INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN 2278 – 0211 (Online)

Craft Technology and Barriers to Innovation and Social Change in Mughal India (1526-1707)

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Abstract:
The itineraries of European travellers are an important source material for the study of Mughal India. Although we find abundant political information in the Persian sources but they tell little about the socio-economic life of the common masses. For this, we depend largely on the accounts of European travellers who, came to India as traders, adventurers, missionaries and later as colonizers. This paper attempts to examine the European impressions and interpretations of Indian craft technology and barriers to innovation during the Mughal period.

Keyword: *European, labour, Mughal, History, travelers, socio economic, craft technology, traders, adventurers, political, Education, tools.*

1. Introduction

India enjoyed superiority in textile technology until the last quarter of the 18th century. On the basis of agricultural produce a number of crafts and industries were carried on, on a small scale, in the village. The labour employed was hereditary,[1] the implements and methods of work were crude, but the quality of the products was excellent. European travellers and traders of the 17th and 18th centuries conceded the superiority of Indian cotton and silk fabrics, hence of techniques and technology employed therein. Indian cotton goods had been imported into the countries of the Mediterranean from time immemorial, where inhabitants at an early date attempted to imitate them.[2] They had been in great demand till mid-18th century as "their quality was so peculiar that no nation on the globe could either equal or rival them.[3] Before the discovery of machine spinning and weaving in Britain in the second half of the eighteenth century, the Indian subcontinent was probably the world's greatest producer of cotton textiles. The overseas markets in Asia and Africa were of course long dominated historically by Indian products, and to the demands of the two continents. Europe added its own in the seventeenth and eighteenth centuries.[4]

The success of Indian cotton industries in maintaining its existing overseas markets and in creating new ones in the West before the period of Industrial Revolution owed as much to the possession of highly specialized technical skills in' manufacturing as 'o the lower costs of production. The European observers who had visited India during the 17th and 18th century found it a matter of great surprise "how cloths of such an extraordinary niceness" could be produced with few and humble, mechanical tools.[5] So much superior indeed were the production! Of the Indian spinning-wheel and handloom to those turned out by the manufacturers of Lancashire until the mid-18th century that not only were Indian cal roes and prints preferred to the home made article, but the Manchester and Blackburn weavers actually imported Indian Yarn in large quantities for employment in their factories.[6]

Looking at the technological improvements that took place in Western Europe between 1450 and 1750 and paved the way for the Industrial Revolution, we can group them into two categories. First, the introductions of basic mechanical device such as gearing, belt driving, screw, lever, crank, spring, etc. into one process after another and second, the concentrated applications of larger and larger amount of power and heat in mechanical and chemical operations. In Mughal India a number of mechanical principles frequently employed in modern machines were in use but the range of their application was limited.

Prior to Babar we do not find any clew reference to gearing. He described its use in the 16th century Punjab and Sirhind.[7] Mughal miniatures from Akbar's court more clearly depict this mechanism.[8] But this mechanism was not used by Akbar in serious industrial operations. Its use was limited to fancy devices.

Another important technological device in medieval India was belt driving. It was a convenient device for transmission of power especially for increasing or reducing speeds of motion of a wheel in direct alignment to main wheel.[9] The jewellers used the bow-string to impart rapid motion to the narrow shaft of their drill. The bow-string drill continued to be used in Mughal India and is described by Thevenot[10] and illustrated .n an early 17th century Mughal miniature.[11] In 1674, Fryer wrote about a mill in which driving belt was used : "They cut Diamonds with a Mill turned by men the string reaching, in manner of our cutlers wheels, to lesser than that are in flat Press, where under steel-wheels the diamonds are fastened; and with its own Bort are worn in what cut the Artist

pleases".[12] But it remained exceptional. Till the early years of the 19th century, the "common drill" remained the one turned by the bow-string,[13] it was an important part of the equipment of Indian carpenter and blacksmith.[14]

The threaded screw, as a metal fixing device, dates in European technology from the middle of the 15th century only. It contributed greatly to the sophistication of instruments by replacing soldering, rivets and wedge —fittings and, on the other, called forth the development of powerful lathes to cut grooves on the screw. The first account of such screw in India occurs in Thevenot (1666), "The Indians of Dehly cannot make a screw as our Locksmiths do: all they do, is to fasten to each of the two pieces that are to enter into one another, some iron, copper or silver wire, turned screw-wise, without any other art than soldering the wire to the pieces; and in opening them, they turn the screws from the left hand to the right contr-iwise to ours, which are right to the lefts.[15] The metallic screw was thus knocking at the doors but the possibilities of screw remained unexplored in India. The soldering of wire did not give way to the cutting of grooves which alone would have given a strong enough screw and made its wider use possible.

