

## TECHNOLOGY AND PROCESS OF SOME OF THE PRINCIPAL INDUSTRIES OF EIGHTEENTH CENTURY HINDUSTAN

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### IRON

Iron deposits occurred in various parts of the Empire such as Suket Mandi<sup>1</sup> (in the subah of Lahore), Narnol,<sup>2</sup> Kalinjir,<sup>3</sup> Gwalior,<sup>4</sup> Kumaon,<sup>5</sup> Beenmahl and other districts of the Ajmer suba,<sup>6</sup> Surat,<sup>7</sup> Berar<sup>8</sup> and Bengal.<sup>9</sup> Each of these mines possessed a varying degree of iron content, for instance while the Narnol mine yielded only about 15 to 25 per cent of metal,<sup>10</sup> the returns from the Suket mandi mines was much higher and of superior quality.<sup>11</sup> Iron metal was used in manufacturing hundred and one objects,<sup>12</sup> beginning from heavy, sharp military equipment<sup>13</sup> down to tiny sewing needles,<sup>14</sup> fine nails<sup>15</sup> and medicinal iron filings.<sup>16</sup> Conversion of the natural ore into required objects for use passed through two main processes of purifying which are, processing it into iron and then shaping the iron into the desired form. The primary process of cleaning the ore was more elaborate, tough and time consuming while the subsequent process was relatively easier. Though the industry was erratically distributed over a vast geographical area, the technique employed in them at any given point of time was almost uniform.<sup>17</sup>

.The original blocks of ore extracted from the mine were mixed with earth which could be separated only by subjecting them to intense heating. A furnace was therefore built by sinking a hollow in the ground and in a manner as to leave two openings, one above to admit fresh block of ore, the other at the bottom in order to allow the separated dross to run out. Also a wall was erected at the back of the furnace so as to enable the bellowmen to lean-on for support during their long arduous task. Two giant sized bellows were employed to be worked by as many as twenty men round the clock in two shifts of ten men each. The bellow work kept stirring the furnace fire into big flames and as line coals were placed both above and below them in the furnace the flames covered the entire lot of ore block. Thus treated, the imperfectly cleaned but melted iron ore, on being cooled, congealed into massive cakes while still standing in the pit of the cooled furnace. Large and heavy pincers were used to drag out lumps of metal, which in the process of operation were carefully separated from the residuary scoria. It was then carried to another furnace to be refined. When heated to a flaming red hot colour it was beaten hard with heavy hammer into small pieces.

By repeating over and over again the process, the melted iron was forged into bars of about one yard in length and three to four inches thick with both the ends tapering off. While forging the metal into shape one man held the heavy anvil in place and another beat it with sledge hammer into shape.<sup>18</sup>

While the smelting process was presumably performed near the natural deposits, the semi or, at times fully refined metal could be carried to farther off places, for instance to towns, to be forged into required moulds. Sold by weight,<sup>19</sup> it was certainly always advisable to keep the ironware free of rust, which could be removed by rubbing it with lemon.<sup>20</sup> Sword blades or knives could be sharpened by an admixture of sambar salt, glazing varnish and *shakh-i-gosfand* (?) and some other additives.<sup>21</sup>

Iron could be converted in steel by some more heating and beating process in which some copper was added. Indian steel was highly esteemed and it was used primarily for making weapons.<sup>22</sup>

#### COTTON TEXTILES

Though cotton fabrics were produced universally in the empire, a substantial proportion of its aggregate output was centred in the towns.<sup>23</sup> Because the towns provided all the essential requirements of the industry such as the workmen attracted from the adjacent areas, raw cotton or yarn from its markets, complementary services such as bleaching, dyeing, printing, painting or finishing touches but above all the core of consumers of the final product. Thus the prosperity of the industry came to be linked directly with the prosperity of the towns.

But as the 18th century was ushered in, the darkening clouds over the political horizon of the empire, specially over its western and southern zones, could not admit of a particularly happy and singularly bright prospects for a surviving skilled artisan of the industry from the 17th century boom.<sup>23</sup> Each succeeding decade witnessed the steady fragmentation of the Empire, weakening of the Central authority and deterioration to the point of complete breakdown in the law and order situation. The unchecked or imperfectly checked predatory forces, such as that of the Sikhs, Jats, Marhattas and sundry others, swelling their numbers further emboldened them in destructive activities. Pre-eminent towns and moving caravans were their primary targets of plunder. Consequently, while there was an exodus of skill, as from Ahmadabad since 1712,<sup>24</sup> the general inhabitants too continuously flowed out of the towns,<sup>25</sup> specially from the premier ones, greatly shrinking their market potential. The insecurity of land routes, hitherto fit even for wheeled carriages over long distances, a factor of great commercial advantage to the area dislocated the traditional trade pattern, rendering the sea outlets inaccessible to the upcountry producers. The Kabul route on the extreme north-west frontier was blocked because of the Sikh insurgents. These factors further aggravated the situation lowering the demand position. The

uprooted urban population, both skilled and non-skilled, converged on small towns and villages of particularly relatively quiet areas, east of river Ganges.

