developed and are issued to the service. One of these is attached to the caisson of field batteries by means of a suitable bracket; the other is known as the hand fuze setter and is intended for use in case the bracket fuze setter should become disabled or the gun for any reason separated from its caisson. The hand fuze setter is carried in a leather case in the trial box of the gun. Each battery is provided with six bracket fuze setters and each gun with one hand fuze setter.

Small-arms cartridge department.—The increase in the velocity of the small-arms bullet has necessitated a longer velocity range. A new firing gallery 150 feet long has been built as an annex to the proof house and completely equipped with firing rests and target frames.

Fifty million ball cartridges for the caliber .30 rifle and 3,640,000 for the caliber .38 revolver, besides blanks, gallery practice and other cartridges for miscellaneous purposes, have been manufactured during the year. New improvements to machines have been made, greatly increasing the efficiency and somewhat diminishing the cost of cartridge manufacture. Among them may be specially mentioned nine priming machines which have been provided with varnishing attachments, eliminating all hand work in this operation. Ten pocket sizing machines have been altered to perform also the venting operation, saving the cost of running ten venting machines. An automatic cartridge wiping attachment has been applied to twelve loading machines. By this ingenious device all hand wiping, a slow and costly operation, is avoided.

Preparations are completed for the manufacture of the model of 1906 cartridge, which replaces that heretofore used for the model of 1903 rifle. The bullet has a very sharp point and weighs 150 grains. The standard powder for the caliber .30 rifle is found to be unsatisfactory for this high velocity, principally on account of excessive erosion and attendant inaccuracy. Upward of 100 samples furnished by E. I. Du Pont de Nemours Powder Company have been tested, from which one has been selected as best adapted to the new cartridge.

Department of sights and instruments for fire control.—The increased output of the sight department has required additional floor space, which has been secured by removing the drawings and blueprints to the second floor of the east storehouse. The space thus gained is used for a tool room and to contain graduating machines and a few standard tools. This department has been employed to its full capacity during the year in the manufacture and repair of sights, plotting boards, and other instruments required for fire control by the field and seacoast artillery. The principal improvement in equipment has been the installation of appliances for optical glass work, including lens and prism grinding and polishing machines. The arsenal is now in a position to economically and efficiently manufacture and repair all lenses and prisms required by the Department. One of the most successful instruments in the course of manufacture is a special plotting board for the use of the fire commander. The special feature of this board is a ball-bearing pantograph attachment and template, by means of which the azimuth and range of any target observed from any one of the several stations of a fortification shown

on the template may at once be determined and the necessary data secured for any of the stations or guns shown on the template. The template is simply an inverted map, to a suitable scale, of the entire fire command with which the board is to be used.

WATERVLIET ARSENAL.

This arsenal was commanded during the year by Lieut. Col. I. MacNutt, Ordnance Department, U. S. Army, who is also a member of the Board for Testing Rifled Cannon. It is the army gun factory and supplies a large percentage of the cannon of all calibers used in the military service, together with the spare parts, tools, etc. The value of all the material under manufacture during the year was \$2,207,545 and the value of the material completed was \$931,395.34.

Work under the appropriation of \$20,000 for electrifying the heavy machines in the gun shop at this arsenal, which became available July 1, 1906, has been nearly completed. A 200-kilowatt steam turbo-generator set has been purchased and installed. All heavy lathes have been equipped with individual motors, except the four largest, which, due to the large size of the individual motors required for starting, have been equipped as a group driven by a single motor. The installation of the few remaining motors will be completed within two or three months, resulting in a thoroughly mechanical and economic system of machine operation throughout the shop.

A pyrometer purchased and installed in connection with the shrinkage furnace has resulted in increased output due to better knowledge and control of heat conditions. Compressed air instead of steam is now used in connection with the oil burners for this furnace and also for the operation of the steam hammers during the summer months, so that the steam plant is now entirely shut down during this period.

The old Corliss engine has been removed, the engine room overhauled and repaired, giving sufficient space for an electrical store-room and the installation of the new turbo-generator set.

The tool room has been improved, storage space for tools increased, steel lockers built, and the most important machines put on concrete foundations.

The capacity of the smith shop has been brought up to the requirements of the gun shop by the purchase and installation of two steam hammers and a suitable furnace for heating material for forging.

The amount of work done at this arsenal during the year was somewhat less than for the preceding year, with a reduction in the number of employees from 377 to 322. This number, however, will shortly be increased, due to a large order for 21-inch torpedo tubes for the United States Navy.

Notwithstanding the decreased force, the low cost of production at this arsenal has been gratifying, comparing most advantageously

with the prices paid to private establishments for identical articles of manufacture, and this despite the high price paid for labor at Government establishments, resulting from short hours, numerous holidays, and vacations.

While, as in the past, the main work of the arsenal has been the manufacture of guns of various types, an increasing proportion of the total labor has been on other work. This during the past year has been largely on the manufacture of spare parts for guns, trays, caps for projectiles, the labor of capping projectiles, fuse bushings, and plugs. The labor expenditures for these purposes amounted to \$97,467.51, while that for the manufacture of guns amounted to \$137,354.02. The guns manufactured constituted therefore 61 per cent of the total work done and were made up of the following:

- 1 10-inch rifle, model of 1900.
- 3 8-inch rifles for United States, for Navy Department.
- 5 7-inch rifles for United States, for Navy Department.
- 21 6-inch R. F. guns, model of 1905.
- 1 5-inch R. F. gun, model of 1900.
- 35 3-inch R. F. guns, model of 1903.
- 2 4.7-inch siege guns, model of 1906.
- 2 3.8-inch field guns, model of 1905.
- 71 3-inch field guns, model of 1905.

The appropriations are not sufficient to employ this fine plant, a considerable portion of which must therefore stand idle during the year.*

The arsenal has been notable for the promptness and accuracy of all its reports, records, and returns, and the economy of clerical labor with which this result has been brought about.

WATERTOWN ARSENAL.

This arsenal was commanded during the year by Lieut. Col. F. E. Hobbs, Ordnance Department, U. S. Army.

The principal operations during the year have comprised the manufacture of gun carriages of various calibers, parts for the modification of seacoast gun carriages, and the usual large amount of repair and alteration work for carriages mounted at seacoast fortifications on the Atlantic coast, and to a limited extent also for those on the Pacific coast. The manufactures have also included implements, targets, and maneuvering material, and a large quantity of steel castings required for the manufactures at other arsenals.

The gun carriages completed during the year are 3 10-inch disappearing carriages, model of 1901, and 1 12-inch disappearing carriage, model of 1901. Much attention has been given to the production of sets of parts for the modification of 12-inch mortar carriages, model of 1896, designed to make this part of the seacoast armament more efficient. Eighty sets of these parts have been completed and

shipped to the fortifications, so that the actual work of alteration can proceed.

The other important items of manufacture during the year have been:

- Loading platforms for subcaliber firing.
- Counterbalance devices for 12-inch disappearing carriages, model of 1896.
- Trays with tray supports for ammunition trucks for 10-inch disappearing carriages.
- Tray supports for ammunition trucks for 12-inch disappearing carriages.
- Armor-piercing projectiles, grooved and prepared for fuzes.
- The alteration of dummy projectiles.

Work is in progress on 55 15-pounder barbette carriages, model of 1903, 4 12-inch mortar carriages, model of 1896 MII, 5 12-inch disappearing carriages, model of 1901, and on a large number of parts required to alter or modify carriages of the older models, that they may be made as efficient as those of later design.

The plant has been operated well up to its capacity, except that more machinists could have been utilized. The total value of material under manufacture during the year was \$957,814.18. The value of the material completed was \$495,554.20.

Smith shop.—Some 300 tons of forgings for carriages under manufacture and for alteration or improvement of the armament have been manufactured in this shop during the year, in addition to a large amount of miscellaneous smith work. The physical qualities of the tested steel forgings have been satisfactory, and the use of steel ingots produced in the arsenal foundry for the manufacture of these forgings has been continued with satisfaction so far as promptness and economy of production are concerned.

Attention was invited in my last annual report to the limited forging capacity of this shop and the desirability of improving and increasing its facilities. An estimate is submitted for the introduction of a fuel oil heating system and its application to the blacksmith forges and the furnaces now installed.

Pattern shop.—The disadvantages under which the manufacture of patterns has been conducted for years have been entirely corrected by the modification of part of the pattern storehouse for this use under an appropriation made by the act approved June 25, 1906. The new shop has been completed and in operation for the past five months. It is well equipped and provided with conveniences, is well lighted and ventilated, and is of sufficient capacity so that any pattern work which may probably be needed can be promptly taken up and completed. The nature of the material in this storehouse and shop is such as to call for special protection from the possibility of fire, and there is consequently to be installed in it a complete automatic sprinkler system covering the whole building.

Foundry.—The capacity of this shop is about 2,000,000 pounds of steel, iron, and bronze castings per annum, and it has been operated to this capacity during the year. The quality of the product has been good and the loss from all causes has been small. Successful experiments have been conducted during the year in the production of castings of bronze No. 4 from the raw material. These castings have heretofore been made by remelting ingots of manganese bronze purchased from the manufacturers. A considerable saving in cost has resulted, amounting to about $1\frac{1}{2}$ cents per pound. The production of double-blow steel castings for any large individual castings which may be needed has been successfully continued. The work is, however, such a strain on the plant and the personnel that it will not be continued as a regular shop practice, but applied only in special or exceptional cases.

Appropriation made at the last session of Congress will permit the prosecution of the very necessary improvements in this building, viz, the replacing, so far as practicable, of all woodwork by fire-proof material and the roofing over of a space between the foundry and foundry shed, to be used for cleaning and chipping castings.

Machine and erecting shop.—Further progress has been made in increasing the efficiency of these shops by the installation during the year of a number of new machine tools heavier and more powerful than those they replaced, or supplying a need in the shop equipment, and also by the attachment of a new and more powerful motor to the large planer. The completion of work has been somewhat hampered by scarcity of machinists and by calls on the shop personnel for men fitted for inspection work, and to assist in mounting carriages at fortifications or to make alterations in gun carriages of the older models, and also by delay in the receipt of large steel castings from the manufacturers.

Testing laboratory.—Routine tests connected with current department manufactures and tests for other departments of the Government have occupied much time during the year, and in addition there have been conducted investigative tests upon ordnance material and of a general character. Supplementary tests have been made upon wheels for mobile artillery carriages, and the thorough examination which has not been made on these wheels has furnished, it is believed, much valuable information on a matter which had not heretofore had the benefit of definite tests of strength.

Ingot metal, as illustrated in the Harmet process of fluid compression, has been further examined. The lack of structural homogeneity has been shown to extend practically to all parts of the ingot, and, though the arrangement of the defective portions and the shapes of the same had been evidently modified by the fluid compression, the presence of defects throughout the ingot show that the

lack of homogeneity had only been obscured to a certain degree. The state of metal in an ingot is one of special importance and interest. The tests of this ingot are, consequently, of much value, and a series of tests in this direction will be inaugurated.

Investigative tests on industrial material for engineering and architectural purposes have been further carried out in continuation of the series of preceding years on concrete columns, plain and reenforced, and several brick piers have also been tested. The data obtained are important and appear to be much desired by engineers and constructors generally, since the requests for information as to determined data have been very numerous during the year.

An increase in the amount of the yearly appropriation for the laboratory was made at the last session of Congress, which will permit addition to the personnel and the procurement of test material, so that the testing machines may be operated more nearly to their capacity, and a greater amount of investigative work can be performed than has heretofore been possible. Attention will be especially directed to the investigation of ingot metal, to blooms and billets and rolled or hammered shapes from ingots, to special steels and their treatment, and generally to data connected with mechanical engineering problems. Attention will also be given to the preparation of a comprehensive general index of the reports of tests of metals from 1882 to the present time, and the preparation of a special volume giving the results of the more important series of tests which have been prosecuted since the establishment of the laboratory.

Northern Armament District.—The commanding officer of this arsenal is the armament officer of the Northern District, and is charged with maintaining in an efficient condition the seacoast armament from Maine to the eastern entrance of Long Island Sound. The required inspections of the armament have been made, and all necessary repairs have been promptly completed, so that the armament is in satisfactory service condition. Much additional work has been done during the year in proof of guns and carriages and in special experimental firings. The alterations or modifications of the armament which have been ordered, to keep it in the highest state of efficiency, have also demanded much work and attention.

NEW YORK ARSENAL.

This arsenal was commanded during the year by Col. John E. Greer, Ordnance Department, U. S. Army, who is also chief ordnance officer Department of the East, armament officer of the Central Armament District, and performs inspection duties.

The arsenal being mainly a purchasing and shipping agency, without facilities for manufacturing, its operations are limited to those of purchasing, receiving, and issuing stores to the Army and

militia. It also receives through the custom-house such stores as are purchased abroad.

Its operations are necessarily confined to the care and preservation of the public buildings and the property stored therein, except that all work incident to the office of the chief ordnance officer Department of the East, the armament officer of the Central Armament District, and the inspector of ordnance is attended to by the arsenal employees.

More than 1,500 issues of stores were made during the year. These stores were selected, prepared, packed, hauled to wharf, and delivered to the depot quartermaster, and were contained in 7,271 packages, weighing 726,285 pounds. The stores received were covered by 201 invoices and were contained in 10,640 packages, weighing 1,066,436 pounds.

All buildings, walks, roads, drains, and gutters have been kept in repair and the grounds cared for and improved.

This arsenal is regarded as of great importance to the Ordnance Department as a purchasing and shipping agency and place of temporary storage of ordnance stores, but its principal value is as a depot for arming and equipping troops, especially of a military expedition in time of war.

AUGUSTA ARSENAL.

This arsenal has been throughout the year under permanent command of Col. David A. Lyle, Ordnance Department, U. S. Army, who is also a member of the board on life-saving apparatus under the Secretary of the Treasury, chief ordnance officer of the Department of the Gulf, and armament officer of the Southern Armament District.

This arsenal is a depot for supplying ordnance and ordnance stores to the Department of the Gulf and to the organized militia and educational institutions in the South Atlantic and Gulf States. It embraces also the offices of the chief ordnance officer of the Department of the Gulf and of the armament officer of the Southern Armament District, and has a small machine shop engaged upon work incident to alterations and repairs of the seacoast armament in that district.

During this fiscal year manufactures aggregating in value \$10,640.41 have been in progress in these shops, and manufactured articles to the value of \$10,321.91 completed; 459 seacoast projectiles have been prepared for detonating fuzes, and 499 fitted for base covers. In addition, the shops have worked in conjunction with the resident and other machinists in the Armament District upon numerous repair and alteration orders.

Seven machinists, resident, have been maintained at forts in the district, the one in Galveston Harbor having the assistance of three laborers (reduced from four) to care for the armament of the three ungarrisoned forts. A new repair shop having been equipped at

Fort Taylor, Fla., the number of these shops is now seven. Establishment of two new artillery districts and orders for alteration work necessitate two more resident machinists and several armament machinists, and men are being engaged for these needs.

Plans for installation of new machinery have been nearly completed—specifications being desirably delayed until the completion of the railroad spur track permits cost of freight delivery to be properly provided for. An appropriation of \$3,000 during the last session of Congress provides for this track, and specifications now in progress will soon be completed.

Out of current repair allotments the capacity of the storehouse has been much increased by staging for stores and by bracing floors.

At a cost of about \$600 the office building has been altered, increasing materially the space available for business.