1.1. Treadles

Just as the spinning wheel quickened spinning, so the addition of pedals or treadles to the loom to control the headdle — harners greatly quickened weaving. The weaver could now use his two feet for alternately lifting the two sets of headdles while his hands would be engaged solely in throwting the shuttles to and fro.

The loom-treadles were a Chinese discovery of the second century.[16] Treadles began to be used in European looms only by the late 12th century. Owing to the poor state of research in production technology of the Islamic world, there are no means of knowing when the treadles became common there. The loom treadles became generalized in India sometimes before the 17th century, though the possibility cannot be excluded that they came simultaneously with the spinning wheel, as an appendage of the invaders.

1.2. Crank

Lynn white indicates the development of compound crank from the 15th century onwards in Europe.[17] We can find examples of crank handles as in the cotton-gin in Indian traditional technology.

1.3. Springs

The metallic spring in use in pre-modern India technology was a simple bar bent into a bow-shape. The Hindi term for spring, Kamani, bow, comes naturally from this shape. Its greatest use in Mughal India seems to have been in locks and in muskets. The metallic coiled or spiral springs that developed in Europe never became familiar to Indian smith. In India indigenously made clocks did not, however. make their appearance. Ovington thought that this was because the clocks, "Seldom continue their just motions for any time by reason of the Dust that flies continually in the Air, which is apt to clog and stop the wheels."[18] Bowery supposed that Indians did not make the mechanical clocks not because they were "not so ingenuous to make them," but because they had their own convenient and accurate water clocks."[19] Both these factors could have been responsible for India's failure to imitate European clocks. Thus we find that Indian craft technology remained isolated and their forms undeveloped, in comparison to European technology of the sixteenth and seventeenth centuries. Even in the agricultural technology, besides human muscles, cattles were the sole source power. In the Mughal imperial mints thousands of coins were uttered every day, yet stamping was done by manual hammering of the steel dics.[20]

The absence of powers .drive restrained the ability of Indian smiths to obtain high enough temperature in large forges or furnaces. At the beginning of the 19th century forges of iron-smiths manufacturing muskets in Kashmir were still fed by these bellows worked manually by single operators," as is the case through India generally."[21] In absence of a sufficient amount of air to the furnaces only small amount metal could be melted at one time in each furnace. This greatly affected the quality of the metal when it had to be used in a large mass as in cannon; so Thevenot stated, "They have cannon also in their towns, but since they melt in the metal diverse Furnaces, so that some of it must needs be better melted than others when they mingle together, their canon is commonly good for nothing"[22] This explains the complaint made by English factors at Bombay in 1668. "The greatest scarcity in these parts we find to be iron work.' [23]

In spite of the above mentioned backwardness in technology, India was, in the 16-17th centuries, one of the advanced countries of the world in so far as the volume of craft or non agricultural production is concerned. Here was functioning money economy by almost any definition, accompanied by extensive employment in the craft-sector, a large urban population and a considerable volume of manufactured goods produced for long distance and overseas market.[24] In technology too, there were spheres where Indian craftsmen were able to use processes not used in contemporary Europe.

Cloth-printing seemed to be an Indian practice which others were not beginning to follow. Blocks were used on a large scale for direct color-printing. Tavernier says of the Indian calico exported in enormous qualities to all parts of one world, that it was all printed; only in one locality (Masulipatanam) was it still painted for a luxury market.[25] Iron in the seventeenth century not only imported Indian printed calico, it also used the Indian words for printing blocks and the printed calico of its own craftsmen. The cotton fabrics of India were also exported to England. The delicacy of their fabric, the elegance of their design and the brilliancy of their colors rendered them as attractive to the better classes of consumers in England. So much superior were the production of the

Indian spinning wheel and hand-loom to those turned out by the manufacturers of Lancashire in the middle of the last century that not only were Indian calicoes and prints preferred to the home-made articles but the Manchester and Blackburn weavers actually imported Indian yarns in large quantities for employment in their factories.[26] It was only after 1779 when new discoveries were made in England in this direction that the west were able to beat out of their own markets the weavers of the east. It appears that there was a

marginal alternation of Indian loom due to the demand of the European market. There is a reference in English Company records regarding alternation in looms in Woriar Pollam to meet the demands of the Company for a specific variety of longcloth and salempores[27] Similarly three hundred looms were altered at Fort St: David for the weaving of salempores.[28] Many times the number of warp threads was increased or decreased to weave cloth suitable to the export market.[29] In the consultations of 1672 Kasi Viranna, the chief merchant of the English East India Company claimed that the punjams of the looms at Madras had been altered from four to ten for the weaving of long cloth, salemports, moores and percalles.[30] Thus a competent technology went hand to had with low wages in contributing to the popularity of Indian textiles abroad.[31]

