SCIENTIFIC AND TECHNOLOGICAL BASE TO THE NON-AGRARIAN ACTIVITY IN BRITISH GUJARAT

R. D. Choksey, a prolific writer on the economy of Gujarat has observed for the colonial period that the Gujarat's economy got adversely affected during the 19th century. He opines:[1]

> The old village industries were dying. The best example is spinning and weaving which perished before the machine made goods, cartage disappeared with bus transport, rice husking and flour mills deprive the women of their occupation. Copper and brass utensils crippled the potter's art. In these and many other ways the change in taste, habit and fashions ruined the village economy. Spinning and weaving in some form remained and was not lucrative...

This observation of Choksey indicates that the sub-regions, i.e., British Gujarat under study had enjoyed economic prosperity in past, i.e., the medieval Gujarat which underwent change (**my emphasis**). For him, the change is adverse because the "village economy" was affected. However, to me this change is multi-dimensional and progressive; away from the concept of self-sufficiency and indicates the inter-dependency in context to rural-urban continuum. This observation also indicates the revamption of urban economy when attempts for raising agrarian surplus is noted; mud pottery is replaced by copper and brass utensils; emergence of diverse culture and fashion pattern contributed to the significant change in the textiles manufacture.

In the section three of Chapter Two on Pre-Colonial Non-Agrarian Environment, we have discussed about cotton manufacture, varieties of dyes used in cotton and silk fabric and ready goods; paper making; wood work; work on leather; iron products; navigational skills; &c. This chapter documents the transformation in the mode of production and attempts to understand the scientific basis behind the change and the adoption of new techniques.

[1] R. D. Choksey (1968), *Economic Life in the Bombay Gujarat, 1800-1939*, 224.

Cotton Textile Manufacture

Cotton had been documented as prominent cash crop of the region since the Harappan times.[2] Black soil tract in Gujarat was best suited for its cultivation (**see Map III**).[3] Cotton products from Gujarat remained in frequency along the Indian Ocean Rim. During the ancient and medieval times, the *Gujarati* cotton traders from the Central Asia, Far East, Africa and South East Asia visited frequently for their requirements of ready textile goods produced by the traditional handicrafts industries employing simple techniques.[4] These handmade textiles were highly praised and became popular in Europe during the pre-colonial period. But the monopoly which *Gujarati* artisans enjoyed in the manufacture of textiles was severely damaged with the birth of machine made cloth in Europe during the Industrial Revolution.[5]

After the establishment of the British rule in Gujarat (post 1818); drastic changes are observed in consumption pattern of raw cotton and its demand in the European markets.[6] The British preferred to trade raw cotton instead of ready goods.[7] We find references related to export of Indian cotton to different destinations in Europe; and in England in particular.[8] It is mandatory to provide an overview of raw cotton variety, trade pattern and its requirement abroad.

The Indian variety of cotton consisted of short staples. These staples helped in the development of traditional industry which remained potential sector of Indian craftsmanship. After the Industrial Revolution in England, the textile industry also

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[2] Ruth Barnes (1997), *Indian Block-Printed Textiles in Egypt: The Newberry Collection in the Ashmolean Museum*, Oxford, 181.
[3] Surendra Gopal (1975), *Commerce and Crafts of the Gujarat in the Sixteenth and Seventeenth Century*, 192-93.
[4] *Ibid*., 54, 61, 68 and 70
[5] Pedro Machado (2012), "Awash in a Sea of Cloth: Gujarat, Africa and the Western Indian Ocean, 1300-1800", in Giorgio Riello and Prasannan Parthasarathi (eds), *The Spinning World: A Global History of Cotton Textiles, 1200-1850,* New Delhi: Primus Books, 161-67.
[6] Prasannan Parthasarathi and Ian Wendt (2012), "Indian Cotton Manufacturing from the Late 18th Century", in *ibid*., 398-99.
[7] Surendra Gopal (1975), *Commerce and Crafts of the Gujarat in the Sixteenth and Seventeenth Century*, 220.
[8] Beverly Lemire (2012), "Revising the Historical Narrative: India, Europe and the Cotton Trade, *c*. 1300-1800", in Giorgio Riello and Prasannan Parthasarathi (eds), *The Spinning World: A Global History of Cotton Textiles*, *1200-1850*, 223