The sanitary condition of the post is excellent—improved during the year by installation of sewer-connected water-closets, and of new water supply, which latter improvement will save the services of two men, besides some money expenditure, while providing a fire protection not previously available.

The extent of business is partially indicated by the amount of disbursements, \$41,681.24; of stores received, 1,970,000 pounds; and of stores shipped, 567,700 pounds.

BENICIA ARSENAL.

This arsenal was commanded during the year by Maj. J. W. Benét, Ordnance Department, U. S. Army, who is also chief ordnance officer, Department of California, and armament officer of the Western Armament District.

The manufactures consisted of target material for seacoast forts, field batteries, and small arms target practice, and parts of guns and carriages to replace parts broken or of obsolete design in the Western Armament District.

Cartridges for target practice and saluting purposes were manufactured and issued for the field and seacoast guns on the Pacific coast, and a large number of A. P. and D. P. projectiles for seacoast guns were tapped for fuze plugs and grooved for base covers.

It has been decided to replace the steam engine formerly used as an independent source of power, by an internal combustion engine using distillate from California crude mineral oil. The boiler house now left available for other purposes is being prepared for the installation of a tinning plant and plant for repairing small arms.

Several new machine tools have been added to the carpenter shop, and the shop is being rearranged. Electric elevators have been ordered for the carpenter and machine shops and for the old shop building now used as a receiving storehouse.

The main road leading to the north and south storehouses has been graded and macadamized, and more of the board walks have been replaced by concrete sidewalks.

Five sets of quarters occupied by enlisted men have been painted, and all buildings, walks, roads, etc., have been kept in repair.

Four-inch water pipe has been purchased to replace the remaining portion of the 3-inch pipe of the water system laid many years ago, and 3-inch pipe has been substituted for 2-inch pipe in supplying the standpipes in the shops.

Transportation facilities have been improved by the purchase of a Knox Atlas auto truck of 3 tons capacity. This will be particularly useful on account of the steep grades of the roads from the railroad station and dock to the storehouses.

SAN ANTONIO ARSENAL.

This arsenal has been commanded during the year by Col. John Pitman, Ordnance Department, U. S. Army, and Lieut. Col. Frank Baker, Ordnance Department, U. S. Army. Its work has consisted principally in issues of supplies and equipments to troops in the Department of Texas, and supervision of repair of light artillery material in the Departments of Texas and the Colorado.

UNITED STATES POWDER DEPOT.

This depot was commanded from the beginning of the year until May 14, 1907, by Lieut. Col. O. B. Mitcham, Ordnance Department, U. S. Army, when he was relieved by Maj. B. W. Dunn, Ordnance Department, U. S. Army, who was in turn relieved on June 10, 1907, by Maj. Odus C. Horney, Ordnance Department, U. S. Army, who is in command at the present time.

This depot is used for the storage, preparation, and issue of powder, ammunition, and high explosives.

Two storehouses for the storage of sodium nitrate are nearing completion, and contracts for the material for two others have been entered into, and their erection will be completed during the coming year.

Contracts have been made for most of the machinery for the new shops, and part of it has been delivered. The shops will be in active operation in a few months.

The new Army Powder Factory has been located at this depot, and the work of construction has progressed satisfactorily, although, owing to the congested condition of the market, considerable difficulty has been experienced in obtaining delivery of material and machinery. It is expected that the manufacture of smokeless powder will begin in a few months. The additional work incident to the

erection and operation of the powder factory has rendered necessary the assignment of two assistant officers for duty at this depot.

In consequence, two sets of quarters are to be erected during the coming year; the building known as the Guardhouse is being fitted up as an office, and the present office building will be altered for use as a residence.

On June 30 the number of employees was 186. The total disbursements for the fiscal year 1906-7 were \$159,069.35. The number of receipts and issues of stores during the year was 666, involving the handling of 7,338,552 pounds of freight.

MANILA ORDNANCE DEPOT.

The depot was commanded during the year by Maj. E. B. Babbitt, Ordnance Department, U. S. Army, to September 21, 1906; by Capt. D. M. King, Ordnance Department, U. S. Army, from September 21, 1906, to November 14, 1906; since November 14, 1906, by Maj. C. B. Wheeler, Ordnance Department, U. S. Army, who is also the chief ordnance officer of the Philippine Division. His assistant was Capt. D. M. King, Ordnance Department, U. S. Army.

Employees.—There are approximately 220 employees, of whom 18 are Americans. This does not include an enlisted force of 50 men, who are employed in shops, storehouses, and in performing guard duty. Considerable difficulty has been experienced in conducting the office work on account of a large number of changes in the clerical force during the year. Endeavor has been made to obtain certifications from the register of eligibles prepared by the Philippine civil service board, but it has been found impracticable to fill vacancies as they occur.

Volume of business.—One thousand two hundred and fifty-one ordnance property returns were received at the depot during the year; 1,130 of these were given a preliminary examination and forwarded to this office. Errors in these returns are, as far as practicable, adjusted by correspondence in the Philippines before being forwarded, thus materially facilitating the settlements of officers' property accounts.

Ten thousand one hundred and twenty-five letters and indorsements were received at and 11,826 letters and indorsements were sent from the depot during the year. As the larger part of this correspondence is with the Army at large, its recording involves comparatively greater labor than would be the case with correspondence with ordnance establishments, because of the necessity of copying all letters and indorsements.

Two thousand two hundred and sixty-six requisitions for ordnance stores were received from troops and acted upon. The vouchers for stores issued numbered 3,158, and the total weight of stores issued

amounted to 2,074 gross tons. The vouchers for stores received numbered 1,152, and the total weight of such stores amounted to 1,820 gross tons.

The amount of stores received and issued during the fiscal year was much greater than for some years, owing to the rearming of the troops in the Philippines Division with the United States magazine rifle, model of 1903, and the issue of new equipments. This exchange of arms was made with satisfactory promptness, and the old arms are being overhauled and repaired at the depot prior to their return to the United States for storage.

The expenditures at the depot during the fiscal year amounted to approximately \$66,500. The proceeds of sales of ordnance stores to officers for their personal use and of repairs to officers' equipments aggregated \$8,756.40. The proceeds of sales (including cost of transportation) to and of repairs for the Insular Government aggregated \$15,842.89. The vouchers for disbursements numbered 334 and those for cash sales 1,534.

Improvements.—Stone and concrete floors were laid in six storehouses. This was necessary, as the old wooden floors were destroyed by white ants, and has materially facilitated the movement of stores by trucks.

The harness shop has been moved to the old office building, and the place formerly occupied by the harness shop is now used as a receiving storehouse for all obsolete and unserviceable stores. This avoids transferring these stores across Plaza Moriones and results in appreciable economies.

Two casemates were fitted up for reloading, refuzing, overhauling, and cleaning field and siege ammunition.

Storage of ordnance property.—All ordnance stores, with the exception of some 3.2-inch field artillery material, have been stored under cover in 13 storehouses. There are in addition two detached magazines at the disposal of the department. Arrangements which have recently been made, together with the two magazines which have been authorized by Congress, will, it is hoped, very nearly meet all storage requirements at that depot.

Work at the depot.—The depot is maintained for the purpose of distributing supplies to troops serving in the Philippines Division, including the Philippine scouts, repairing arms and equipments, manufacturing such supplies as are not on hand and are needed at the time, and it is also a storage place for material held in reserve. For this purpose, in addition to the storehouses, there are carpenter, harness, machine, blacksmith, tin, and paint shops, a foundry and nickel-plating plant and an armory exclusively devoted to the repair of small arms and appurtenances. The power used is electric and is furnished from a central plant at the depot.

In addition to overhauling and repairing a large amount of material turned in for that purpose, the depot has been engaged during the year in the manufacture of arm racks, machete scabbards, ammunition boxes and hangers for 75-millimeter ammunition, target frames, dummy ammunition, reloading tools for gallery practice, and leg-gings, revolver holsters, saddlecloths, waist belts, etc., for sale to officers. Several thousand rounds of field and siege gun ammunition were also modified, loaded with explosives, and repacked.

When the seacoast armament is installed in fortifications in the Philippine Islands, this depot will be charged with its maintenance and repair, in addition to that of the mobile artillery now in service in those islands.

THE ORDNANCE BOARD.

Membership of the Ordnance Board June 30, 1907: Col. Charles S. Smith, Ordnance Department, U. S. Army; Lieut. Col. William L. Marshall, Corps of Engineers, U. S. Army; Lieut. Col. Rogers Birnie, Ordnance Department, U. S. Army; Maj. Millard F. Harmon, Artillery Corps, U. S. Army; Maj. Tracy C. Dickson, Ordnance Department, U. S. Army.

Col. H. L. Harris, Artillery Corps, U. S. Army, has been associated with the Board since April, 1907, for the consideration of the subject of observation telescopes for battle and fire commanders' stations.

The following is a list of the principal subjects reported upon from July 1, 1906, to June 30, 1907:

Reference No.	Subject.	Date of report.
GUNS.		
38522.....	6-pounder semiautomatic guns; Benét-Mercier, Driggs-Seabury Ordnance Corporation; U. S. Rapid-Fire Gun and Power Company.	Apr. 23, 1907.
38961.....	Erosion tests, 6-pounder guns, quick and slow burning powders.....	Dec. 3, 1906, and May 8, 1907.
38961.....	Comparative accuracy endurance of 6-pounder guns with 2,400, 2,600, and 3,000 feet per second velocity.	Nov. 28, 1906.
38499.....	2.38-inch field gun, carriage, and limber, model of 1905.....	Oct. 26, 1906, and Jan. 10, 1907.
38893.....	3-inch field gun, No. 64, model of 1905, overcompressed by longitudinal shrinkage.	Dec. 7, 1906.
4044.....	Bursting test 3-inch nickel steel tube, high-explosive shell.....	Apr. 24, 1907.
38580.....	Semiautomatic mechanism for 3-inch R. F. guns.....	Dec. 3, 1906.
38603.....	3-inch R. F. gun (semiautomatic) and carriage, model of 1903.....	Feb. 9, 1907.
38603.....	Lining tube for 3-inch R. F. gun, No. 1, model of 1903.....	Dec. 29, 1906.
38603.....	3-inch R. F. guns, model of 1903, overcompressed by longitudinal shrinkage.	June 14, 1907.
39480.....	3.8-inch field gun, carriage, and limber, model of 1904.....	Oct. 27, 1906, and Jan. 10, 1907.
38539.....	4.7-inch siege gun and carriage, model of 1904.....	May 17, 1907.
13738.....	Experimental breech mechanisms, 5-inch R. F. gun. No. 18, model of 1897.	Feb. 15, 1907.
38142.....	6-inch siege howitzer and carriage, model of 1905.....	Mar. 6, 1907.
3710.....	6-inch wire gun, Brown and Crozier designs.....	Feb. 28 and June 1, 1907.
11381.....	Metallic gas check for cannon. (Lieut. W. J. Hawkins, Ordnance Department.)	Aug. 4, 1906.
37514.....	Gas-check pads for cannon, wire-cloth covering.....	Aug. 10, 1906.
39013.....	Metallic gas check for 6-inch R. F. gun. (W. D. Smith).....	Mar. 30, 1907.

Reference No.	Subject.	Date of report.
GUNS—continued.		
22653.....	Breechblock locking device and tray back-latch, 12-inch gun, model of 1900.	Oct. 10 and Dec. 13, 1906; Apr. 8, 1907.
11381.....	Breechblock locking device, 12-inch gun, model of 1900. (Watervliet Arsenal.)	Mar. 6 and Apr. 8, 1907.
11381.....	Safety firing device for guns on disappearing carriages. (Watervliet Arsenal.)	Jan. 11, 1907.
39085.....	Rifling curve, 14-inch rifle.....	June 4, 1907.
CARRIAGES.		
38801.....	6-inch disappearing carriage, No. 1, model of 1905.....	Feb. 25, 1905, Mar. 14, Apr. 29, and May 17, 1907.
POWDERS.		
25284.....	Small-arms smokeless powder, specifications.....	July 10, 1906.
25284.....	Influence of web thickness in 15-pounder R. F. and 12-inch guns.....	Aug. 28, 1906.
38499.....	Smokeless powder for 2.38-inch field gun.....	Aug. 8, 1906.
38001.....	Field gun (smokeless) powder containing 5 per cent aldehyde.....	Sept. 27 and Dec. 19, 1906, and Mar. 29, 1907.
25284.....	Samples of lots 9, 10, and 11, Navy smokeless powder.....	Oct. 19, 1906.
25284.....	Influence of varying web thicknesses in 15-pounder R. F. gun, model of 1903.	Nov. 8, 1906.
37438.....	Reduced charges, 6-inch guns, model of 1900, for 2,600 feet per second velocity.	Nov. 7, 1906, and Mar. 16, 1907.
6667.....	Stability of smokeless powder stored with chemically treated cloth.	Dec. 7, 1906.
31627.....	Flare-backs from smokeless-powder charges.....	Feb. 13, 1907.
PROJECTILES.		
37514.....	1-pounder steel shell, experimental.....	Feb. 9, Feb. 23, and Apr. 24, 1907.
38522.....	6-pounder service and Benét bands, compared.....	Oct. 26, 1906.
20210.....	3-inch shrapnel, experimental, thin case.....	June 19, 1907.
29328.....	Field shrapnel tests at Fort Riley, Kans. Field Artillery Board.....	June 8, 1907.
30306.....	3-inch shrapnel reported defective at West Point, N. Y.	Mar. 30, 1907.
23100.....	Field ammunition. Burst of high-explosive shell in bore and comparison of shrapnel and shell for ballistic value.	May 17, 1907.
20210.....	Cause of premature bursts of field shrapnel with dummy fuze.....	May 23, 1907.
30024.....	Ballistic efficiency of shrapnel bullets.....	Aug. 29 and Oct. 10, 1906.
38800.....	Shrapnel for 3.8-inch field gun.....	Oct. 31, 1906.
38650.....	Shrapnel for 4.7-inch siege gun.....	Mar. 29, 1907.
23565 BBB.....	Structural strength of 6-inch A. P. shell.....	Feb. 27 and Mar. 30, 1907.
23565 BBB.....	6-inch projectiles, long head, 7 calibers radius.....	May 16, 1907.
23565 BBB.....	6-inch A. P. shot, hard points, Maj. B. W. Dunn.....	May 21, 1907.
23565 BBB.....	Modification of 6-inch A. P. shot to improve ballistic value.....	May 24, 1907.
23565 BBB.....	Efficiency of high-explosive torpedo shell, under water explosion.....	Jan. 29, 1907.
37514.....	12-inch A. P. projectile, common, to 12-inch rifle and mortar.....	Mar. 9, 1907.
37514.....	Torpedo (high-explosive) shell for 12-inch mortar.....	June 22, 1907.
35802.....	Banding of projectiles.....	Aug. 21, 1906.
37512.....	Tubular bullet, Wm. Gaillac.....	Aug. 17, 1906.
38883.....	Gas check and tracer for projectiles; Bethlehem Steel Works.....	July 5, 1906.
3107.....	Reduced caliber 12-inch projectile.....	Aug. 1, 1906.
27987.....	Cap for A. P. projectiles, J. W. Britton.....	Oct. 24, 1906.
FUZES.		
35964.....	12-second time fuze, Bethlehem Steel Works.....	July 3, 1906.
30024 BBB.....	F. A. combination 21-second fuze modification, resistance ratio 1.7, etc.	Sept. 26, 1906.
30024 BBB.....	F. A. combination 21-second fuze, with interior venting.....	Aug. 25, 1906, Jan. 16 and May 3, 1907.
30024 BBB.....	Base percussion fuze, major and medium caliber, in 3-inch mountain gun.	Feb. 5, 1907.
38505.....	Watson base percussion fuze, centrifugal plunger.....	Oct. 27, 1906.
38491.....	Bethlehem Steel Works, base percussion, centrifugal fuze.....	Oct. 31, 1906.
37999.....	Base percussion fuzes, Wilson-Lynch and Wilson-Chase.....	Mar. 8, 1907.
38363.....	Simple centrifugal plunger for base percussion fuze.....	May 23, 1907.
25100.....	300-grain detonating fuze after exposure 3½ years to 110° F. in dry house.	July 20, 1906.
30024 BBB.....	Arming ratio for major caliber detonating fuze, ring resistance.....	June 1, 1907.
35543.....	Delay action of major caliber detonating fuze with gun cotton and black powder priming charges.	June 12, 1907.

