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PROJECT REPORTS

History of the Ordnance Establishments of British India: 1700-1947*

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In order to maintain the military technological superiority, the East India Company (EIC) had to regularize and systematize its military production. This resulted in the construction and maintenance of the ordnance establishments comprising of factories, magazines & manufactories. Small factories and magazines were used for storing arms and munitions and arsenals (to repair damaged guns and wagons) in British-India.

The British officers considered the ordnance establishment as the fourth arm of defence. And most of the ordnance factories of British-India remained operational in independent India. Besides providing military supplies, the ordnance factories provided employment to a large number of colonized region. Further, the ordnance infrastructure imparted technological skills to the labour force.

All these developments had massive economic and cultural impact on colonial India's society. Nevertheless, there is no study of the ordnance factories of British-India (except an official history of Cossipore Gun and Shell Factory by Arun Bandopadhyay). Instead of a chronological narrative, the aim of this project was to provide a thematic study of the ordnance establishments of the *Rāj* for the last three and half centuries. The objective was to trace the history and background behind military industrialization in the subcontinent and carried out under the following chapters:

I. Introduction: Military Technology Transfer in a Colonial Context

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II. The Emergence of the Ordnance Establishments in British-India: 1700-1810

III. The Metropole as Step Mother: Bureaucratic Obstruction and Stunted Modernization of the Ordnance Factories

IV. Finance, Technology and Munition Production in the Ordnance Factories: 1860-1890

V. Personnel and Production: Gradual Indianization of the Ordnance Establishments' Labour Force: 1890-1947

VI. Global Warfare and Decolonization: The Ordnance Establishments during the two World Wars, 1914-1945

VII. Conclusion: Guns or Butter: The Ordnance Factories in the Nehruvian Era and in the Age of Computer Warfare: Past Imperfect, Future Uncertain

What were the political, military and economic imperatives behind the EIC's scheme of setting up a series of arsenals, magazines and factories in British-India? Continuous warfare with the indigenous powers like the Marathas, Sikhs, and modernization of the weapon systems of these indigenous powers forced the British to establish manufacturing centres in India. From seventeenth century onwards, firearms became more important than cavalry in the conduct of warfare. And this was a global trend. Let us take a quick snap shot regarding the nature of handguns and artillery used in pre-colonial India. The Rohillas fought as infantry and were armed with matchlocks. The barrels for matchlocks were prepared by forming bits of iron into rods which were as thick as the finger. Then, they were twisted and three or four of them joined together. Another strip of iron one third of an inch thick was welded to it. Then, it was formed into a band which was twisted and beaten into a solid cylinder. Finally, a hard steel chisel bored it. Stephen Peter Rosen claims that Indian musket barrels were better than British barrels because they were made with spiral rather than longitudinal welds. Hence, they were stronger and less likely to burst and were able to take a larger gunpowder charge and shoot twice as far as the European muskets.

In course of time, the matchlocks were replaced by the lighter, more reliable and rapid firing flintlock muskets whose powder was ignited by a

spark produced through the action of flint on steel. The new guns were lighter and did not require any rest and the rate of fire further improved with the use of paper cartridges. In 1696, the Swedes introduced this weapon. The Dutch, English and the French armies adopted flintlocks by 1700s. The flintlocks were made more effective by replacement of the plug bayonets (which hindered firing), by ring and socket bayonets which allowed firing with the blade in place. Jadunath Sarkar tells us that Shah Alam's infantry was equipped with flintlocks. Sarkar continues that in 1759, the Rohillas had flintlocks.

India produced 200,000 tons of iron in 1750, which was about the same as in all of Europe in that year excluding Russia. And the Indian iron production was largely devoted to shipbuilders and gun makers. Rosen asserts that qualitatively Indian steel was better than British steel because surface iron ore was better than that available in Europe. Indian bronze was not as good as British bronze but Indian brass was better than European brass and made better artillery barrels. Probably, the problem for the indigenous powers lay with their doctrine of warfare.

Before Third Panipat (1761), the Maratha artillery could not be aimed properly in the battlefield, due to lack of elevating screws. Sadashiv Rao Bhau's guns were made of brass (cast bronze) and were mounted on teakwood carriages. Cast iron was cheaper, harder and more enduring than bronze. In England, cast iron guns were manufactured as early as 1543. Deficient bellows was the principal hurdle behind manufacturing cast iron field guns in India. Hence, the Indian rulers used European experts in order to establish European style foundries.