In the circumstances, the 18th century artisan even of cotton fabrics, the principal industry of the era, uprooted from his centuries-old urban habitat and thrown in the midst of rural or semi-rural environment, could adjust himself only by discarding some of the frilly dimensions and confining his techniques adequate for the production of non-sophisticated current local demands.

Unfortunately, however, no indigenous documentary source has as yet been uncovered describing the weaving and spinning processes as obtained in the various parts of the country. Though possibly uniform in broad framework, techniques of these processes could have differed in details depending upon climatic and other local exigencies.<sup>26</sup>

Of the two cotton yielding organic sources, *sembhal*—the perennial full sized tree, and *kāpās*, the herbacious annual plant, it was the latter, *kāpās*, which was eminently suitable for fabricating cloth. The *sembhal* cotton lacked the attribute of being twisted and the capacity to yield endlessly long yarn while the *kāpās* cotton qualified on both the counts. Thus, while the *sembhal* cotton was set aside for wadding and quilting purposes, the *kāpās* cotton was used for cloth weaving.<sup>27</sup>

After collecting the *kāpās* cotton from the fields it was cleaned of foreign bodies in the heap. For the next process of ginning a wooden bow shaped apparatus was used (as is done even now) to make the cotton absolutely free of dirt. Putting the apparatus in contact with cotton and striking it with a longish wooden mallet with tapering ends the cotton was cleaned. The knots of the cotton were thus loosened and opened up converting it into downy fleece. For spinning the yarn either *carkhā* for coarser yarn was used or spindle, *takli*, was made to produce finer or superfine yarn. Both these mediums are still used much the same way in parts of the country.

Similarly, weaving process current in the undeveloped parts of the country does not seem to have undergone any substantial change in the course of intervening centuries. However, a brief description of weaving as obtained at Lucknow, late in the 18th century may be set out here. The weavers bought their yarn from the bazars, set a couple of labourers to first undo, then wind the yarn on a wooden bobbin-nar, which happens to be hollow inside. After moistening the yarn it was inserted in the shuttle, which on operation was to constitute the woof of the fabric. The warp was laid out on a faric length frame to which *narkul* stalks were stuck upright from the ground at certain intervals along with two *nāris* which were fixed by wedges on the ends of long reeds. A person walking along round the uprights dropped by a skilful movement of his hands, the two threads, one from each *nāri*, so as to lap on the alternate uprights. When the warp was thus stretched out, it was dressed with a paste of flour and dried. It was then taken to a loom and each alternate thread was

drawn through a hole in one *rachch* and the other thread was drawn through the interstices of the *hatta* or batten. The ends were finally fastened to the beam. The other end of the warp was attached to a hook or a peg or any other contrivance swung from or fastened to the ceiling. There was but one beam in the loom. The place of the second was taken up by the three reeds which were so disposed as to prevent the threads from becoming entangled behind the *rachch*. To the *rachch* were attached treddles and by their movement the shed was produced through which the shuttle flew.<sup>28</sup> The material was now ready for further treatment.

Thus the crude wooden apparatus, with some touches of iron pieces here and there, unattended by any elaborate or sophisticated equipment was capable of yielding satisfactory results. The equally simple mode of operation, which, with some practice could lend skill to the craft, enhanced its value. Therefore in the 19th century when money was dear but time, labour and raw cotton plentiful, the weaving industry managed to survive the crisis span.

#### PAPER

Introduced at Delhi as late as the 13th century,<sup>29</sup> paper manufacture was the youngest industry in the medieval context of the subcontinent. Primarily an urban industry, over the centuries it had got well diffused in the Empire; indeed by about the 17th century most of the towns are attested to have had a *kaghazi* ward.<sup>30</sup> Sialkot,<sup>31</sup> Agra,<sup>32</sup> Delhi,<sup>33</sup> Shahzadpur,<sup>34</sup> Kalpi,<sup>35</sup> and Lahore,<sup>36</sup> were some of the noted centres of the craft. Daulatabad<sup>37</sup> and Ahmadabad<sup>38</sup> had however, achieved much wider repute for the excellence of their paper products with regard to their durability, gloss and smoothness, so that they also commanded overseas market. Bark,<sup>39</sup> hemp,<sup>40</sup> rag<sup>41</sup> and by about the 18th century, waste paper<sup>42</sup> were being used as the raw material for producing varieties of paper known as *hariri*,<sup>43</sup> *shami*,<sup>44</sup> *mansinghi*,<sup>45</sup> art and ornamental paper,<sup>46</sup> *zard*,<sup>47</sup> *wasli*,<sup>48</sup> *arwali*,<sup>49</sup> and *billori*.<sup>50</sup>