Reference No.	Subject.	Date of report.
EXPLOSIVES.		
35543.....	Loading tools for high explosive projectiles.....	Jan. 9, 1907.
35543.....	Instructions for loading projectiles with high explosives.....	Apr. 13, 1907.
SIGHTS.		
38969.....	Queen & Co. 3-inch objective telescopic sight.....	Aug. 30, 1906, Sept. 24 and Nov. 3, 1906.
37512.....	America Company night shooting light.....	Sept. 21, 1906.
39064.....	Pneumatic hood for eyepiece, telescopic sight, Captain Phillips, Ordnance Department, U. S. Army.	Oct. 13, 1906.
38545.....	Special panoramic sight for mobile artillery.....	Nov. 2, 1906.
ARMORED TARGETS.		
35543.....	Representative ship targets, cruiser, and battleship, armored.....	Dec. 22, 1906, Jan. 8, Feb. 11, and Apr. 25, 1907.
ELECTRICAL APPLIANCES.		
23100.....	Underwater telephone.....	Aug. 17, 1906.
37715.....	Snap switches and junction boxes.....	Jan. 17, 1907.
30160 F.....	Mica sockets for conduit system on gun carriages.....	Jan. 31, 1907.
23565 E.....	Portable electric light for seacoast gun carriages.....	Feb. 28, 1907.
34206.....	Electric hoists for 12-inch barbette carriage. Sprague and Yale & Towne.	Apr. 17, 1907.
MISCELLANEOUS.		
23850.....	Simple shell tracer for projectiles.....	Aug. 30, 1906.
35964.....	Monel metal.....	Dec. 12, 1906.
6357.....	Angle of elevation for guns and mortars in ordinary.....	Oct. 12, 1906.
31456.....	Method of lubricating bore of guns, Wm. M. Douglas.....	Dec. 6, 1906.
38364.....	Lanyard safety device 6-inch gun, model of 1903, on disappearing carriage.	Mar. 9, 1907.
39104.....	Hand grenade, with explosive.....	Apr. 23, 1907.
		May 27, 1906.

The following is submitted as an appendix:

Report of board on tests of revolvers and automatic pistols. (9 plates.)

Very respectfully,

WILLIAM CROZIER,
Brigadier-General, Chief of Ordnance.

The SECRETARY OF WAR.

APPENDIX.

REPORT OF BOARD ON TESTS OF REVOLVERS AND AUTOMATIC PISTOLS.

(9 plates.)

SPRINGFIELD ARMORY,
Springfield, Mass., March 28, 1907.

Proceedings of board of officers convened by the following order:

SPECIAL ORDERS, }
No. 305. }

WAR DEPARTMENT,
Washington, December 28, 1906.

[Extract.]

* * * * *

12. A board of officers, to consist of—

Col. Philip Reade, Twenty-third Infantry,
Maj. Joseph T. Dickman, Thirteenth Cavalry,
Capt. Guy H. Preston, Thirteenth Cavalry,
Capt. Ernest D. Scott, Artillery Corps,
Capt. John H. Rice, Ordnance Department,

is appointed to meet at 10 o'clock a. m., Tuesday, January 15, 1907, or as soon thereafter as practicable, at Springfield Armory, Springfield, Mass., for the purpose of testing such revolvers and automatic pistols as may be referred to the board by the Chief of Ordnance.

Captain Rice will act as recorder of the board.

A programme of tests will be drawn up and the trial conducted and expedited in the most practical manner for the purpose of ascertaining a design of automatic pistol or revolver best adapted to fulfill the requirements of the military service.

The board will report as to whether, in its opinion, the design selected is a sufficient improvement upon the service caliber .38 revolver to justify its adoption.

Upon the completion of the programme the board will submit a report of the tests with recommendations to The Military Secretary of the Army, and upon the adjournment of the board the members thereof will return to their proper stations.

The travel directed is necessary in the military service.

By order of the Secretary of War:

THOMAS H. BARRY,
Brigadier-General, Acting Chief of Staff.

Official:

HENRY P. MCCAIN,
Military Secretary.

1. The board met pursuant to the foregoing order at 2.20 o'clock p. m., on January 15, 1907, all the members being present. Meetings were held twice daily, Sundays excepted, until January 26, when ad-

jourment was taken in accordance with telegraphic authority from The Military Secretary, and the members of the board proceeded to their proper stations, pending instructions to reconvene.

2. The board reconvened at 9.30 a. m., March 20, 1907, in accordance with the following order:

SPECIAL ORDERS, }
No. 62. - }

WAR DEPARTMENT,
Washington, March 15, 1907.

[Extract.]

* * * * *

23. Capt. William M. Cruikshank, Artillery Corps, is detailed as a member of the board of officers appointed by paragraph 12, Special Orders, No. 305, December 28, 1906, War Department, for the purpose of testing such revolvers and automatic pistols as may be referred to the board by the Chief of Ordnance, vice Capt. Ernest D. Scott, Artillery Corps, who is hereby relieved. The board, as now constituted, consisting of Col. Philip Reade, Twenty-third Infantry; Maj. Joseph T. Dickman, Thirteenth Cavalry; Capt. Guy H. Preston, Thirteenth Cavalry; Capt. William M. Cruikshank, Artillery Corps, and Capt. John H. Rice, Ordnance Department, will reassemble at the Springfield Armory, Springfield, Mass., at 10 o'clock a. m., March 19, 1907, or as soon thereafter as practicable, for the purpose of resuming the tests, and upon the adjournment of the board the members thereof will return to their proper stations. The travel directed is necessary in the military service.

* * * * *

By order of the Secretary of War:

J. FRANKLIN BELL,
Major-General, Chief of Staff.

Official:

HENRY P. McCAIN, *Adjutant-General.*

All the members were present. Meetings were held twice daily thereafter, Sundays excepted, until March 28, 1907, when adjournment was taken in accordance with the above order.

3. The weapons referred to the board by the Chief of Ordnance, with their weights when empty, were as follows:

Automatic pistols, caliber .45.

[Weight, including magazine.]

	Lbs.	oz.
The Colt.....	2	2½
The Luger.....	2	8
The Savage.....	2	3
The Knoble single action.....	2	11½
The Knoble double action.....	2	10½
The Bergmann.....	2	3½
The White-Merrill.....	2	6½

Double-action revolvers, caliber .45.

[Weight.]

The Colt.....	2	7
The Smith & Wesson.....	2	6

Automatic revolver, caliber .45.

The Webley-Fosbery.....	2	10
-------------------------	---	----

Ten rounds of ammunition weighs for the pistols 0.483 pound, and for the revolver 0.5 pound.

4. Programmes of test were adopted, copies of which are inclosed. These programmes were departed from in certain minor particulars, which may be noted in the reports of tests, also inclosed herewith.

5. The following specifications for automatic pistols for mounted service embody the views of the board:

- (1) Caliber not less than .45.
- (2) The magazine to hold not less than 6 cartridges.
- (3) Weight of bullet not less than 230 grains.
- (4) Initial velocity not less than 800 feet per second.
- (5) Trigger pull, measured at center of contact of finger with trigger, not less than 6 pounds.
- (6) A simple and durable mechanism with as few parts as possible, capable of being readily dismounted and assembled, using as few tools as practicable. The number of springs, screws, and pins should be reduced to a minimum, particularly in the case of flat springs.
- (7) As compact mechanism as possible and a shape adapted to carrying in a holster.
- (8) Adapted for use as a short-range weapon, not as a carbine.
- (9) The breech to be closed and locked before the firing pin can reach the primer.
- (10) An automatic safety, such that the arm may be carried cocked and with a cartridge in the bore without danger and be ready for the first shot without any other action than pulling the trigger.
- (11) Vertical in preference to side ejection of cartridge case.
- (12) Reasonable certainty of action in automatic loading and ejection.
- (13) Comparatively easy action in ejecting by hand in case of misfire or jam.
- (14) Automatic indication that the arm is loaded.
- (15) Automatic indication that the last cartridge has been fired from the arm.
- (16) Good balance and a shape of grip adapted to the hand.
- (17) A form of magazine catch that can easily be operated by the pistol hand and which allows the magazine to drop out.

The following features are desirable:

- (1) No special tools for dismounting or assembling.
- (2) Such design and relation of parts that each may be readily replaced if required. Parts riveted together or permanently joined are objectionable.
- (3) Loading by box magazine, and not by clip.
- (4) An automatic indication of the number of cartridges in the magazine, the mechanism to be so arranged as to prevent the entrance of dust, etc.
- (5) A position of the center of gravity as near as practicable to the axis of the bore.

The following features are preferable:

- (1) A bolt securely locked to the barrel until the bullet has left the bore.
- (2) A bolt in one piece rather than one with a separate head.
- (3) A loading mechanism which will permit the use of nonjacketed bullets.

6. The requirements for revolvers are too well known to need insertion in this report.

7. The board does not recommend for the military service the Webley-Fosbery automatic revolver, the Knoble automatic pistols, the Bergmann automatic pistol, or the White-Merrill automatic pistol for the reasons stated in the reports of tests of those arms.

8. This leaves for further consideration the Luger, Colt, and Savage automatic pistols, and the Colt and Smith & Wesson revolvers.

9. In the opinion of the board, the advantages of automatic pistols are as follows:

(1) Reduced shock of recoil, increasing accuracy and reducing tendency to flinch.

(2) Facility of recharging, especially in cold weather or when mounted.

(3) Greater number of rounds in magazine than is carried in any revolver cylinder.

(4) Great rapidity of fire.

(5) Trigger has but one function—that of releasing striker.

(6) Relatively short total length, increasing ease of carrying and drawing.

(7) Superior accuracy and ballistic qualities.

(8) Reduced chance of misfire.

(9) Favorable location of center of gravity.

(10) Desirable balance and grip.

(11) Comparative ease of putting arm into action after severe rusting.

10. The principal disadvantages of automatic pistols are considered to be as follows:

(1) In case of misfire the use of two hands is necessary to deliver the next shot.

(2) Undemonstrated reliability of functioning under service conditions.

(3) Ammunition in good condition and manufactured with special care is required.

(4) Accuracy of construction and delicate adjustment of parts are required.

(5) Comparative unfamiliarity with the weapon on the part of those eligible for military service.

(6) Impracticability of firing blank cartridges for instruction and at maneuvers.

11. The principal advantages of double-action revolvers are, in the opinion of the board, as follows:

(1) In case of misfire but one hand is required to deliver the next shot.

(2) Demonstrated reliability in service.

(3) Practical certainty of firing contents of cylinder.

(4) Ammunition of wide divergence in characteristics, including blanks, may be used.

(5) Widespread familiarity with revolver on the part of those eligible for military service.

(6) Ease of cleaning.

12. The principal disadvantages of double-action revolvers are considered to be as follows:

(1) Extreme shock of recoil with large calibers, impairing accuracy and tending to produce flinching.

(2) Practical impossibility of reloading in combat, when mounted, in cold weather, or when wearing gloves.

(3) Difficulty of partial reloading.

(4) Double function of trigger, causing derangement of aim.
(5) Relatively great total length, causing difficulty in carrying and drawing.

(6) Inferior accuracy and ballistic qualities.

13. The advantages of the automatic pistol and the disadvantages of the double-action revolver, especially those enumerated under sub-heads 1, 2, and 3, in each case are deemed by the board of such importance that it desires to state its conviction that the principle of the automatic hand firearm should be adopted for the military service, and that the adoption of a specific arm should be contingent only upon the question of whether it is mechanically satisfactory in service.

14. The distinguishing characteristics of the Luger automatic pistol are as follows:

(1) The shape of the grip conforms to the anatomical features of the hand.

(2) The center of gravity is well to the rear. There are two points of support as the arm lies naturally in the hand.

(3) An automatic and a mechanical safety are provided.

(4) There is an automatic indication that the chamber is loaded, visible to the eye, and sensible to the touch.

(5) The empty magazine may be expelled with the pistol hand.

(6) The parts are easily accessible.

(7) The arm has vertical ejection.

(8) The final seating of the cartridge is mainly dependent upon remaining momentum and not upon spring action.

(9) The retraction of the breech mechanism by hand is difficult.

(10) The magazine holds seven cartridges.

15. The distinguishing characteristics of the Colt automatic pistol are as follows:

(1) No automatic safety is provided.

(2) The firing mechanism includes a flying firing pin and a hammer with notches and sear.

(3) There is no automatic indication that the chamber is loaded.

(4) Both hands are required to withdraw the magazine.

(5) Some of the parts are difficult to dismount and assemble.

(6) The arm has side ejection.

(7) The arm is noticeably flat, neat, compact, and portable.

(8) The total length is short compared with the length of the barrel.

(9) The retraction of the breech mechanism by hand is not difficult.

(10) The magazine holds seven cartridges.

16. The distinguishing characteristics of the Savage automatic pistol are as follows:

(1) The center of gravity is well to the rear. There are two points of support, as the arm lies naturally in the hand.

(2) A mechanical safety only is provided.

(3) There is no automatic indication that the chamber is loaded.

(4) The empty magazine may be expelled with the pistol hand.

(5) The parts are accessible.

(6) There are no pins, screws, or flat springs.

(7) There is great simplicity, with small number of parts.

(8) The arm has side ejection.

(9) The barrel is free to rotate within limits, and is locked to the breech mechanism by the friction due to the bullet taking the rifling.

(10) The retraction of the breech mechanism by hand is not difficult.

(11) The grip is noticeably thick and is provided with corrugated metal side plates.

(12) The cartridges are staggered in the magazine.

(13) The magazine holds eight cartridges.

17. The distinguishing characteristics of the Smith & Wesson double-action revolver are as follows:

(1) There is a sliding block safety device for holding the hammer on rebound.

(2) A front cylinder lock maintains the barrel and cylinder in alignment.

(3) The cylinder latch operates forward.

(4) The barrel is pinned to the frame to prevent rotation.

(5) The grip and trigger-guard are too small.

(6) The shoulder of the frame, against which the hand rests, is vertical and narrow.

(7) The cylinder may be revolved by manipulating the trigger and without cocking the hammer.

(8) The cylinder rotates to the left and swings out to the left.

(9) The barrel of the weapon tested was $6\frac{1}{2}$ inches in length.

18. The distinguishing characteristics of the Colt double-action revolver are as follows:

(1) There is a positive safety device interposed under the hammer on rebound.

(2) The cylinder latch operates to the rear.