Before the Second Anglo-Maratha War (1803-5), the *Peshwa* (Prime Minister of the Maratha Confederacy) had 40-pounder guns which were cast by a Portuguese in Pune. The carriages of such guns had wheels made of solid teak. Sangster, a Scottish military mercenary was hired to cast field guns in Agra for Mahadji Sindia. And the muskets manufactured in Sangster's arsenal in finish and durability were equivalent to the British products. De Boigne, a Savoyard was also hired by Mahadji for modernizing his military apparatus. Boigne appointed Perron, a French, who was an artisan skilled in operating the cannon foundry. Use of the European experts for modernizing the military apparatus was not unique to pre-colonial India. During the early

decades of the nineteenth century, Egypt also utilized European advisors for making gunpowder and firearms. The Agra Fortress under De Boigne became a depot for arms and munitions. Mahadji's Gwalior Arsenal cast huge brass guns. De Boigne's contingent was equipped with 3, 6 and 12-pounder guns. The guns constructed at Mathura and Agra had elevating screws. These guns were modelled on the French pattern and in quality were equivalent to those possessed by the EIC. Iqtidar Alam Khan asserts that besides copying European military technology, the Marathas also resorted to limited improvisations. The Maratha gun makers attempted to cast bronze casings around the wrought iron barrels in order to raise the strength of wrought iron barrels to the level of those cast in bronze, thus economizing on the use of copper which was in short supply and costlier as well. Iron cannon balls were manufactured at Gwalior where there were iron mines. Saltpetre and sulphur were imported from Bikaner to Agra where gunpowder was manufactured. In the Battle of Delhi (11 Sept. 1803) during the Second Anglo-Maratha War, the Marathas used round, chain and grape shot against Lord Lake's British-Indian Army. The grape shot was introduced in West Europe during the fifteenth century. It consisted of small round shots packed in nets and sacks and bore resemblance to cluster of grapes.

The EIC realized that importing military stores from Britain was not only costly but also intermittent and inadequate due to lack of adequate shipping space. Hence, the search for utilization of India's raw materials. The ordnance establishment of British-India manufactured gunpowder, small arms and various types of cannons, mortars and howitzers. Gunpowder was made by mixing together under pressure, saltpetre (nitrate), sulphur and charcoal in the following proportion: 75%, 10% and 15% respectively. The nitrate functioned as an oxidizer in the burning reaction. Saltpetre is made from the nitrgenous materials rotting in the ground and is converted by bacteria to form nitrates. High temperature and humidity in India accelerated the decomposition process. India had abundant supply of saltpetre or potassium nitrate due to huge demographic resources and large number of domestic animals especially in Orissa and in the Ganga Valley. The earth of the Ganga Valley was richly impregnated with saltpetre in a natural state which was extracted by lixiviation, evaporation and crystallisation. In Bengal, saltpetre was gathered in large masses wherever it effloresced on the soil especially during the rainy season. In India, the men from the '*loneah*' and

the '*nuniah*' castes collected the saltpetre rich earth and undertook its initial treatment by refining through boiling it in water before it could be used for making gunpowder. Towards the end of eighteenth century, the saltpetre found in India was much better than those produced in France. However, the Indians failed to refine saltpetre properly. Unless the saltpetre was cleared of dirt, the burning of gunpowder was adversely affected. From the last decade of the eighteenth century, the European powers used chemical engineers in the refineries. The EIC found out that buying saltpetre in India was much cheaper than importing it.

The same logic applied for the other important component of the gunpowder-sulphur. In 1819-20, sulphur was sent from England for manufacturing gunpowder. However, on storing the material-strength deteriorated. So, it was decided to use the local product. Sulphur was procured from the Indian *bazaars* (markets). The price varied between Rs 2 *Anna* 12 (16 *Anna* = Rs 1) to Rs 5 *Anna* 8 per *maund* (1 *maund* = 80 pounds). By 1822, Fort William had a huge stock of sulphur and it was able to meet the demands of the other two presidencies.