Cotton weaving was only introduced into England in the seventeenth century, and in 1721, an act was passed prohibiting, in the interest of Manchester, the importation of printed calicoes from India. It may also be mentioned that in 1784 a ship arrived at Liverpool with eight bags of cotton from the United States, which were seized on the ground that so much cotton could not have been produced there soon after the whole aspect of the cotton trade of the world had changed and India then fell into a position of very secondary importance. Instead of furnishing Europe with cotton goods she now became dependent on England for her own supplies, a remarkable inheritance of the triumph of improved mechanical contrivances and intelligent agriculture over hereditary skill and primitive traditions.[32]

1.4. Boats and Ships

Building of boats and ships had been in practice at a large scale in different ports of India. There were many kinds of native boats serving on different rivers for different purposes. Having known the usefulness of iron-built steam vessels, the European observers and experts in India made a different assessment of native boats and of the techniques and technology employed in their construction. Heber feared that "nothing can be seen more clumsy or dangerous than these boats.[33]

The great bulk of commerce in the Indian seas was carried in ships built in India. The main centres of ship building industry were Surat, Bombay and Daman on the western coast and Hugli, Dacea. Chittagong and Sylhet in Bengal. Surat was famous for the construction of incomparably to the best ships in the world of all sizes and capacity over a thousand tons.[34] The material used in ship building consisted of teak timber and planks imported from Pegu and sisoo timber from Bihar and Oudh. While their ribs, knees and breast-hooks or the frame were composed of sisoo timber, the beams and the inside planks composed of teak.[35] Its carpenter's technique of riveting planks was thought superior to the European practice of simple chaulking and their water-tanks made planks were thought more convenient than European cooper's casks.[36] They also succeeded in learning European ship-wrigh.'s skill. In 1668 it was said of them that, "these carpenters are growne soe expert that masters of their art that there are many Indian vessails that in shape exceed those that came out of England or Holland."[37] For haulage and launching of ships ingenious devices involving the use of capstan, tackle, cradle and bed-rollers were employed.[38]

Thus, we find that although the techniques and technology used by Indian workmen in this branch were primitive, yet they were not inferior in any way to any other contemporary undertaking. Grose admitted in 1750s that "as navigators, Indians are not inferior to the Europeans, though the latter are more vigorous."[39] By 1775 Indian workmen became so expert in the art of ship-building that ship-builders in England started fearing competition from them.[40] Technology, however, has no limitations. It has no end to its perfection and development. India enjoyed superiority in textile technology until the last quarter of the 18th century. But the Industrial Revolution in England not only turned the trade balance in favour of England but also led to the discardation of the indigenous technology of India. Consequently, the same breed of European observers who had spoken high of Indian techniques and technologies began to regard it as "most primitive, rude, clumsy, unscientific and stagnated heritage of the oriental nation.[41] The effects of the improved machinery for the manufacture of the cloth and thread on the industry of Indian weavers were more extensive than one can at first sight perceive. Not only the export cloth trade was abandoned but also of the introduction of European cloth threw a great number of weavers outemployment.[42] But it was not so easy to eliminate the deep-rooted skill. The

Muslim of Dacca, as exhibited at the London Industrial Exhibition of 1851, was claimed to be the "finest instance to be found in the world at the production of difficult effect by means apparently quite inadequate" and considered as "something wonderful.[43]

On one hand, the mechanical devices of Indian worker were crude and on the other hand, Indian craftsman possessed such skill that with its use he could produce articles which were exported to foreign countries. Bernier observes, "Numerous are the instances of handsome pieces of workmanship made by persons destitute of tools sometimes they imitate so perfectly articles of European manufacturers that the difference between the original and copy can hardly be discerned.[44] Fryer speaking of a Surat Coral worker, "wondered (at) the tools he worked with, more than his Art because we see it surpassed in Europe but with far more invention of instruments. Here Hands and Feet being all the Vice and the other Tools unshaped bits of iron.[45] He also refers to the washer-man who avoiding use of soap, saved a small expense but had to work so much harder. "And by this small Taste of their unweariedness in painstaking their cheapner of everything and their faring hard, all their other craftsmen may be valued who work for nothing comparatively with our Europeans, though in many things they exceed them for curiosity, as in staining of Calicuts and fine work either in Gold or silver".[46]