(3) The barrel is not pinned to the frame.

(4) The shoulder of the frame, against which the hand rests, is rounded and broad.

(5) The cylinder may be revolved by manipulating the trigger and without cocking the hammer.

(6) The cylinder rotates to the right and swings out to the left.

(7) The cylinder rod nut is apt to be lost.

(8) The barrel of the weapon tested was $5\frac{1}{2}$ inches in length.

19. The following table gives the results of tests made, excluding the rust and dust tests. The term "malfunction" includes all failures due merely to the improper working of the mechanism, and excludes all failures due to jamming of cartridge or empty case.

Weapon.	Number of shots.	Malfunctions.	Misfires.	Jams.	Ammunition.
Automatics:					
Luger	225	8	4	17	Frankford Arsenal.
Do.	746	4	.....	14	Luger.
Savage	631	12	22	9	Frankford Arsenal.
Do.	250	06	2	.....	Commercial.
Colt	604	.....	1	24	Frankford Arsenal.
Do.	300	2	.....	3	Commercial.
Revolvers:					
Colt	1,056	.....	18	.....	Frankford Arsenal.
Smith & Wesson	1,136	.....	6	.....	Do.

* Failures to eject last cartridge case of series; corrected with one hand by spilling.

20. After the dust test, the three automatic pistols under consideration all operated with comparatively little difficulty. The contents of one magazine were fired from the Colt in 1 minute and 56 seconds when the magazine was loaded after the arm had been subjected to dust, and in 1 minute and 53 seconds when the arm was subjected to dust with a loaded magazine inserted. The corresponding times for the Savage automatic, under similar conditions, were $51\frac{3}{4}$ seconds and 53 seconds, and for the Luger 2 minutes and 50 seconds, and 2 minutes and 32 seconds. The Luger did not operate as satisfactorily as the other two.

21. In the rust test, the contents of the magazine were fired from the Colt in 1 minute and 8 seconds; from the Savage in 2 minutes, and from the Luger in 3 minutes and 20 seconds. The first two mentioned operated successfully as self-loaders, while the Luger was operated by hand.

22. From a careful consideration of the characteristics of each weapon and of the tests made by the board, it is of the opinion that the Savage and the Colt automatic pistols possess sufficient merit to warrant their being given a further test under service conditions. With commercial ammunition especially adapted to the arm each has shown promising certainty of action. Among the most desirable features of the Savage pistol are its simplicity and small number of parts and their accessibility, the lack of screws or flat springs, the number of cartridges (eight) held by the magazine, the position of the center of gravity, the way the pistol lies in the hand, the expulsion of the magazine by the pistol hand, and the ease with which the breech mechanism may be retracted. Among the most desirable features of the Colt pistol are its flatness, compactness, neatness, and ease of carrying, the comparatively short total length, and the ease with which the breech mechanism may be retracted.

23. It is, however, desired to emphasize the view of the board that both these pistols should be changed in certain particulars for the military service, and that these changes should be required of the manufacturer before either is considered for final adoption. Both weapons are defective in having side ejection, no automatic indication that the chamber is loaded, and no automatic safety. The grip of the Savage should be made, if possible, more convenient for the hand, and the corrugated metal plates of the grip should be replaced by wooden plates securely fastened on. The retention of the mechanical safety in the locked position should be made more positive. The front sight should be moved slightly to the rear and should be more securely attached. The trigger stirrup of the Colt should be strengthened and its pin made longer. The hammer should be of a modified type exhibited to the board, which facilitates cocking by the thumb of the pistol hand and should not be of the type ordinarily furnished. A location of the magazine catch that will permit of expulsion of the magazine by the pistol hand is preferred.

24. The Luger automatic pistol, although it possesses manifest advantages in many particulars, is not recommended for a service test because its certainty of action, even with Luger ammunition, is not considered satisfactory, because the final seating of the cartridge is not by positive spring action, and because the powder stated by Mr. Luger to be necessary for its satisfactory use is not now obtainable in this country.

25. The results obtained in these tests of automatic pistols with special commercial ammunition and with Frankford Arsenal ammunition do not furnish a sufficient basis for ascertaining the degree of reliability of these weapons in actual service. While the conditions will not often be as severe as in the dust and rust tests, yet in the hands of troops the arms and the ammunition would be exposed to a variety of usage and climate which can not be foreseen and reproduced in tests. The most vital question to be determined concerning automatic pistols in their present state of development is that of reliability of function, which should be equal to or closely approximate that of the revolver. For this purpose, it is believed that the pistols and ammunition should be actually issued to a limited number of units, in substitution for and to the exclusion of their revolvers, with instructions to use them, carry them, and conduct target practice with them precisely in the manner previously prescribed for revolvers. In the target practice course a complete record should be kept of all malfunctions, misfires, and jams, and of the repairs necessary to keep the weapons in serviceable condition; a similar record should be kept by some troops at the same posts equipped with caliber .45 revolvers. If the troop commanders designated to conduct these service tests be selected with care, a comparison of reports should show whether automatic pistols of the best type are sufficiently reliable for general adoption, the decision being based upon data which have not previously been developed in our own or other armies so far as known.

26. On account of the well-recognized and urgent necessity for a caliber not less than .45 for active service, in view of the fact that in the opinion of the board service tests of automatic pistols covering a considerable period of time are necessary, and because a satisfactory caliber .45 revolver can be obtained, the board considers that a sufficient number of these revolvers should be issued as soon as practicable to arm the troops serving in the Philippine Islands.

27. The tests show that both of the revolvers submitted are desirable weapons, but the board prefers the Colt for the following reasons:

- (1) Less shock to the user, due to the broader and more rounded shoulder against which the hand rests.

- (2) The better shape and size of grip and trigger guard.

- (3) The greater simplicity and fewer parts.

- (4) The present familiarity of the troops with the Colt revolver.

This revolver should, however, have the barrel pinned to the frame to prevent rotation, and should have the parts adjusted so as to prevent the rotation of the cylinder by pressure on the trigger which does not cock the hammer.

28. As a result of careful consideration of the tests made and as a result of the views hereinbefore presented the board recommends as follows:

- (1) That sufficient Colt double-action revolvers, caliber .45, be issued to arm the troops in the Philippines as soon as practicable.

- (2) That sufficient Colt automatic pistols, caliber .45, to completely arm three troops of cavalry be obtained and issued for a service test of not less than one year.

(3) That sufficient Savage automatic pistols, caliber .45, to arm completely three troops of cavalry be obtained and issued for a service test of not less than one year.

(4) That one troop of cavalry stationed at each of the posts to which the automatic pistols may be assigned be armed completely with Colt double-action revolvers, caliber .45, for a period of not less than one year.

(5) That the pistols and revolvers so issued be used to the exclusion of the present weapons, which should be turned in.

(6) That the troop commanders to whose organizations the pistols and revolvers referred to above may be issued be carefully chosen for their interest in the selection of a proper weapon.

(7) That these pistols and revolvers be used in all respects as are the present revolvers in drills, target practice, maneuvers, etc., and that a complete and detailed record be kept of all misfires, malfunctions, and jams, and of the repairs necessary to keep the arms in a serviceable condition.

(8) That at the end of one year after date of issue complete and detailed reports be submitted by the respective troop commanders to the Adjutant-General.

29. Attached hereto will be found photographs of all the arms submitted to the board for test.

PHILIP READE,

Colonel, Twenty-third Infantry, U. S. Army, President of Board.

J. T. DICKMAN,

Major, Thirteenth Cavalry, U. S. Army.

GUY H. PRESTON,

Captain, Thirteenth Cavalry, U. S. Army.

WM. M. CRUIKSHANK,

Captain, Artillery Corps, U. S. Army.

J. H. RICE,

Captain, Ordnance Department, U. S. Army, Recorder.

[First Indorsement.]

To the Chief of Ordnance. A. G. O., April 2, 1907.

[Second Indorsement.]

OFFICE OF THE CHIEF OF ORDNANCE,

Washington, April 23, 1907.

1. Respectfully returned to The Adjutant-General.

2. The board considers that an increase of caliber of the pistol to .45 of an inch is necessary, and recommends that the troops in the Philippines be armed with Colt double-action revolvers of this caliber. This Department has not on hand any double-action revolvers of caliber .45, and to purchase the number required for arming the troops in the Philippines would cost in the neighborhood of \$40,000. The board is rather of the opinion that the use of these revolvers would be temporary only, and that they might be superseded later by automatic pistols. Under these circumstances and because of the expense involved it is recommended that this purchase and issue be not made unless it is apprehended that there will be serious military operations in the Philippines during the next year.

3. The board has found much promise from the automatic pistol, but it has not considered that it has reached such a stage of perfection as to justify its present adoption and issue to troops as a service weapon. The recommendation that a sufficient number of Colt and Savage automatic pistols, caliber .45, to arm three troops of cavalry with each be obtained and issued for a service test of a year, is rather a process to secure a service development of the pistol than a service test of it; the use under service conditions of peace time being expected to develop imperfections and the methods of curing them. This recommendation is approved.

4. The recommendation that a troop of cavalry stationed at each of the posts to which automatic pistols may be issued be armed with the Colt double-action revolvers, caliber .45, is apparently for the purpose of securing a comparative test of these revolvers and the automatic pistols. The revolvers if issued would be used under peace-time conditions, when they would secure the care and attention which soldiers in garrison are required to give their weapons and would not be subject to the hard usage of campaign conditions which, when had without field service, must be artificially produced. It is believed that the competitive test of the board itself, with the rough treatment specially inflicted upon the weapons, constitutes a better comparative test than one which would be secured in the service; and it is thought that the care and attention which the board has given to the study and examination of the weapons is more painstaking than that which could be expected from officers commanding troops in the service, and diverted by other duties, and that the conclusions and recommendations of the board should command more confidence than those of troop commanders submitted under the conditions suggested. It is therefore recommended that issue of Colt double-action revolvers to troops in the United States be not made.

5. The recommendation that the automatic pistols be used in all respects as are the service revolvers, to the exclusion of revolvers in the troops which have them, and that a record be kept of all imperfect action and report made thereof to the Adjutant-General, is concurred in.

(Signed)

WILLIAM CROZIER,
Brigadier-General, Chief of Ordnance.

[Third indorsement.]

13092-780.

WAR DEPARTMENT,
THE ADJUTANT-GENERAL'S OFFICE,
Washington, May 3, 1906.

Respectfully returned to the Chief of Ordnance, inviting attention to the inclosed approved memorandum of the Assistant to the Chief of Staff.

It is desired that these papers be returned to this office at the earliest practicable date with information as to when the Savage and Colt automatic pistols will be shipped to the officers mentioned in the memorandum, in order that proper instructions may be issued to those officers with regard to submitting a report of the test of the pistol.

Attention is invited to the inclosed copy of letter of this date to the president of the board of officers convened for the purpose of testing revolvers and automatic pistols.

By order of the Secretary of War.

(Signed)

HENRY P. MCCAIN,
Adjutant-General.

MEMORANDUM FOR THE ASSISTANT SECRETARY OF WAR.

Subject: Proceedings of a board of officers for the purpose of testing such revolvers and automatic pistols as may be referred to it by the Chief of Ordnance.

The following weapons were referred to the Board:

Automatic pistols, caliber .45.

- | | |
|------------------------------|------------------------------|
| 1. The Colt. | 5. The Knoble double action. |
| 2. The Luger. | 6. The Bergmann. |
| 3. The Savage. | 7. The White-Merrill. |
| 4. The Knoble single action. | |

Double-action revolvers, caliber .45.

- | | |
|--------------|------------------------|
| 1. The Colt. | 2. The Smith & Wesson. |
|--------------|------------------------|

Automatic revolver, caliber .45.

The Webley-Fosbery.

The board adopted a programme of tests and also a number of specifications for automatic pistols for mounted service and state that the requirements for revolvers are too well known to need insertion in the report.

The board eliminates the Webley-Fosbery automatic revolver, the Knoble automatic pistols, the Bergmann automatic pistol, and the White-Merrill automatic pistol for reasons given in the reports of tests of those arms.

The board then enumerates:

1. The advantages of automatic pistols.
2. The disadvantages of automatic pistols.
3. The advantages of double-action revolvers.
4. The disadvantages of double-action revolvers.

After consideration of these four statements, the board remarks that—

The advantages of the automatic pistol and the disadvantages of the double-action revolver, especially those enumerated under subheads 1, 2, and 3 in each case, are deemed by the board of such importance that it desires to state its conviction that the principle of the automatic hand firearm should be adopted for the military service, and that the adoption of a specific arm should be contingent only upon the question of whether it is mechanically satisfactory in service.

The distinguishing characteristics of the different automatic pistols and double-action revolvers under consideration are classified.

The three automatic pistols under consideration, viz, the Luger, Colt, and Savage, were given the dust and rust tests.

The board then remarks—

From a careful consideration of the characteristics of each weapon and of the tests made by the board, it is of the opinion that the Savage and Colt automatic pistols possess sufficient merit to warrant their being given a further test under service conditions. With commercial ammunition especially adapted to the arm, each has shown promising certainty of action. Among the most desirable features of the Savage pistol are its simplicity and small number of parts and their accessibility, the lack of screws or flat springs, the number of cartridges (eight) held by the magazine, the position of the center of gravity and the way the pistol lies in the hand, the expulsion of the magazine by the pistol hand, and the ease with which the breech mechanism may be withdrawn. Among the most desirable features of the Colt pistol are its flatness, compactness, neatness, and ease of carrying, the comparatively short total length, and the ease with which the breech mechanism may be withdrawn.

It is, however, desired to emphasize the view of the board that both these pistols should be changed in certain particulars for the military service, and that these changes should be required of the manufacturer before either is considered for final adoption. Both weapons are defective in having side ejection, no automatic indication that the chamber is loaded, and no automatic safety. The grip of the Savage should be made, if possible, more convenient for the hand, and the corrugated metal plates of the grip should be replaced by wooden plates securely fastened on. The retention of the mechanical safety in the locked position should be made more positive. The front sight should be moved slightly to the rear and should be more securely attached. The trigger stirrup of the Colt should be strengthened and its pin made longer. The hammer should be of a modified type exhibited to the board, which facilitates cocking by the thumb of the pistol hand, and should not be of the type ordinarily furnished. A location of the magazine catch that will permit of expulsion of the magazine by the pistol hand is preferred.

The Luger automatic pistol, although it possesses manifest advantages in many particulars, is not recommended for a service test because its certainty of action, even with Luger ammunition, is not considered satisfactory, because the final seating of the cartridge is not by positive spring action, and because the powder stated by Mr. Luger to be necessary for its satisfactory use is not now obtainable in this country.

The results obtained in these tests of automatic pistols with special commercial ammunition and with Frankford Arsenal ammunition do not furnish a sufficient basis for ascertaining the degree of reliability of these weapons in actual service. While the conditions will not often be as severe as in the dust and rust tests, yet in the hands of troops the arms and the ammunition would be exposed to a variety of usage and climate which can not be foreseen and reproduced in tests. The most vital question to be determined concerning automatic pistols in their present state of development is that of reliability of function, which should be equal to or closely approximate that of the revolver. For this purpose it is believed that the pistols and ammunition should be actually issued to a limited number of units, in substitution for and to the exclusion of their revolvers, with instructions to use them, carry them, and conduct target practice with them precisely in the manner previously prescribed for revolvers. In the target practice course a complete record should be kept of all malfunctions, misfires, and jams, and of the repairs necessary to keep the weapon in serviceable condition; a similar record should be kept by some troops at the same posts equipped with caliber .45 revolvers. If the troop commanders designated to conduct these service tests be selected with care, a comparison of reports should show whether automatic pistols of the best type are sufficiently reliable for general adoption, the decision being based upon data which have not previously been developed in our own or other armies so far as known.