In 1669, the EIC constructed its first gunpowder mill at Bombay. In 1741, the output of the powder in this mill was considered superior than the quality of powder imported from Britain. Preparation of gunpowder required pulverizing which meant the initial mixing of charcoal and sulphur. In this process, the charcoal was broken down into particles and got mixed with sulphur. The quality of powder was dependent on how well this was done. Initially, the labourers used stone mortars for pressing the various components of gunpowder. In 1768, buffaloes were used for turning the machinery used for pressing gunpowder. Mule driven mills for grinding the ingredients of gunpowder were used in the Portuguese Gunpowder Factory at Goa from 1630 onwards. In 1779, the output of the Bombay Powder Mill rose by about 1,000 barrels per season.

The demand for gunpowder rose during the Second Anglo-Maratha War (1803-05). This, in turn witnessed the expansion of gunpowder manufacturing capacity of the EIC's ordnance establishments. On 4 May 1804, 1,000 barrels were sent to Ishapore Powder Work which was manufacturing gunpowder. The warehouse supplied 1,000 pounds of saltpetre to Ishapore. The Allahabad Manufactory was established for manufacturing

gunpowder. Between 1798 and 1805, the ordnance establishment of Bengal Presidency supplied the Cape of Good Hope with gunpowder worth 11,164 sterling pounds (freight charges not included). In the 1830s, each of three EIC's presidency had an establishment for making gunpowder. The factories making gunpowder generally pursued production policy on the assumption of three years' consumption in peacetime.

From late eighteenth century, the ordnance infrastructure of British-India underwent a steady expansion. The Bengal Presidency was the biggest, most economically prosperous and strategically important presidency of British-India. During the first half of the nineteenth century, Cossipore replaced the Grand Arsenal of Fort William as the most important manufactory of eastern India. Gradually, Fort William became a centre for distribution of military stores, while Cossipore took over the task of producing gun-carriages and then brass guns. However, Cossipore faced problems as regards seasoning of the timber. So, the task of producing gun carriages was taken over by Fatehpur and later Jabbalpur.

Had an uprising occurred in Punjab in the summer of 1857, when north India was in flames, then it would have resulted in the end of the British rule. The Enfields (muzzle-loading rifles) replaced the smoothbore percussion muskets. The Enfields in the hands of the crack British troops gave them an advantage over the 'mutineers' equipped with outdated smoothbore Brown Bess muskets. The rifling of the Enfield increased the spin of the bullet giving it better range and higher penetrating power. Between May 1857 and May 1858, the Punjab government used the convicts (whose mortality rate was about 7%) for manufacturing 80,000 Enfield cartridges. Besides the Lahore Fort with munitions of war and more than 7,000 barrels of powder, the big Ferozepur Magazine and the Phillour Arsenal had most of the siege materials which were used by the Delhi Field Force for capturing Delhi from the 'rebels' in September 1857. The Ferozepur Arsenal provided 18 guns along with 16 elephants (for drawing the guns) and 548 wagons (which carried the shots and shells of the guns) to the Delhi Field Force.

Towards the end of the nineteenth century, though Cossipore retained its premier position within the Bengal Presidency, as far as gross expenditure was concerned, the Gun Carriage Factory of Jubbulpore and the Clothing Factory at Shahjahanpore overtook Cossipore. This was because of the shifting

contours of British military strategy. The Bengal Presidency ceased to be the premier deployment theatre of the British-Indian Army. The North-West Frontier became the principal trouble spot of the Empire. Hence, most of the military units were deployed along the Indus frontier and supplied from the Ferozepore Arsenal and the factories in Uttar Pradesh. This resulted in expansion of the productive potential of all those factories vis-a-vis the factories in Madras Presidency and Bengal. Some factories in the Bombay Presidency were even shut down.