There was availability of skilled labour in India in abundance. Babur said that one "good thing in Hindustan is that it has unnumbered and endless workmen of every kind.[47] The large population of skilled artisans had its natural corollary in low wages; the two phenomena necessarily existed together.[48] The principal reason for the inability of Indians to accept many crucial advances of modern European pre-industrial technology lay in the fact that these demanded investments which the individual artisan could not make. This deficiency could conceivably have been made up in part at least if the ruling class had been interested in technological improvement. So in order to compensate the lack of adequate tools they put in additional labour and application of skill. Craftsmen were divided into

many categories. Palsaert describes the artisans of Agra: "Goldsmiths, (Calico) painters, embroiderers, carpet makers, cotton or silk weavers, blacksmiths, copper-smiths, tailors, masons, builders, stone-cutters, a hundred crafts in all, for a job which one would do in Holl and here passes through four men's hand before it is finished.[49] Abul Fazl also gives ample testimony of such specialization while describing artisans and labourers employed at the court. In building construction alone he lists several categories of workmen, namely, the plasterer, stone-cutter, carpenter (five classes), lattice-maker, sawyer, brick-layer, well-digger, well-cleaner, tile-maker, brick-pounder, glass-cutter, bamboo-cutter, thatcher, bamboo-scaffolding maker, lac varnisher and water carrier.[50] Similarly he describes workmen employed in the mint.

The division into specialized skills was greatly facilitated by the caste system. Babur writes, "There is a fixed caste for every sort of work and for everything, which has done that work or thing from father to son till now".[51] Bernier also points out, "No one (aspires) after any improvement in the condition of life wherein he happens to be born. The embroider brings up his son as an embroiderer, the son of a gold-smith becomes a goldsmith and the physician of the city educates his son for a physician. No one marries but in his own trade and profess-ion; and this custom is observed almost as rigidly". [52] But Morris has rightly argued in his article that the caste has not interposed any effective barrier to mobility of labour in the long run at any rate.[53] In Mughal period, we do not find any such complaint in the voluminous commercial literature of the European Companies that there was scarcity of workers because of caste restrictions.

It was not, therefore, any scarcity of skilled labour brought on by the caste system but, very opposite, its abundance that constantly inhibited attention to labour and skill saving devices. This inhibition would have been present whether the artisan was himself a commodity producers or he was subjected in varying degrees to the merchant, so long as he worked with his own tools in his hut. Domestic conditions were practically universal. The weaver used to buy his own materials, worked at home and then he took his cloth to market for the merchant to buy. This was probably the most general practice. Sometimes the merchant, in order to ensure regular supply, gave money in advance.[54] But this too had no effect on how the artisan worked, though if the merchant gave orders for unaccustomed specifications the weavers might have had to alter their looms, and ask for money to meet the cost.[55] If t he material to be worked was very expensive, or dose supervision was needed to ensure manufacture to specification, the artisan could be called up from his home and made to work in the karkhana of the employer.[56] Hughes established in 1620, "Cor Conna", the English factory at Patna. lie employed a hundred workmen and expected to keep two to three hundred silk winders employed all the year round. Subsequently the Dutch and the English followed it in their "silk factories" in Bengal.[57] Of these karkhanas, Bernier writes, "Large halls are seen in many palaces, called karkhanas or workshops for the artisans.

In one hall embroiderers are busily employed, superintended by a master. In another you see the goldsmiths; in a third, painters; in a fourth, varniters in lacquer work; in a fifth, joiners, turners, tailors and shoe-makers; in a sixth, manufacturers of silk, brocade and those fine muslins of which are made turbans, girdles with golden flowers and drawers worn by females so delicately fine as frequently to wear out in one night."[58]

Abul Faz1 offers detailed descriptions of the different establishments at Akbar's Court. But one is forcibly struck by the fact that while he gives minute details of wages, prices of materials and so on, he never quotes prices of the craftsmen tools. In Akbar's karkhanas the artisans were expected to bring their own tools when they came to work and tools were, therefore, something to which the King and his officials, concerned only with the quality of the end product, were largely indifferent.

It can be argued that the availability of cheap skilled labour prevented the emergence of capitalistic organization even though large number of skilled labourers was employed by a single man in his productive undertakings. The responsibility of the employer to provide tools to his artisans was unheard of, and thus we find that there could be no investment of upper class in potential machines. Affluent groups of society-were not directly involved in the production. The artisans had to invest money and bring out production on his own. Indian workmen living on the brink of subsistence had hardly any means to bring out technological innovations.[59]

The stability of the Mughal Empire was highly instrumental to emergence and development of towns, and so, flourishing of urban craft and craft technology. The exploitation of agrarian manpower-both skilled and unskilled-by the Mughal Kings, on which craft production depended, restricted technological development. The agrarian labour force was largely exploited for spread of urban craft industries, and the latter exclusively depended on the development of towns and the magnitude of urbanization. It was the stability of the Mughal "treasury" that determined the sustained economic condition of the king-men and the country. The urban craft flourished under this stability during the Mughal rule in India, but not for long. The agrarian crisis that emerged during the later half of the 17th century aggravated the problem of agrarian exploitation, and so deteriorated the stable economic condition of the Mughal government with the consequence that the scale on which urban craft had so far been pursued in the empire could no longer be sustained. The inevitable succeeding condition of backwardness in craft technology coupled with urban decline was further compounded by a possible fall in the volume of craft production in the country.

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