The method and technique employed in this industry was equally uncomplicated though tedious and elaborate, entailing long hours of human attention and attendance. Paper-making however, specially required absolutely clean water free from all impurities such as iron. Even if for other purposes ordinary water was used, the pulp had to be washed in pure water in order to make it perfectly white.

Hemp paper, called *arwali* at Lucknow in the 19th century, passed through four main stages in its manufacture, soaking, pounding, washing and drying. Four maunds of hemp was steeped in a *hauz* filled with 20 seers of *sajji* and 15 seers of lime. The mass was then pounded with *dhelki*, a wooden mallet, then washed clean. The process was repeated 30 times within a span of four months. The paper maker then lifted up the paste on a *chiq* spread on a large frame, pressed the pulp with hand, drained it and then dried it. This paper was reckoned suitable for manuscripts and being in great demand was turned out in a large quantity.<sup>51</sup>

For the bark paper, the bark was soaked in water, laid out on a smooth stone slab, beaten well with a mallet 15 inches long,  $2\frac{1}{2}$  to 3 inches broad. One of the four sides of the mallet was groomed very coarse, other less coarse, third exceedingly fine and the fourth side was done in a graph pattern. The beating was done with each side in succession, the resinuous matter contained in it was found to be more adhesive. The beating separated the fibres of the bark, which when properly beaten looked like a web of fine linen. Placing together all the bark pieces one upon the other, it was beaten again. The material thus formed was exposed to the sun, which lent it a milk white colour. A hard object like shell was used to rub the paper surface into smoothness.<sup>52</sup>

Paper made from waste paper was called *wasli*, again at Lucknow in the 19th century. Fifteen seers of waste paper was placed in a large vat (filled with water ?) and trampled with the feet until reduced to pulp. It was then washed in the river water and subsequently thrown into a large hauz filled with sixty pitchers (size) of water. It was allowed to remain there for twenty days after which period it was transformed into a pasty state. Lifting up the paste on a *chiq* spread out on a large frame, it was pressed with hand, drained and dried. The yield weighed ten seers of mill boards measuring three by two feet.<sup>53</sup> *Wasli* paper was generally used as boards for book binding.<sup>54</sup>

The finishing touches consisted of thickening, starching, and affixing seal to the paper. A superior variety of white rice was chosen for starching. The rice was rubbed twice with edible salt then washed clean. After soaking it in water for 72 hours it was meshed with fingers and water was rinsed out. Some clean water was then added to the rice and then placed on the fire to boil. It was continuously stirred until it assumed thick consistency. The paper sheet spread out on a clean wooden block was evenly coated with the cooled starch by means of a clean white piece of cotton rag. The paper sheet was then covered with *kirpas* and placed under sun. The process was repeated on the reverse side as well. Seals imprinted while the paper was still moist made well defined impressions.<sup>55</sup> The paper when dry was ready for the market. But if the paper maker wishes to produce coloured paper, he could do it before having set it for starching.<sup>56</sup> The colouring agents were here too much the same<sup>57</sup> as for dyeing cotton fabrics.<sup>58</sup> Coloured paper was in demand mostly for entertainment purposes.<sup>59</sup> The colouring process, ought to come along with the starching process. For example, if saffron coloured paper was desired, then starch, water and saffron in the ratio of 2 *dams*, 22 *dams* and 4 *masha*, was to be mixed together, put on slow fire so that saffron leaves were perfectly dissolved, cooled and then evenly sprinkled over the entire sheet, along with the starch.