The *Rāj* faced a contradiction between importing latest state of arms in small quantities at prohibitive costs from Britain or mass production of copied designs of arms and munitions of the Royal Arsenal at Woolwich in the Indian ordnance factories. Lord Bentinck's penny-pinching policy and the demands for guns and shots during the 1857 Uprising prevented large-scale closure of the factories in the mid nineteenth century. During the 1880s, the management of Cossipore was very eager as regards innovating and introducing new military items like rifled brass guns. However, the bureaucracy in Britain and the colonial bureaucracy in British-India created obstacles. The Inspector General of Ordnance in charge of Bengal Presidency and his superior, the Director General of Ordnance emphasized uniformity rather than originality. They were unwilling to take risks and were against experimenting with costly new products. They bluntly ordered the successive superintendents of the ordnance factories of India to stick to the official norms of copying the metropolitan products rather than thinking of producing new military items. Actually, the Inspector General and the Director General of Ordnance Department were carrying out the Secretary of State for India's order. The latter supported the British private companies' plan to sell their obsolete semi-finished products to the Indian factories. They were not eager to see the ordnance factories in India emerge as competitors to the private British firms making weapons. A vicious circle emerged between under-funding of the ordnance factories of India and production of inadequate amount of state of arts equipment needed by the British-Indian Army. Importing the latest weapons like mortars and howitzers proved too costly for the colonial state. But, then the Indian ordnance factories in particular lacked the machinery for producing advanced weaponry like rifled artillery, fuzes for the shells, etc. The colonial polity lacked the financial muscle to modernize the machinery in the factories. The replacement of steam power

with electrical power in the ordnance factories of British-India occurred in halting stages. As a result, the ordnance factories continued to produce obsolete products even during the first decade of the twentieth century.

One of the principal bottlenecks behind expansion of the ordnance factories' manufacturing capacity was absence of adequate number of trained personnel. Most of the higher ranking officials posted in the ordnance factories of British-India were from the Royal Artillery branch on temporary deputation. However, the supply of such officers was inadequate and they were quite costly to maintain. The only alternative was indigenization of the higher ranks. However, an underdeveloped colony like British-India failed to produce personnel trained in science and adept at scientific management of manpower. The British never opened any institution in India for providing scientific training to the Indians. But, due to pressure of the two global wars (1914-18, 1939-45), the *Rāj* was forced to tap the skilled manpower potential within India. Gradually, Indians were trained in higher education and they were allowed to fill up the higher posts in the factories. The Factory Lists show that in the inter-war period (1920-39), there was a huge influx of educated middle class Indians within the higher echelons of the factory bureaucracy.

Inadequate modernization of the factories remained a bane till the onset of the two global wars. The Second World War hit the British Empire like a typhoon. The London government realized that Britain itself lacked the manufacturing capacity for meeting the requirements of Total War. Especially during Hitler's war, the *Luftwaffe* heavily bombed Britain and the U-Boats (German submarines) cut off the isle's sea lines of communications. The ruling elite of Britain understood that the traditional policy of importing raw materials from the colonies and exporting finished industrial products to them, would work no more. Instead, in desperation, the metropole ordered the colonies to mobilize their manufacturing capacity by utilizing local raw materials. The *Munitions Board Reports* show that instead of depending on the mother country, London government asked for help from the colonies. This was a god send opportunity for the Indian ordnance factories. Instead of playing a second fiddle to the British factories, for the first time, they seriously considered the manufacturing options open before them. The rapid expansion of Cossipore and its sister concerns' productive potential (together they employed about 40,000 people) enabled the British-Indian Army to

meet the challenges of World War II and also provided the newly independent Congress government with a viable military productive base. This allowed the post-colonial Indian government to survive in the cruel post war era.

Source: This project draws from the *Parliamentary Papers* (available at the National Library Calcutta and National Archives Library, New Delhi), Ordnance Board Records, the Proceedings of Military Board, the Secretary of State's Military Despatches, Military Department Proceedings, *Munition Board Reports* available at the National Archives of India and Central Secretariat Library, Cabinet Papers at Nehru Memorial Museum and Library, New Delhi, and the Annual Factory Records plus the Factory Lists. Some of the works which have already been used are given below.

Archival Sources: National Archives of India, New Delhi

Primary Sources:

Foreign Department: 1. Foreign Department Proceedings, 2. Foreign Secret Consultations, 3.General Report on the Administration of the Punjab Territories from 1856/57 to 1857/58 inclusive together with a brief account of the Administration of the Delhi Territory, from the reoccupation of Delhi upto May 1858, nos. 3189-3412

Military Department: 1. Military Board Proceedings, 2. Military Letters to the Court of Directors British Library, London, 3. Notes and Minutes by Lord Napier of Magdala, MSS.EUR.F.114, 5(4), India Office Records (henceforth IOR), 4. Roberts, General Frederick, *Correspondence with India while Commander-in-Chief in Madras, 1881-85*, vol. 3 (Simla: Govt. Central Printing Office, 1890), pp. 104-5, L/MIL/17/5/1615, IOR