On account of the well-recognized and urgent necessity for a caliber not less than .45 for active service, in view of the fact that in the opinion of the board service tests of automatic pistols covering a considerable period of time are necessary, and because satisfactory caliber .45 revolver can be obtained, the board considers that a sufficient number of these revolvers should be issued as soon as practicable to arm the troops serving in the Philippine Islands.

The board states that it prefers the Colt revolver, and gives four reasons for this decision, but recommends certain changes in its con-

struction. After giving the tests careful consideration and "as a result of the views heretofore expressed," the board recommends:

1. That sufficient Colt double-action revolvers, caliber .45, be issued to arm the troops in the Philippines as soon as practicable.

2. That sufficient Colt automatic pistols, caliber .45, to arm completely three troops of cavalry be obtained and issued for a service test of not less than one year.

3. That sufficient Savage automatic pistols, caliber .45, to arm completely three troops of cavalry be obtained and issued for a service test of not less than one year.

4. That one troop of cavalry stationed at each of the posts to which the automatic pistols may be assigned be armed completely with Colt double-action revolvers, caliber .45, for a period of not less than one year.

5. That the pistols and revolvers so issued be used to the exclusion of the present weapon, which should be turned in.

6. That the troop commanders to whose organizations the pistols and revolvers referred to above may be issued be carefully chosen for their interest in the selection of a proper weapon.

7. That these pistols and revolvers be used in all respects as are the present revolvers in drills, target practice, maneuvers, etc., and that a complete and detailed record be kept of all misfires, malfunctions, and jams, and of the repairs necessary to keep the arms in a serviceable condition.

8. That at the end of one year after date of issue complete and detailed reports be submitted by the respective troop commanders to The Adjutant-General.

The Chief of Ordnance in his indorsement on the proceedings of the board, remarks that:

2. The board considers that an increase of caliber of the pistol to .45 of an inch is necessary, and recommends that the troops in the Philippines be armed with Colt double-action revolvers of this caliber. This Department has not on hand any double-action revolvers of caliber .45, and to purchase the number required for arming the troops in the Philippines would cost in the neighborhood of \$40,000. The board is rather of the opinion that the use of these revolvers would be temporary only, and that they might be superseded later by automatic pistols. Under these circumstances, and because of the expense involved, it is recommended that this purchase and issue be not made unless it is apprehended that there will be serious military operations in the Philippines during the next year.

3. The board has found much promise from the automatic pistol, but it has not considered that it has reached such a stage of perfection as to justify its present adoption and issue to troops as a service weapon. The recommendation that a sufficient number of Colt and Savage automatic pistols, caliber .45, to arm three troops of cavalry with each be obtained and issued for a service test of a year, is rather a process to secure a service development of the pistol than a service test of it; the use under service conditions of peace time being expected to develop imperfections, and the methods of curing them. This recommendation is approved.

4. The recommendation that a troop of cavalry stationed at each of the posts to which automatic pistols may be issued be armed with the Colt double-action revolvers, caliber .45, is apparently for the purpose of securing a comparative test of these revolvers and the automatic pistols. The revolvers, if issued, would be used under peace-time conditions, when they would secure the care and attention which soldiers in garrison are required to give their weapons, and would not be subject to the hard usage of campaign conditions which, when had without field service, must be artificially produced. It is believed that the competitive test of the board itself, with the rough treatment specially inflicted upon the weapons, constitutes a better comparative test than one which would be secured in the service; and it is thought that the care and attention which the board has given to the study and examination of the weapons is more painstaking than that which could be expected from officers commanding troops in the service, and diverted by other duties, and that the conclusions and recommendations of the board should command more confidence than those of troop commanders submitted under the conditions suggested. It is therefore recommended that issue of Colt's double-action revolvers to troops in the United States be not made.

5. The recommendation that the automatic pistols be used in all respects as are the service revolvers, to the exclusion of revolvers in the troops which have them, and that a record be kept of all imperfect action and report made thereof to The Adjutant-General, is concurred in.

Recommendation No. 1.—The board recommends that the troops in the Philippines be armed with the Colt revolver, caliber .45.

In view of the facts, as set forth by the Chief of Ordnance, that there are no caliber .45 revolvers on hand, that it would cost in the neighborhood of \$40,000 to arm the troops in the Philippines, and that these pistols might be superseded later by automatic pistols, it is recommended that this recommendation of the board be not approved, and that paragraph 2 of the indorsement of the Chief of Ordnance be concurred in.

Recommendations Nos. 2 and 3.—The results of the tests of the board show much promise for the automatic pistol, and they recommend that three troops of cavalry be completely armed with the Colt automatic .45, and three troops with the Savage automatic .45. These recommendations are concurred in by the Chief of Ordnance, and it is recommended that they be approved.

Recommendation No. 4.—The board recommends that one troop of cavalry at each of the posts to which the automatic pistol may be assigned, be armed with Colt double-action revolver for a period of not less than one year.

The Chief of Ordnance states in substance that this recommendation is apparently for the purpose of securing a comparative test, that the revolvers would be used under peace conditions and receive garrison care, that he believes that the competitive test of the board with the rough treatment specially inflicted constitutes a better test than one which could be secured in the service, and that the recommendations of the board should command more confidence than those of troop commanders submitted under the conditions suggested.

It is plain that the board is satisfied that the revolver or pistol should be caliber .45. They state in their report, paragraph 6, page 4 [page 85 of this publication], that "the requirements for revolvers are too well known to need insertion in this report."

This is especially true of the Colt double-action revolver. It is not seen, therefore, what advantage a special comparative test as recommended by the board would have.

The reasons given by the Chief of Ordnance for not concurring in this recommendation of the board are deemed good, and it is therefore recommended that this recommendation be not approved.

Recommendations 5, 6, 7, and 8 are concurred in by the Chief of Ordnance, and their approval is recommended.

It is also recommended that the Chief of Ordnance be informed in substance as above and directed to have sufficient Savage and Colt automatic pistols, caliber .45, to completely arm three troops of cavalry with each, shipped to following troop commanders for test and report, in accordance with the recommendations of the board:

- | | |
|---|-----------|
| 1. Capt. James A. Cole, Sixth Cavalry. | } Savage. |
| 2. Capt. Frank Tompkins, Eleventh Cavalry. | |
| 3. Capt. H. A. Sievert, Ninth Cavalry. | |
| 4. Capt. H. LaT. Cavanaugh, Tenth Cavalry. | } Colt. |
| 5. Capt. Charles A. Romeyn, Second Cavalry. | |
| 6. Capt. R. A. Brown, Fourth Cavalry. | |

If for any reason the above-named officers are detached from command of their troops during the test, the test will be continued and reported on by the troop commander.

It is further recommended that the president of the board be informed in substance as above.

Very respectfully,

(Signed) WM. P. DUVAL,
Brigadier-General, General Staff,
Assistant to the Chief of Staff.

13092-829.]

WASHINGTON, May 18, 1907.

THE ADJUTANT-GENERAL, U. S. ARMY,
Washington, D. C.

SIR: 1. Referring to O. O. 13092-780 (M. S. 1181296), report of the board recently in session at Springfield Armory for the test of revolvers and automatic pistols, and to the third indorsement thereon, I have the honor to inform you that circular advertisements were issued for 200 Colt automatic pistols and 200 Savage automatic pistols.

2. The Colt's Patent Fire-Arms Manufacturing Company quoted a delivery of ten months, so that these arms can not be issued to the service in less than ten months.

The Savage Arms Company stated that they were unwilling to accept an order for the number of pistols specified, and consequently no Savage automatics can be furnished. It is therefore proposed to purchase 200 Luger automatic pistols in lieu thereof, and information is desired as to whether they should be issued to the troops already designated for test of the Savage pistols. The date of delivery of the Luger pistols can not be given at this time, but it will probably be about the same as for the Colt.

Very respectfully,

(Signed) WILLIAM CROZIER,
Brigadier-General, Chief of Ordnance.

13092-829.]

(M. S. 1181296.)

[First indorsement.]

WAR DEPARTMENT,
THE ADJUTANT-GENERAL'S OFFICE,
Washington, May 28, 1907.

Respectfully returned to the Chief of Ordnance, who will purchase a sufficient number of Luger automatic pistols, caliber .45, to completely equip the three troops of cavalry that were to have been supplied with the Savage automatic pistol, as indicated in memorandum from the assistant to the Chief of Staff, which was sent to the Chief of Ordnance as an inclosure of indorsement from this office of the 3d instant.

By order of the Secretary of War:

(Signed)

HENRY P. MCCAIN,
Adjutant-General.

NOTE.—The Savage Arms Company has, since the date of the above correspondence, accepted an order for 200 Savage automatic pistols.

PROGRAMME FOR TESTS OF REVOLVERS.

1. Examination of revolver as to design, appearance, balance, etc.
2. Special examination will be made as to safety features.
3. Dismounting and assembling. The times required to totally dismount and assemble, except removal of the barrel.

4. The number of—
 - (a) Pins and screws.
 - (b) Small springs.
 - (c) Other parts.

5. The number and kind of tools required to dismount and assemble.

6. Twenty rounds (10 single and 10 double action) to be fired into butt to observe working of revolver.

The above tests will be made with the revolver in the hands of, and operated by, the inventor or his representative, if present.

7. Velocity at 25 feet, mean of 5 shots.

8. Accuracy and penetration at 75 feet; 10 shots for accuracy, 5 for penetration.

9. Rapidity with accuracy; target 6 by 2 feet, range 100 feet. The number of shots fired to be 18. Revolver fired from hand. Time and number of hits to be noted in each case.

To be conducted by representative of the inventor, if present. Firing to begin with chamber and cylinder empty, and cartridges arranged as desired by the firer.

10. Rapidity at will. Same as preceding test, except that the revolver will be fired without aim into a butt at short range, and hits will not be considered.

11. Endurance. Revolver will then be fired deliberately 500 rounds, cooling after each 50 shots.

12. Velocity. Same as paragraph 7, above.

13. Excessive charges. Revolver to be fired 5 times with cartridges, in which the charge of powder is increased to produce a pressure in the chamber 25 per cent greater than the regular pressure.

14. Pierced primers. Revolver will be fired once with a cartridge in which the primer has been thinned so as to insure piercing. Two rounds will then be fired to observe action.

15. Dust. Both ends of barrel will be tightly corked and the revolver will be exposed, in a box prepared for that purpose, to a blast of fine sand for one minute. The surplus sand may then be removed by blowing thereon, jarring of the piece, or wiping with the bare hand only.

The cylinder should be—

- (a) Empty when exposed to dust.
- (b) Loaded when exposed to dust.

In "b" the cartridges may be removed and wiped, then reloaded.

16. Rust. The mechanism will be thoroughly cleaned of grease by boiling in a solution of soda, both ends of the barrel tightly corked; the revolver then placed in a saturate solution of sal-ammoniac for five minutes. After being hung up indoors for twenty-two hours, five shots will be fired into a sand butt.

17. Supplementary tests. Any piece which successfully passes the foregoing tests may be subjected to such supplementary tests, or

repetitions of previous ones, to further determine its endurance or other qualities as may be prescribed by the Chief of Ordnance or by the board.

General remarks.—During the above tests the revolver will be entirely in the hands of the board, except when specially stated otherwise, and no alterations or repairs other than those possible on the ground will be allowed, except by special permission of the board. If the revolver fails in any test, the remainder of the programme may be discontinued in the discretion of the board.

In case of misfires cartridges will be opened to determine the cause, and if due to ammunition the test will be repeated.

PROGRAMME OF TESTS OF AUTOMATIC PISTOLS.

1. Examination of pistol as to design, appearance, balance, suitability for mounted troops, etc.

2. Special examination will be made as to safety features.

3. Dismounting and assembling. The times required for each of the following operations:

(a) To dismount the breech and magazine mechanism, with the exception of the magazine catch.

(b) To complete dismounting.

(c) To assemble, except the breech and magazine mechanism.

(d) To complete assembling.

4. The number of—

(a) Pins and screw.

(b) Small springs.

(c) Other parts.

5. The number and kind of tools required to dismount and assemble.

6. Twenty rounds to be fired into butt to observe working of pistol.

The above tests will be made with the pistol in the hands of and operated by the inventor or his representative, if present.

7. Velocity at 25 feet, mean of 5 shots.

8. Accuracy and penetration at 75 feet; 10 shots for accuracy, 5 for penetration.

9. Rapidity with accuracy; target 6 by 2 feet, range 100 feet. Number of shots fired to be three times the capacity of clip. Pistol fired from hand. Time and number of hits to be noted in each case. To be conducted by representative of company, if present. Firing to begin with chamber and magazine empty, and clips or holders arranged as desired by firer.

10. Rapidity at will. Same as preceding test, except that the pistol will be fired without aim into a butt at short range, and hits will not be considered.

11. Endurance. Pistol will then be fired deliberately 500 rounds as a self-loader, cooling after each 50 rounds.

12. Velocity. Same as paragraph 7, above.

13. Decreased charges. Pistol to be fired 12 rounds as a self-loader with cartridge in which the powder charge has been decreased so that the first four will give pressure of 25 per cent less, the second four 15 per cent less, and the last four 10 per cent less than the service pressure.

14. Excessive charges. Pistol to be fired 5 times as a single loader, with cartridges in which the charge of powder is increased to produce a pressure in the chamber 25 per cent greater than the regular pressure.

15. Pierced primers. Pistol will be fired once with a cartridge in which the primer has been thinned so as to insure piercing. Two rounds will then be fired to observe action.

16. Dust. With the mechanism closed and both ends of the barrel tightly corked pistol will be exposed, in a box prepared for that purpose, to a blast of fine sand for one minute. The surplus sand may then be removed by blowing thereon, jarring of the piece, or wiping with the bare hand only.

The magazine should be—

(a) Empty when exposed to dust.

(b) Loaded when exposed to dust.

In both cases pistol should be used as a self-loader, and in the second the cartridge may be removed and wiped, then reloaded. In case of self-loading, failures to work in either case the piece will be tried by operating by hand.

17. Rust. The mechanism will be thoroughly cleansed of grease by boiling in a solution of soda, the ends of the barrel tightly corked, and the pistol then placed in a saturated solution of sal-ammoniac for five minutes. After being hung up indoors for twenty-two hours, five shots will be fired into a sand butt, using pistol as a self-loader. In case the self-loading mechanism fails to work, the pistol will then be tried by operating by hand.

18. Supplementary tests. Any piece which successfully passes the foregoing tests may be subjected to such supplementary tests, or repetitions of previous ones, to further determine its endurance or other qualities as may be prescribed by the Chief of Ordnance or by the board.

General remarks.—During the above tests the pistol will be entirely in the hands of the board, except when specifically stated otherwise, and no alterations or repairs other than those possible on the ground will be allowed, except by special permission of the board. If the pistol fails in any test the remainder of the programme may be discontinued in the discretion of the board.

In case of misfires the cartridges will be opened to determine cause, and if due to the ammunition the test will be repeated.

TEST OF COLT AUTOMATIC PISTOL, CALIBER .45.