### CONCLUSION

The foregoing survey of the techniques, followed in producing iron ware, cotton fabrics, and paper in the pre-modern era of India, does not focus any scientific attitude to the issues involved. The study however demonstrates a consistent use of extremely

unpretentious equipment obviating the need for any considerable outlay to set up one's own manufactory. This factor would, in turn, in part at least, account for (i) the ubiquity of the crafts and low production cost which enabled it to command a ready market even in the lean decades of the 18th century, (ii) when the independent producer worked away from large towns he felt no urgent pressure for a complex organisational bond, so that he was far more vulnerable to all kinds of political and economic hazards than his urban counterpart who, through his association with the local professional organization was somewhat protected. (iii) Craftsmen were encouraged to quick occupational mobility. More particularly in cases of part time manufacturers, such as cultivators, dairy farmers or horse breeders, who would encounter no difficulty in shifting from one craft to other, for instance, from potter's work to weaving craft; as no long term training period was required to learn those unsophisticated hand and foot work. Possibly too frequent occurrence of change in craft with the resultant imbalance in the obtaining social order, was the impulse that had led the Hindu legists of the ancient past imposed restrictions on any attempt at moving away from the craft to which one was born. (iv) Practice makes a man perfect. Thus over a period of time, the high magnitude, list of diverse varieties, and excellence achieved in production by the pre modern India became phenomenal.

Finally, the study manifests a keen sense of quick adaptability of the Indian artisan as they adopted the production of the imported industries, such as firearms or that of paper.

#### REFERENCES

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- <sup>4</sup> A.A. II, 192.
- <sup>5</sup> A.A. 285.
- <sup>6</sup> Manucci, 432, Todd, 477.
- <sup>7</sup> Supplement, 250; A.A. II, 123.
- <sup>8</sup> A.A. II, 110.
- <sup>9</sup> A.A. II, 151.
- <sup>10</sup> *Gleanings*, op., cit. 328.
- <sup>11</sup> *Ibratnamah*, 1, 45.
- <sup>12</sup> Naqvi, *Urban Centres*, p. 130.
- <sup>13</sup> Op. cit., 231.
- <sup>14</sup> *Siraj*, 81.
- <sup>15</sup> *Ibratnamah*, 1, 46.
- <sup>16</sup> *Rehyclah*, 166, *Bayaz*, 136a.
- <sup>17</sup> Captain Campbell, *Report on the manufacture or bar iron in South India*, 3rd Aug. 1842.
- <sup>18</sup> *Gleanings*, op. cit., pp. 327-28
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- <sup>20</sup> *Bayaz*, 136a.
- <sup>21</sup> *Ibid*.
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- <sup>24</sup> Chaudhuri, K. N., *The trading World of Asia & the English East India Company*, Delhi, 1978.
- <sup>25</sup> Naqvi, *op. cit.*, 48-49.
- <sup>26</sup> *op. cit.* 153.
- <sup>27</sup> —, 146.
- <sup>28</sup> Hoey, *Trade*, 123.
- <sup>29</sup> Amir Khusru, *Qiran-us sa'dain*, 173; also Barni, 64.
- <sup>30</sup> Such as at Farrukhabad, Irvine, *The Bangash Nawabs*, 280.
- <sup>31</sup> *Khulasa*, 95; *Bayaz*, 151a; *Ibratnamah*, I, 19.
- <sup>32</sup> *A.A.* I, 102-15.
- <sup>33</sup> See map of Shahjahanabad by Faiz Ali, *Red Fort museum*, Delhi.
- <sup>34</sup> Mundy, II, 98. It is situated near Allahabad.
- <sup>35</sup> *Ma'asir-ul-kirām*, I, 85.
- <sup>35a</sup> *A.A.* 11. 164; *Ajaib*, 185b.
- <sup>36</sup> *A.A.* I, 102-15.
- <sup>37</sup> *Badshahnahma*, I, 501; Khafi Khan.
- <sup>38</sup> *Mir'at-i-Ahmadi*, I, 15.
- <sup>39</sup> Herring, 22-23; Mahuan, *J.R.A.S.*, 1893, p. 532.
- <sup>40</sup> Hoey, *Trade*, 128.
- <sup>41</sup> Khuda Bakhsh, *Renaissance of Islam*, Patna, 1937, p. 468.
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- <sup>43</sup> *Bayaz*, E. K., IV, 79, 174, vol. V, p. 142. 168.
- <sup>44</sup> *Qiran-us-Sa'dain*, 173.
- <sup>45</sup> *Khudasat*, 95.
- <sup>46</sup> *Mirat-i-Ahmadi*, I, 15.
- <sup>47</sup> Hoey, 128.
- <sup>48</sup> *Ibid.* 127.
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- <sup>50</sup> *E.K.* IV, 80.
- <sup>51</sup> Hoey, *Trade*, 128.
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- <sup>53</sup> Hoey, *Trade*, 127-28.
- <sup>54</sup> *Op. cit.*, 127.
- <sup>55</sup> *Bayaz*, 120a-b.
- <sup>56</sup> *Op. cit.*, 121a.
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