Secondary Source (Books and Articles):

———, *Societies and Military Power: India and its Armies* (New Delhi: Oxford University Press, 1996)

Bandopadhyay, Arun, *History of Gun and Shell Factory Cossipore* (Kolkata: Allied, 2002)

Barter, Richard, *The Siege of Delhi: Military Memories of an Old Officer* (London: Folio Society, 1984) [First written in 1869]

Barthorp, Michael and Douglas Anderson, *The British Troops in the Indian Mutiny: 1857-59* (1994, reprint, Oxford: Osprey, 2000)

Beckett (Associate Editor), *The Oxford Illustrated History of the British Army* (Oxford: Oxford University Press, 1994)

Bhattacharya, Asitesh, 'Gunpowder and its Applications in Ancient India', in Brenda J. Buchanan (ed.), *Gunpowder, Explosives and the State: A Technological History* (Aldershot: Ashgate, 2006)

Black, Jeremy, *A Military Revolution? Military Change and European Society, 1550-1800* (Houndmills, Basingstoke: Macmillan, 1991)

Bret, Patrice, 'Gunpowder Manufacture in Cairo from Bonaparte to Muhammad Ali: Adaptation, Innovation and the Transfer of Technology, 1798-1820', in Brenda J. Buchanan (ed.), *Gunpowder, Explosives and the State: A Technological History* (Aldershot: Ashgate, 2006)

Buchanan, Brenda J., 'Saltpetre: A Commodity of Empire', in Buchanan (ed.), *Gunpowder, Explosives and the State: A Technological History* (Aldershot: Ashgate, 2006)

Chase, Kenneth, *Firearms: A Global History to 1700* (Cambridge: Cambridge University Press, 2003)

Compton, Herbert, *A Particular Account of the European Military Adventurers of Hindustan from 1784-1803* (1892, reprint, Karachi: Oxford University Press, 1976)

Egerton, W., *An Illustrated Handbook of Indian Arms and those of Nepal, Burma, Thailand Malaya* (1880, reprint, Bangkok: White Orchid Press, 1986)

Forrest, George W. (ed.), *Selections from the Letters, Despatches and other State Papers preserved in the Military Department of the Government of India*, vol. 1 (1893, reprint, New Delhi: AES, 2006)

Heathcote, T.A., 'The Army of British India', in David Chandler (General Editor), Ian

History of the Indian Ordnance and Clothing Factories (Simla: Govt. of India Press, 1938)

Holmes, Richard, *Sahib: The British Soldier in India, 1750-1914* (London: HarperCollins, 2005)

Khan, I.A., 'The Indian Response to Firearms, 1300-1750', in Brenda J. Buchanan (ed.), *Gunpowder, Explosives and the State: A Technological History* (Aldershot: Ashgate, 2006)

Lenman, Bruce, *Britain's Colonial Wars: 1688-1783* (Harlow, Essex: Pearson, 2001)

MacMunn, George, *Vignettes from Indian War* (1901, reprint, Delhi: Low Price Publications, 1993)

Roberts of Kandahar, Field-Marshal Lord, *Forty One Years in India: From Subaltern to Commander-in-Chief*, vol. 1 (London: Richard Bentley and Sons, 1897)

Rogers, Colonel H.C.B., *A History of Artillery* (Syracus, New Jersey: Citadel Press, 1975)

Rosen, Stephen Peter, 'Military Effectiveness: Why Society Matters', *International Security*, vol. 19, no. 4 (1995)

Roy, Kaushik, *War, Culture and Society in Early Modern South Asia: 1740-1849* (London: Routledge, 2011)

Sarkar, Jadunath, *Fall of the Mughal Empire*, vol. 2, *1754-71* (1934, reprint, Delhi: 1991)

Selections from the Public Correspondence of the Administration for the Affairs of the Punjab: Punjab Mutiny Report (1881, reprint, Lahore: Sang-e-Meel Publications, 2005)

Shejwalkar, T.S., *Panipat: 1761* (Poona: Deccan College Postgraduate and Research Institute, 1946)

The Army in India and its evolution including an account of the establishment of the Royal Air Force in India (1924, reprint, Delhi: Anmol Publications, 1985)