1. A representative of the company dismounted the breech and magazine mechanism, with the exception of the magazine catch, in $4\frac{1}{2}$ seconds, and completed the dismounting in 2 minutes and 50 seconds, making a total time of 2 minutes $54\frac{1}{2}$ seconds. He then assembled the arm, except the breech and magazine mechanism, in 5 minutes and 31 seconds, and completed the assembling in $8\frac{3}{4}$ seconds, making the total time 5 minutes $39\frac{3}{4}$ seconds. Two links which are secured to the barrel by rivets were not dismounted. Four drifts, 1 double-end drift, 1 hammer, and 1 screw-driver were used in the work.

2. The parts consist of—

Nonriveted pins	7
Riveted pins	2
Small screws	6
Flat springs	2
Small spiral springs	1
Large spiral springs	2
Other parts	23
Total	43

3. The following rounds were fired, using Frankford Arsenal ammunition:

(a) Twenty rounds into sand butt to observe action of mechanism.

(b) Six rounds, 1 of which missed the target, for velocity at 25 feet from the muzzle, giving a maximum of 833 feet per second, a minimum of 767 feet per second, and an average of 793.8 feet per second.

(c) Ten rounds for accuracy at 75 feet; mean absolute deviation, 2.4 inches.

(d) Seven rounds, 2 preliminary and 5 for penetration, in soft pine, giving an average of $5\frac{1}{2}$ inches for the 5 shots.

(e) Twenty-one rounds for rapidity with accuracy, fired by a representative of the company at a target 6 feet by 2 feet, range 100 feet. The loaded magazines were arranged on a table, as desired by the operator, the weapon being empty at the beginning of the test. Time required for 21 shots was 32 seconds; the number of hits was 2.

(f) Twenty-one rounds fired into sand butt by a representative of the company for rapidity without accuracy, the loaded magazines being placed in a convenient position and the weapon being empty at the beginning of the test. The time required for the 21 rounds was $8\frac{3}{4}$ seconds.

(g) Five hundred rounds for endurance. Jams occurred in the following rounds, due to the cartridge being caught between the chamber and the bolt: 191, 192, 237, 240, 242, 246, 249, 258, 265, 270, 278, 333, 338, 342, 375, 404, 408, 426, 469, and 568. In rounds 277, 350, 355, and 401 the cartridge jammed crosswise of the chamber. Round 355 was a misfire. At the end of this test the link pin was found to have worked loose.

(h) Seven rounds, 2 lost and 5 for velocity, at 25 feet from the muzzle, giving a maximum of 814 feet per second, a minimum of 714 feet per second, and an average of 775 feet per second.

(i) Twelve rounds with reduced charges; 4 cartridges giving a decreased pressure of 25 per cent, 4 cartridges giving a decreased pressure of 15 per cent, and 4 cartridges giving a decreased pressure of 10 per cent. The action was normal.

(j) Five rounds with cartridges, giving an excess pressure of 25 per cent. The action was normal.

(k) One round with pierced primer. The action was normal.

(l) Both ends of the barrel were tightly corked and the pistol was exposed for one minute, in a box prepared for the purpose, to a blast of fine sand, the magazine being empty. A representative of the company removed the surplus sand by blowing, jarring, and wiping the piece with the bare hand only. Time required to fire 7 shots

was 1 minute and 56 seconds, using the arm as a self-loader. Seven more shots were then similarly fired.

(*m*) The above test was then repeated, except that the arm contained a loaded magazine when exposed to dust. Time required to fire 7 shots was 53 seconds, using the arm as a self-loader. Seven more shots were then similarly fired.

NOTE.—After this test part of the sear was found broken and a new sear was inserted.

(*n*) The pistol was thoroughly cleaned and both ends of the barrel tightly corked; it was then placed in a saturate solution of sal-ammoniac for 5 minutes, after which it was hung up indoors and allowed to remain thus for about 22 hours. A representative of the company prepared the arm for firing in 1 minute and 5 seconds. The firing of 7 shots, using the arm as a self-loader, required 3 seconds after the magazine was loaded. Seven more shots were similarly fired, except that in round 641 the slide failed to go entirely home, which was corrected by striking with the hand. The pistol was then oiled without dismounting and 7 more shots were similarly fired, the slide failing to go home fully on round 642, correction being made as before. In preparing for firing a wooden rod was used to manipulate the mainspring, as well as to release the slide catch. The slide was worked rapidly back and forth and the hammer was snapped several times.

(*o*) Two hundred and fifty rounds fired from a Colt automatic pistol not previously used in these tests and with the commercial ammunition sold for this weapon, for observation of action. The pistol had a modified hammer. Round 232 jammed, the nose of the bullet being caught in the receiver by the bolt, the point below horizontal. In round 238 the hammer followed the slide, but caught at the safety, apparently due to springing of the trigger stirrup.

(*p*) A primed cartridge case was inserted in the arm and the primer was discharged, with the hammer fully forward, by striking the muzzle on the floor. It was also found that if the magazine be partly withdrawn it was possible to fire by pressing the bottom of the magazine forward, drawing the top rear portion against the trigger stirrup.

(*q*) Fifty rounds fired for observation of action, using the same pistol as in test (*o*) and Colt ammunition. In rounds 252 and 293 the cartridge was caught by the bolt, nose pointing downward against the rear of the receiver. The difficulty was corrected by slightly withdrawing the bolt. Round 259 did not reload, the slide moving forward without seating the cartridge.

The total number of rounds fired was 959.

TEST OF LUGER AUTOMATIC PISTOL, CALIBER .45.

1. The inventor of the pistol dismounted the breech and magazine mechanism with the exception of the magazine catch, in $7\frac{3}{4}$ seconds and completed the dismounting in 3 minutes and 17 seconds, making a total time of 3 minutes and $24\frac{3}{4}$ seconds. He then assembled the arm, except the breech and magazine mechanism, in 3 minutes and 55 seconds, and completed the assembling in $18\frac{1}{2}$ seconds, making a total of 4 minutes and $13\frac{1}{2}$ seconds. The following parts were not

dismounted, as they were either riveted together or so joined as to make dismounting impracticable except in a machine shop: Breech-block, forward and rear link of toggle joint, and recoil spring; trigger plate and lever; trigger-plate lever and pin; cartridge carrier and pressure knob. Two drifts and 1 screw-driver were used in the work.

2. The parts consist of—

Small flat springs.....	4
Small spiral springs.....	2
Larger spiral springs.....	3
Screws.....	2
Nonriveted pins.....	6
Riveted pins.....	2
Bended pins.....	1
Other parts.....	28
Total.....	48

3. The following rounds were fired, using Luger ammunition except where specifically stated otherwise:

(a) One preliminary and 20 rounds for velocity at 25 feet from the muzzle; 10 with F. A. ammunition and 10 with Luger ammunition. The results were as follows:

	Ammunition.	
	F. A. (feet per second.)	Luger (feet per second.)
Maximum.....	835	790
Minimum.....	802	729
Average.....	808.9	762.6

(b) Thirty rounds fired with F. A. ammunition into sand butt to observe general working of the arm. Cartridge not fully seated in 45th round; corrected by striking breechblock.

(c) Thirteen rounds, 3 preliminary and 10 for accuracy at 75 feet. Mean absolute deviation 1.3 inches.

(d) Twenty-one rounds for rapidity with accuracy fired by inventor at a target 6 feet by 2 feet, range 100 feet. The loaded magazines were arranged on a table as desired by the operator, the weapon being empty at the beginning of the test. Time required for the 21 shots was 1 minute and $3\frac{3}{4}$ seconds, and the number of hits was 14. In rounds 81 and 83 the mechanism jammed, and was released without removing the magazine.

(e) Twenty-one rounds fired into sand butt by the inventor for rapidity without accuracy, the loaded magazines being placed in convenient position and the weapon being empty at the beginning of the test. Time required for the 21 rounds was 32 seconds. Rounds 88 and 89 jammed.

(f) Five hundred and six rounds fired for endurance. The mechanism jammed on the following rounds and was corrected by striking the link: 125, 175, 231, 398, 446, and 451. The case was not extracted in the 416th round. In the 477th and 569th rounds one cartridge nearly left the receiver and the next partially entered the chamber, causing a jam.

(g) Seven rounds—2 preliminary and 5 for penetration in soft pine. The average for 5 shots was $4\frac{3}{8}$ inches.

(h) Five rounds for velocity at 25 feet from the muzzle, giving a maximum of 766 feet per second, a minimum of 730 feet per second, and an average of 750.4 feet per second.

(i) Twelve rounds with Frankford Arsenal ammunition, reduced charges; 4 cartridges giving a decreased pressure of 25 per cent, 4 cartridges giving a decreased pressure of 15 per cent, and 4 cartridges giving a decreased pressure of 10 per cent. The action was normal.

(j) Five rounds with Frankford Arsenal cartridges, giving an excess pressure of 25 per cent. The action was normal.

(k) Both ends of the barrel were tightly corked and the pistol was exposed for one minute, in a box prepared for the purpose, to a blast of fine sand, the magazine being empty. The inventor removed the surplus sand by blowing, jarring, and wiping the piece with the bare hand only. Time required to fire 7 shots was 2 minutes and 50 seconds. The 646th round jammed and the cartridge had to be ejected. In the 647th round the cartridge did not fully seat, which was corrected by striking the link; otherwise the arm operated as a self-loader. Seven more shots were fired at the request of the inventor. Jamming occurred on the 651st and 652d rounds, which was corrected by releasing the magazine and reseating it.

(l) The above test was then repeated, except that the arm contained a loaded magazine when exposed to dust. Time required to fire 7 shots was 2 minutes and 32 seconds. The cartridge did not fully seat in rounds 657, 658, 659, and 662, which was corrected by striking the link; otherwise the arm operated as a self-loader. Seven more rounds were fired at the request of the inventor. The cartridge did not fully seat on the 668th round, which was corrected by striking the link.

(m) The pistol was thoroughly cleaned and both ends of the barrel tightly corked. It was then placed in a saturate solution of sal ammoniac for 5 minutes, after which it was hung up indoors and allowed to remain thus for about 22 hours. Total time required to prepare for firing was 3 minutes. The firing of 7 rounds required 20 seconds after the magazine was loaded. Seven more rounds were fired at the request of the inventor, using a clean magazine. All 14 of these rounds were fired by hand, it being necessary to withdraw the bolt and force it home after each shot. At the request of the operator the arm was then oiled, without dismounting, and 7 more rounds were fired, using the rusted magazine. The action was normal.

(n) One round fired with pierced primer and 2 to observe action of mechanism thereafter. The action was normal.

(o) Ninety-eight rounds to observe action. In rounds 704 and 786 the mechanism jammed, the cartridge being caught between the rear face of the chamber and the bolt, point upward; the bullet was appreciably forced inward. The difficulty was corrected by removing the magazine and withdrawing the bolt.

(p) Fifty-six rounds to observe action of the mechanism with Frankford Arsenal ammunition. Rounds 796, 830, 833, and 838 jammed, the cartridge being caught between the bolt and the receiver, bullet directly upward. In round 803 the cartridge was not fully

seated. Rounds 817 and 824 misfired, the cartridges exploding on second trial. In round 810 the cartridge failed to fully seat, was withdrawn and reinserted.

(*q*) Fifty-six rounds with Luger ammunition to observe action of the mechanism. In round 855 the arm failed to load; in round 865 the cartridge partially upended and was caught between the bolt and receiver.

(*r*) Fifty-six rounds with F. A. ammunition to observe action of mechanism. In rounds 907, 928, 933, 935, 938, and 949 the cartridge was caught between the receiver and the bolt, the bullet pointing directly upward. In round 922 the cartridge was not fully seated, which was corrected by withdrawing the link. In round 929 the cartridge misfired, but exploded on a second trial. In round 956 the loaded cartridge was ejected onto the floor without entering the chamber.

(*s*) One coil of the magazine mainspring was removed and 35 rounds fired with F. A. ammunition to observe action. In round 970 cartridge was not fully inserted, which was accomplished by withdrawing and releasing the bolt. In rounds 971, 985, and 992 the cartridge was caught between the chamber and the bolt, the bullet inclining upward. Round 982 misfired, the cartridge exploding on second trial.

(*t*) Another coil of the magazine spring was removed and 14 rounds of F. A. ammunition fired to observe action of the mechanism. In round 998 the loaded cartridge was completely ejected instead of being inserted in the chamber. In rounds 1,000 and 1,006 the cartridge was caught between the receiver and the bolt, the bullet inclining upward. After round 1,003 the arm was cleaned and oiled.

(*u*) Another coil was removed from the magazine spring and 7 rounds of F. A. ammunition fired to observe action of the mechanism. Round 1,012, cartridge was caught between the chamber and the bolt, the bullet pointing directly upward. In round 1,015 the bullet was caught between the chamber and the bolt, the bullet inclining upward.

(*v*) Seven rounds with the same magazine as above and with Luger ammunition to observe working of mechanism. In round 1,021 the cartridge was not fully seated, which was corrected by striking the link.

The total number of rounds fired was 1,022.

TEST OF SAVAGE AUTOMATIC PISTOL, CALIBER .45.

1. A representative of the company dismantled the breech and magazine mechanism, with the exception of the magazine catch, in $6\frac{1}{2}$ seconds, and completed the dismantling in 2 minutes and 30 seconds more, making total time 2 minutes and $36\frac{1}{2}$ seconds. He then assembled the arm, except the breech and magazine mechanism, in 3 minutes and 35 seconds, and completed the assembling in 18 seconds more, making the total time 3 minutes and 53 seconds. One hammer and 2 drifts were used in the work.

2. The parts consist of—

Nonriveted pins.....	3
Small spiral springs.....	5
Larger spiral springs.....	3
Other parts.....	23
Total	34

3. The following rounds were fired, using Frankford Arsenal ammunition:

(a) Twenty rounds to observe general working of the arm fired into sand butt. On the 18th round the empty case was caught by the bolt, causing a jam, which was released by retracting the bolt.

(b) Five rounds fired for velocity at 25 feet from the muzzle. The results were:

	Feet per second.
Maximum -----	854
Minimum -----	769
Average -----	815

(c) Six rounds fired for penetration in white pine, one of which was a miss. The average for 5 shots was 6.2 inches. In rounds 27, 28, and 31 the empty case was not ejected. On the completion of round 31 a new extractor was inserted.

(d) Thirteen rounds, 3 preliminary and 10 for accuracy. Mean absolute deviation, 1.9 inches. At the 36th round the ejected case struck the operator in the face. The cartridge case was not ejected in round 43. Range, 75 feet.

(e) Four rounds fired by a member of the board to observe working of the weapon.

(f) Twenty-four rounds for rapidity with accuracy fired by a representative of the company at a target 6 feet by 2 feet, range 100 feet. The loaded magazines were arranged on a table as desired by the operator, the weapon being empty at the beginning of the test. The time required for the 24 shots was 1 minute and 24 seconds; the number of hits was 13. At the 65th round the pistol jammed, but the cause could not be determined, as a time record was being taken.

(g) Twenty-four rounds fired into a butt by a representative of the company for rapidity without accuracy, the loaded magazines being placed in convenient position and the weapon being empty at the beginning of the test. The time required for the 24 rounds was 25½ seconds. Three of these rounds were misfires, which exploded on the second trial, cocking being done by hand. The company was then permitted to replace the mainspring, which had taken a permanent set.

(h) Five hundred rounds fired for endurance. The following rounds misfired, but the cartridges exploded on second trials: 112, 113, 133, 148. Round 122 misfired, but was not tried a second time, and round 116 misfired on two trials. After round 151 a new mainspring was assembled. Rounds 203, 257, 347, 370, 376, 382, 400, 429, 435, 487, 561, and 576 were misfires which discharged on second trials. In the following rounds the cartridge case was not ejected, but remained in the receiver: 338, 362, 402, 474, 522, 538, 561, and 594. In the following rounds the mechanism jammed, due to the point of the bullet rising too high and being held between the rear face of the chamber and the front of the bolt. In these cases the magazine was removed and the bolt retracted, allowing the cartridge to drop out: 151, 195, 309, 453, and 587. In round 322 a jam occurred as above, the cartridge being held between the rear face of the chamber and the bolt, and this was corrected by withdrawing the bolt, taking out the magazine and forcing the cartridge completely in. Round 388 jammed as above, the cartridge being entered by retracting the bolt and allowing it to move forward.

(i) Seven rounds, 2 preliminary and 5 for velocity at 25 feet from the muzzle, giving a maximum of 835 feet per second, minimum of 787 feet per second; average 803.8 feet per second. After this test the ejector stud was found to be broken and was replaced.

(j) Eight rounds were fired to test the working of the ejector stud.

(k) Twelve rounds with reduced charges, 4 cartridges giving a decreased pressure of 25 per cent, 4 cartridges giving a decreased pressure of 15 per cent, and 4 cartridges giving a decreased pressure of 10 per cent. The action was normal.

(l) Five rounds fired with cartridges giving an excess pressure of 25 per cent. The action was normal.

(m) Three rounds, 1 with pierced primer and 2 afterwards to observe working of the arm, which was normal. The 630th round misfired, but the cartridge exploded on second trial.

(n) Both ends of the barrel were tightly corked and the pistol was exposed for 1 minute, in a box prepared for the purpose, to a blast of fine sand, the magazine being empty. A representative of the company removed the surplus sand by blowing, jarring, and wiping the piece with the bare hand only. Time required to fire 3 shots was $51\frac{3}{4}$ seconds, the operation as a self-loader being satisfactory.

(o) The above test was then repeated, except that the arm was exposed to dust with a loaded magazine. Time required to fire 8 rounds was 53 seconds. The 639th, 643d, and 644th rounds misfired, but the cartridges exploded on second trial. The 644th round jammed, the fired cartridge case not having been entirely ejected and being caught by the bolt.

(p) The arm was thoroughly cleaned and both ends of the barrel tightly corked. The pistol was then placed in a saturate solution of sal ammoniac for 5 minutes, after which it was hung up indoors and allowed to remain thus for about 22 hours. Total time required to prepare for firing, 1 minute and 52 seconds. The firing of 8 rounds required 11 seconds after the magazine was loaded. The arm was then oiled without dismounting and 8 more shots were fired without difficulty. In preparing the arm for firing, the parts were operated by striking on a bench and manipulating by hand. The magazine spring was operated by using a metal rod to force back and forth. The arm operated as a self-loader during the above rounds.

(q) Two hundred and fifty rounds fired for observation of action with a new barrel chambered for commercial ammunition, which was used in the test. Rounds 144 and 152 jammed. Rounds 2, 48, 64, 88, 152, 208, 249, and 250 failed to eject. These were final rounds of series, and correction was made by turning the arm sidewise and allowing the cartridge case to fall out.

The total number of rounds fired was 913.

TEST OF KNOBLE'S AUTOMATIC PISTOLS, CALIBER .45.

1. Two models were submitted by Mr. W. B. Knoble of Tacoma, Wash., one a single action and the other a double action.

2. No representative of the inventor was present, and the weapons were taken down and put together by an expert employee of the Springfield Armory. The time required to dismount the breech and magazine mechanism, with the exception of the magazine catch, was 1 minute and 3 seconds. The time required to complete the dis-

mounting was 1 minute and 35 seconds, making a total of 3 minutes and 5 seconds, not including the magazine. The time required for assembling was 5 minutes and 12 seconds.

3. The parts consist of—

Small screws	4
Larger screws	3
Nonriveted pins	1
Small spiral springs	4
Larger spiral springs	1
Large flat springs	3
Medium-size flat springs	1
Riveted pins	12
Other parts	30
Total	59

Of these parts 9 are riveted together to form the frame. Two screw-drivers, 2 drifts, and 1 hammer were used in dismounting and assembling.

4. A careful examination and several efforts to fire these weapons showed that they were so crudely manufactured as to render any test without value, smooth working being impossible. It was therefore decided that these arms would be given no further consideration by the board.

TEST OF BERGMANN AUTOMATIC PISTOL, CALIBER .45.

1. This arm was dismounted in 2 minutes and 2 seconds and assembled in 3 minutes and 40 seconds by an expert mechanic from Springfield Armory, no representative of the weapon being present. The magazine stop and ejector, being riveted to the frame, were not dismounted. One hammer, 1 screw-driver, 1 drift, and 1 wooden block were used in the work.

2. The parts consist of—

Riveted pins	3
Nonriveted pins	2
Screws	2
Small spiral springs	5
Larger spiral springs	2
Flat springs	3
Other parts	23
Total	40

3. An attempt was then made to fire 20 rounds to observe the working of the pistol, but it was found that the blow of the hammer was not sufficient to discharge the cartridges, and the test was discontinued.

4. The magazine is located forward of the trigger, which gives a heavy muzzle preponderance and disturbs the balance; it would also interfere with carrying the arm conveniently in a holster. The cartridge carrier in the magazine acts as a stop to retain the bolt in retracted position when the last cartridge has been fired, which makes it difficult to extract the magazine without further retracting the bolt by hand. The arrangement of the hammer, sear, trigger, and trigger strut is not considered desirable. The design of the arm is not favored by the board.

TEST OF WHITE-MERRILL AUTOMATIC PISTOL, CALIBER .45.

1. One of the inventors dismantled the breech magazine mechanism, with the exception of the magazine catch, in $5\frac{3}{8}$ seconds and completed the dismantling in 7 minutes $22\frac{1}{8}$ seconds. He then assembled the arm, except the breech and magazine mechanism, in 10 minutes $15\frac{1}{8}$ seconds and completed the assembling in 9 seconds.

2. The parts consist of—

Small spiral springs	7
Larger spiral springs	1
Flat springs	2
Split flat springs	2
Small S wire springs	2
Small nut	1
Small screws	10
Larger screws	4
Nonriveted pins	3
Riveted pins	2
Magazine spring	1
Small studs	5
Other parts	22
Total	62

In dismantling and assembling one tool comprising a drift and two screw-driver blades was used.

NOTE.—The left side plate of grip was riveted to metal part, and the right side plate was screwed on. The loading lever consists of three parts riveted together and was not dismantled. In addition to the above a clip is supplied.

3. The following rounds were fired:

(a) Twenty rounds to observe action fired into sand butt. The following rounds jammed: 4th, 6th, 9th, 10th and 18th. The 8th round misfired, but exploded on second trial.

(b) Seven rounds—2 preliminary and 5 for velocity at 25 feet from the muzzle, giving a maximum of 864 feet per second, a minimum of 813 feet per second, and an average of 835 feet per second.

(c) Fourteen rounds—4 preliminary and 10 for accuracy at 75 feet from the muzzle. Mean absolute deviation, 1.7 inches. Rounds 30, 31, 34, 36, and 41 misfired, but exploded on second trial.

(d) Thirty rounds for rapidity with accuracy fired at request of inventor by an expert employee of the Springfield Armory at a target 6 feet by 2 feet, range 100 feet. The loaded magazines were arranged on a table as desired by the operator, the weapon being empty at the beginning of the test. Time required for the 30 shots was 2 minutes, $4\frac{1}{2}$ seconds. The number of hits was 25. Rounds 49 and 65 misfired, but exploded on second trial. Rounds 51 and 68 jammed. Round 28 did not load at first trial. The hand of the firer was cut by screws and corrugations on the side of the frame. The slide was removed and various screws were tightened.

(e) Thirty rounds fired into a butt by one of the inventors for rapidity without accuracy, the loaded magazines being placed in convenient position and the weapon being empty at the beginning of the test. The time required for the 30 rounds was 1 minute $21\frac{1}{8}$ seconds. The 78th and 89th rounds jammed. The 79th round misfired, but exploded on a second trial. In the 90th round the arm failed to reload. In the 95th and 96th rounds the loaded cartridge was ejected.

(f) One hundred and ten rounds fired for endurance. On attempting to fire, it was found that the trigger could not be pulled, due to loosening of the trigger screw. Hammer and trigger screws were tightened. The following rounds jammed: 107, 109, 116, 120, 128, 130, 144, 150, 188, 196. The following rounds misfired, but exploded on second trial: 105, 107, 122, 125, 131, 132, 137, 138, 140, 145, 147, 158, 159, 171, 174, 187, 203. The magazine failed to feed in the following rounds: 119, 139, 160, 171, 174, 178, 187, 199, 209. Cartridges were not fully seated in the following rounds: 113, 211. Round 168 misfired and did not explode on second trial. Rounds 169 and 191 failed to eject. The trigger and hammer screws were constantly watched and frequently tightened up.

4. This arm is experimental and its functioning was so unsatisfactory that the test was discontinued. The conception of a loading lever which permits loading by the pistol hand is commended, but its practical application was not entirely satisfactory.

The total number of rounds fired was 211.

TEST OF COLT NEW DOUBLE-ACTION REVOLVER, CALIBER .45.

1. The time required by a representative of the company to dismount the arm was 3 minutes and 50 seconds; the time required to assemble the revolver was 6 minutes and 25 seconds. The firing pin, hammer strut, and hammer stirrup were riveted to the hammer and were not dismantled. One hammer, 1 box wrench, 2 screw-drivers, 2 drifts, 1 special wrench, and 1 mainspring clamp were used in the work.

2. The parts consist of—

Nonriveted pins.....	2
Riveted pins.....	6
Small screws.....	4
Longer screws.....	1
Small spiral springs.....	2
Larger spiral springs.....	1
Small flat springs.....	1
Flat mainspring.....	1
Other parts.....	24
Total	42

3. The following rounds were fired:

(a) Twenty rounds into sand butt to observe action of revolver. The 9th round misfired, the cartridge exploding on second trial.

(b) Eight rounds, 1 a miss, 2 by mistake, and 5 for velocity at 25 feet from the muzzle, giving a maximum of 992 feet per second, a minimum of 923 feet per second, and an average of 955.6 feet per second.

(c) Fourteen rounds, 4 preliminary and 10 for accuracy, at 75 feet. Mean absolute deviation, 1.9 inches. During these firings the light was poor.

(d) Five rounds for penetration in soft pine at 75 feet from the muzzle; average, 6.3 inches.

(e) Eighteen rounds for rapidity with accuracy fired by a representative of the company at a target 6 feet by 2 feet, range 100 feet. The cartridges were arranged on a table as desired by the operator,

the weapon being empty at the beginning of the test. The time required for 18 shots was 1 minute and 9 seconds; the number of hits was 10.

(f) Eighteen rounds fired into sand butt by a representative of the company for rapidity without accuracy, the cartridges being arranged in a convenient position, and the revolver empty at the beginning of the test. The time required for the 18 shots was 35 seconds.

NOTE.—At the completion of these rounds it was found that the ejector-rod nut had been lost. It was replaced.

(g) Five hundred rounds fired into sand butt for endurance. The following rounds misfired, but exploded on second trial: 235, 244, 260, 274, 319, 320, 331, 332, 386, 396, 398, 405, 457, 493, 506, 519, and 531.

(h) Five rounds fired for velocity at 25 feet from the muzzle, giving a maximum of 997 feet per second, a minimum of 905 feet per second, and an average of 957.6 feet per second.

(i) One round fired with pierced primer. Action normal.

(j) Both ends of the revolver were tightly corked and the revolver exposed, in a box prepared for the purpose, with the cylinders empty, to a blast of fine sand for one minute. A representative of the company then removed the surplus dust by blowing, jarring the piece, and wiping with the bare hand only. Six shots were fired by double action in 4 minutes and 36 seconds.

(k) The above test was then repeated, except that the revolver was exposed to dust with the cylinders loaded. Four shots were fired in 46 seconds. Rounds 614 and 615 were skipped, owing to haste of the operator, no indentation being found on the primer. These 2 cartridges were afterwards successfully fired. A number of cartridges could not be entered. These were tried after the cylinder was cleaned and no difficulty was found, showing the diameter of the chamber to be somewhat too small; this fact was verified by measurement.

(l) Both ends of the barrel were tightly corked and the revolver placed in a saturate solution of sal ammoniac for 5 minutes. It was then hung up indoors for about 22 hours and allowed to rust. The arm was loaded and 5 shots fired by double action in 5 seconds after loading had been accomplished. Round 624 misfired, but the cartridge exploded on a second trial. Six additional rounds were fired by double action. Round 630 misfired, but the cartridge was exploded on a second trial. The revolver was then oiled without dismounting and 6 rounds fired by double action. Round 636 misfired, but cartridge exploded on second trial. Sixteen minutes and 47 seconds were required to prepare the arm for firing, all but 3 minutes of which was consumed in fitting cartridges, of which 15 in all were used. The latch was loosened by striking on a bench. Considerable difficulty was found in manipulating the hammer, some sputum being used to lubricate it. Rust was rubbed out of the chambers by working cartridges in and out, afterwards loading with other cartridges. All the cartridges used had been previously tried in the revolver and found to fit satisfactorily.

(m) Five rounds were fired with cartridges giving an excess pressure of 25 per cent. The action was normal.

(n) Twelve rounds fired, 6 with single and 6 with double action, to observe working of the arm.

(*o*) Four hundred and fifty rounds fired for endurance. Before beginning this series a stronger mainspring was inserted in the weapon. Eighteen shots, rounds 666 to 684, were fired in 30½ seconds by a member of the board, beginning with the revolver loaded and 12 cartridges placed in convenient position. Fifty rounds, 752 to 801, were fired by a member of the board in 2 minutes and 40 seconds, beginning with the revolver loaded and the remainder of the cartridges placed in convenient position. After round 953 it was found that the cylinder did not swing in and out with ease, there being interference between the crane and the under side of the barrel; the latter was found to be unscrewed partly and turned slightly to the left.

(*p*) Thirty rounds for accuracy at 75 feet from the muzzle. Average velocity at 25 feet from the muzzle, 915 feet per second; 3 targets of 10 shots each; mean absolute deviation, 1.5 inches, 1.8 inches, and 1.5 inches; average for the 3 targets, 1.6 inches. The revolver used had a 5¼-inch barrel, and was not the one used in previous tests.

(*q*) Thirty rounds for accuracy at 75 feet from the muzzle; 3 targets of 10 shots each; average velocity at 25 feet from the muzzle, 782.8 feet per second; mean absolute deviation, 1.6 inches, 0.9 of an inch, and 1.5 inches; average for the 3 targets, 1.3. The revolver used had a 5¼-inch barrel, and was not the one used in tests *a* to *o*.

(*r*) Five shots for velocity at 25 feet from the muzzle, test of ammunition used for the accuracy trial under *p*. Maximum velocity, 950 feet per second; minimum, 892 feet per second; average, 915 feet per second. The revolver used was the same as in test *p* above.

(*s*) Five rounds for velocity at 25 feet from the muzzle, for the accuracy trial of ammunition used for the accuracy test under *q*. Maximum, 816 feet per second; minimum, 761 feet per second; average, 782.8 feet per second. The revolver used was the same as in test *p* above.

The total number of rounds fired was 1,173.

TEST OF SMITH & WESSON DOUBLE-ACTION REVOLVER, CALIBER .45.

1. A representative of the company dismounted the arm in 4 minutes and 15 seconds and assembled it in 8 minutes and 20 seconds. The extractor bushing, center pin, extractor and spring, locking bolt, plunger, and spring were not dismounted, as they were either forced into place or riveted. Three drifts, 2 screw-drivers, 1 pliers, and 1 hammer were used in the work.

2. The parts consist of—

Screws	9
Nonriveted pins	9
Riveted pins	9
Small spiral springs	7
Larger spiral springs	2
Flat mainspring	1
Other parts	27
Total	64

3. The following rounds were fired:

- (*a*) Twenty rounds into sand butt to observe action of the weapon.
- (*b*) Seven rounds, 2 missing target, and 5 for velocity at 25 feet from the muzzle, giving a maximum of 1,032 feet per second, a min-

imum of 975 feet per second, and an average of 1,007.2 feet per second.

(c) Eighteen rounds, 3 preliminary, 5 by mistake, and 10 for accuracy at 75 feet from the muzzle, giving a mean absolute deviation of 1.6 inches.

(d) Five rounds for penetration in soft pine at 75 feet from the muzzle. The average for the 5 shots was 6.8 inches.

(e) Eighteen rounds for rapidity with accuracy fired by a representative of the company at a target 6 feet by 2 feet, range 100 feet. The cartridges were arranged on a table as desired by the operator, the arm being empty at the beginning of the test. Time required for the 18 shots was 1 minute and 40 seconds, one of these shots being a misfire. The number of hits was 17 out of 17. The firing was done by single action. The misfire was evidently due to a skip on the part of the firer, as the primer showed no mark of the striker.

(f) Eighteen rounds fired into sand butt by a representative of the company for rapidity without accuracy, the cartridges being placed conveniently and the arm empty at the beginning of the test. Time required for the 18 rounds was 36 seconds, double action being used. Rounds 108 and 199 misfired, but cartridges exploded on second trial.

(g) Five hundred rounds fired for endurance. Rounds 188 and 199 misfired, but exploded on second trial.

(h) Six rounds, 1 of which missed the target, and the remainder for velocity at 25 feet from the muzzle, giving a maximum of 1,006 feet per second, a minimum of 927 feet per second, and an average of 965.8 feet per second.

(i) One round fired with pierced primer; action normal.

(j) Both ends of the barrel were tightly corked and the revolver was exposed, in a box prepared for the purpose, to a blast of fine sand for one minute, the chambers being empty. A representative of the company then removed the surplus dust by blowing, jarring of the piece, or wiping with the bare hand only. The time required to fire 6 rounds was 1 minute and 7 seconds, using double action.

(k) The above test was then repeated, except that the arm was exposed to dust with the chambers loaded instead of empty. Time required to fire 5 rounds, using double action, was 37 seconds. The 6th shot was skipped, there being no mark of the striker on the primer. Three of the cases showed marks of the striker on the face outside of the primer, showing that the hammer had gone home before the cylinder was fully revolved.

(l) Both ends of the barrel were tightly corked, the arm was immersed in a saturate solution of sal ammoniac for 5 minutes, hung up indoors for about 22 hours, and allowed to rust. Six shots were fired by double action in 7 seconds after the arm was ready for firing; 6 more shots were also fired by double action. The arm was then oiled without dismounting and 6 more shots were fired by double action. Time required in preparation for firing was 10 minutes and 2 seconds, of which more than half was used in trying to operate the double action. The hammer and striker were finally lubricated with sputum. The catch was released by pushing against the edge of a bench, and the remainder of the parts were manipulated

by hand until they functioned properly. No difficulty was encountered in inserting the cartridges.

(*m*) Five rounds with cartridges giving an excess pressure of 25 per cent; action normal.

(*n*) Twelve rounds fired, 6 by single and 6 by double action, to observe working of revolver.

(*o*) Five hundred and thirty-six rounds fired for endurance. Eighteen rounds, 640 to 658, fired by a member of the board in 36 seconds, beginning with the revolver loaded, the remaining cartridges being conveniently placed. Eighteen rounds, 659 to 676, were similarly fired by another member of the board in $32\frac{4}{5}$ seconds. Rounds 707 and 1,062 misfired, but exploded on second trial.

(*p*) Thirty rounds for accuracy at 75 feet from the muzzle; 3 targets of 10 shots each; average velocity at 25 feet from the muzzle, 852.2 feet per second; mean absolute deviations, 1.2 inches, 0.7 of an inch, 0.9 of an inch; average, 0.9.

(*q*) Thirty rounds for accuracy at 75 feet from the muzzle; 3 targets of 10 shots each; average velocity at 25 feet from the muzzle, 991.4 feet per second; mean absolute deviations, 1.2 inches, 1.6 inches, 1.6 inches; average, 1.5.

(*r*) Five rounds for velocity at 25 feet from the muzzle, testing ammunition used in accuracy trial under (*p*). Maximum, 881 feet per second; minimum, 816 feet per second; average, 852.2 feet per second.

(*s*) Five rounds for velocity at 25 feet from the muzzle, testing ammunition used in accuracy trial under (*p*). Maximum, 1,030 feet per second; minimum, 977 feet per second; average, 991.4 feet per second.

NOTE.—A revolver with $5\frac{1}{2}$ -inch barrel, and not the one used in earlier tests, was employed in tests (*p*), (*q*), (*r*), and (*s*).

The total number of rounds fired was 1,246.

TEST OF WEBLEY-FOSBERY AUTOMATIC REVOLVER, CALIBER .45

1. The revolver submitted to the board was not provided with any cartridge loader, the representative stating that the caliber was too large for the satisfactory use of this part, which is furnished with smaller calibers.

2. The time required for dismounting was 4 minutes and 25 seconds, and for assembling 11 minutes and 20 seconds. The following parts were not dismounted: Extractor lever and spring, the hammer swivels, the sear spring, the shield plate. The time required for dismounting and assembling was greater than necessary, as the representative of the arm was not expert in this work.

3. The parts consist of—

Screws	9
Small spiral springs	3
Larger spiral springs	1
Flat springs	2
Small double flat springs	1
Larger double flat springs	2
Nonriveted pins	4
Riveted pins	5
Other parts	27
Total	54

One screw-driver, 2 drifts, 1 hammer, and 1 pair of pliers were used in dismounting and assembling.

4. Six hundred and twenty rounds were fired from the weapon, as follows:

(a) Twenty rounds fired into sand butt for observation of general working. Round 8 was a misfire, and the cartridge did not explode on the second trial.

(b) Six rounds fired for velocity at 25 feet from the muzzle, 1 missing the target. The results were: Maximum 977 feet per second, minimum 896 feet per second; average 925.2 feet per second.

(c) Twelve rounds, 2 preliminary and 10 for accuracy, at 75 feet from the muzzle. Mean absolute deviation 1.9 inches. Round 36 misfired, but exploded on second trial.

(d) Eighteen rounds for rapidity with accuracy, fired by a representative of the competitor, at a target 6 feet by 2 feet, range 100 feet. The cartridges were arranged on a table, as desired by the operator; the chamber and cylinder were empty at the beginning of the test. The time required for the 18 shots was 1 minute and 5 seconds; the number of hits was 14. There were 2 misfires, so that the number of hits was 14 out of 16.

(e) Eighteen shots fired into a butt for rapidity without accuracy, the revolver being empty at the beginning of the test. The time required was 21 seconds. The 60th round misfired, but discharged on the second trial.

(f) Five hundred rounds for endurance. The following rounds misfired, but exploded on the second trial: 208, 250, 345, 357, 363, 411, 417, 423, 474, 477, 483, 488, 495, 504, 519, 521, 551, 557; rounds 278 and 339 misfired and did not explode on second trial. The body did not fully recoil on rounds 526, 547, and 568, resulting in failure to cock the hammer and suspending the automatic action, since this cocking had to be done by hand.

(g) Five rounds fired for velocity at a distance of 25 feet from the muzzle, giving a maximum of 899 feet per second, minimum 875 feet per second, and an average of 887 feet per second.

(h) Five rounds fired into soft pine for penetration, giving an average of 6.3 inches.

(i) Five rounds fired with charges giving 25 per cent excess pressure, and one round with a pierced primer; the functioning of the arm was normal.

(j) Both ends of the barrel were tightly corked and the revolver exposed in a box, prepared for the purpose, to a blast of fine sand, the chamber being empty. Representative was not present, and the test was conducted by Capt. E. D. Scott, Artillery Corps. Surplus sand was removed by blowing, jarring the piece, or wiping with the bare hand only. The time required to fire 5 shots was 1 minute and 37 seconds, one cartridge having been passed over by the operator. This cartridge was afterwards fired without difficulty. These 5 shots were fired by hand, the recoiling parts failing to function. Six more shots were then fired successfully, using the arm as a self-loader.

The above test was then repeated, except that the arm was exposed to dust while loaded. One minute and 35 seconds were required to discharge 6 shots by hand, the recoiling parts again failing to function.

(k) The arm was thoroughly cleaned and both ends of the barrel were tightly corked. The revolver was then placed in a saturate

solution of sal ammoniac for 5 minutes, after which it was hung up indoors and allowed to rust for about 22 hours. Total time required to prepare the arm for firing was 3 minutes and 6 seconds, of which 16 seconds were required to insert the cartridges. The firing of 6 rounds required 10 seconds after the arm was prepared. The mechanism operated satisfactorily, except on round 603, when the body failed to recoil fully, requiring cocking by hand. Six additional shots were then fired without difficulty. The arm was then oiled, without dismounting, and a third series of 6 shots was fired satisfactorily. In preparing the arm for firing no difficulty was encountered in removing the cylinder, but it was necessary to use considerable sputum in connection with the stud that operates the cylinder and the arm that holds the stud. The parts were loosened by working the body back and forth and manipulating the hammer and trigger by hand.

The total number of rounds fired was 620.

5. The introduction of an automatic feature in a revolver is, in the opinion of the board, not desirable for the military service, the only gain of importance being the reduced "kick," due to the more gradual taking up of the recoil. The difficulty in reloading the arm on horse-back after 6 shots have been fired is the same as in any other revolver; the introduction of the automatic feature adds to the complication and weight of the weapon, and double action is not present. It is, therefore, necessary either to carry this arm with the hammer cocked and locked by the safety (which is not automatic), to cock by using the thumb on the hammer, or to cock by forcing the body and barrel to the rear by pressure in the case of the first shot, or if the recoiling parts do not move fully to the rear in firing, or in case of misfire, the rotation of the cylinder and the cocking must be done by hand. The weight of the revolver without cartridges is 2 pounds and 10 ounces. In view of the above the board decided to discontinue the tests of this arm.



COLT AUTOMATIC PISTOL, CAL. .45



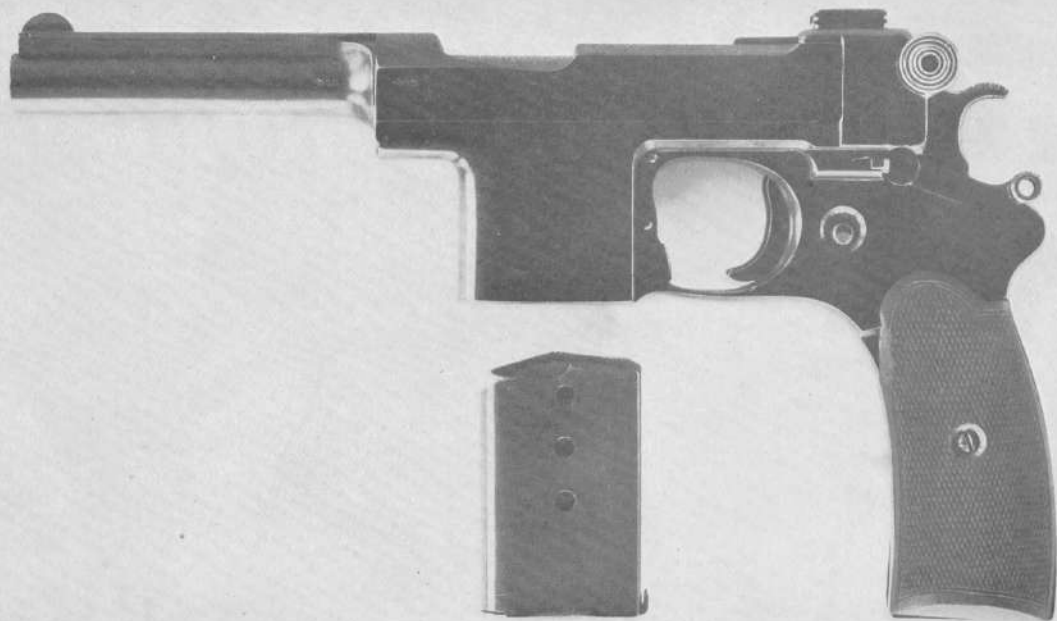
LUGER AUTOMATIC PISTOL, CAL. .45



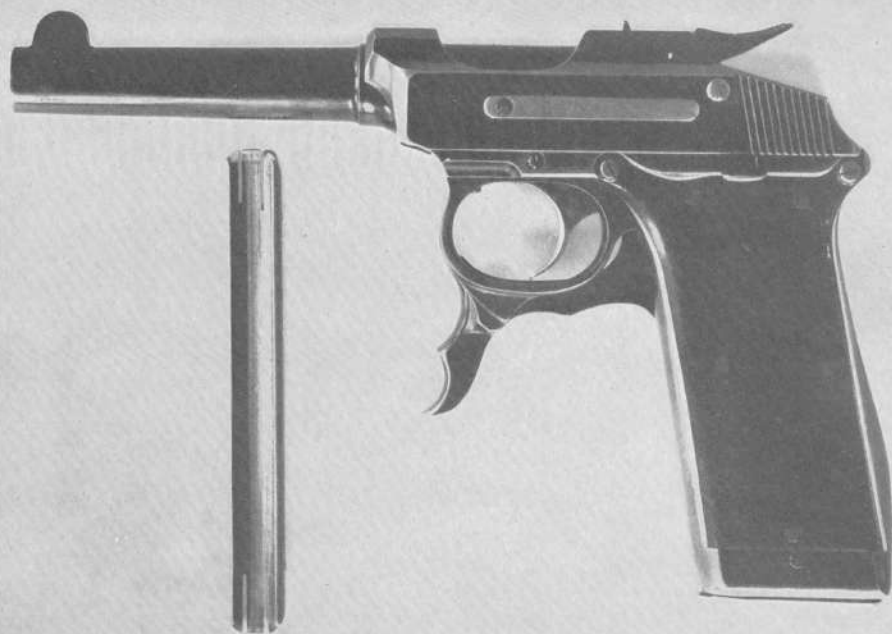
SAVAGE AUTOMATIC PISTOL, CAL. .45



KNOBLE AUTOMATIC PISTOL, CAL. .45



BERGMANN AUTOMATIC PISTOL, CAL. .45



WHITE-MERRILL AUTOMATIC PISTOL, CAL. .45



COLT NEW DOUBLE-ACTION REVOLVER, CAL. 45



SMITH & WESSON DOUBLE ACTION, REVOLVER. CAL..45



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