bloomed. It is noteworthy that the British textile industries worked with long staple cotton.[9] America produced long staple cotton which evolved as the first choice of the England's textile mills.[10] Indian variety was at disadvantage to that of the American one. Indian cotton had its limitation due to the cleaning and packing method.[11] Dust and unwanted materials used to get mixed during the cleaning process. Natives were responsible as sometimes they deliberately adultered the cotton for profit making.[12] Merchants and middlemen also could not escape with their responsibility as they were equal participant in adultering. Besides this, there were other reasons of comparative edge for the American variety. The average waste during manufacture in Surat cotton was 25% whilst from American staple, it was 12½%.[13] From every 100 lbs. of Surat cotton spinners produced 75 lbs. of yarn and American cotton turnout was 87½ lbs. of yarn.[14] English spinners preferred the American New Orleans because the spinners obtained from Surat cotton only 12 oz. (0.75 lb.) of yarn whilst from the American; they obtained 13½ oz. (0.825 lb.) of yarn.[15] Despite all these disadvantages to the American staples, the Indian variety remained in demand because it was more economic than that of the American counterpart.[16]

Indian cotton was considered impure and dirty. This limitation was identified by the British.[17] In the process, government introduced 'Packing Screws' and 'cotton-cleaning' machines in India. But screw presses were time consuming device. Gradually, improvement over this machine was done and 'Geometrical Cotton Screw' was brought in use. It was the outcome of **restructuring** (**my emphasis**). This improved version gained more time for weaving and other textile production related efforts. Robert Burn at Broach invented one such machine.[18] Mr. I. H. Mathar

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[9] R. D. Choksey (1968), *Economic Life in the Bombay Gujarat, 1800-1939*, 130.
[10] *Ibid*.
[11] *Ibid*.
[12] *Ibid*.
[13] W. R. Cassels (1862), *Cotton*: *An Account of Its Culture in Bombay Presidency*, 34.
[14] *Ibid*.
[15] R. D. Choksey (1968), *Economic Life in the Bombay Gujarat, 1800-1939*, 131.
[16] *Ibid*.
[17] Satpal Sangwan (1991), *Science, Technology and Colonisation: An Indian Experience, 1757-1857*, 101.
[18] *Ibid.*, 102.

was awarded for his invention of improved Indian *charkha* which could suit the Indian cotton staple.[19]

British Attempts to Domesticate Cotton: Gin Machine and Its Limitations

The first step in textile manufacture of cotton was collection of raw cotton from the fields and separation of seeds. It was separated from its seeds with the use of an instrument called *charkha* which consisted of two roller and these moved in opposite direction; these were joined with a handle on a stand. Small gap between the rollers allowed only passing of cotton on the other sides; and seeds were gathered in front which was used for oil making, fodder for animals and manure for agriculture.

During the British regime, an attempt was made to remove seeds from the raw cotton using rollers which were made of iron.[20] But this was not brought to use by large section of weavers community.[21] However, wooden *charkha* remained convenient and is reportedly remained in use in the villages of Gujarat.

Sabyasachi Bhattacharya provides us the details of the process of cleaning of cotton: "In the Bombay Presidency, the native cleaned cotton with simple tools like iron roller (*kuda*), flat stone (*amkul*), two wooden soles (*pavuntigis*), three legged stool (*tevuntigi*), &c. Cotton was placed on a flat stone and wooden soles which were attached to the feet of the women sitting on the stool. With her feet the women rolled the iron roller backward and forward until the seed was separated from the cotton fibre. This cotton fibre came out in a continuous web. In the process, she took out all the extraneous matters".[22] This process of cleaning of cotton remained slow and involved much labour. However, the benefit was that the fibre remained completely intact.

[19] *Ibid*.
[20] Sabyasachi Bhattacharya (1970), "Cultural and Social Constrains on Technological Innovation and Development: Some Case Studies", in Surjit Sinha (ed.), *Science, Technology and Culture*: *A Study of the Cultural Traditions and Institutions of India and Ceylon in Relation to Science and Technology*, Delhi: IIC, 50-51.
[21] *Ibid.*
[22] *Ibid.*, 51-52.

Understanding the issue related to the cleaning and packing of the Indian variety, the British introduced 'Saw Gin' machines.[23] Gujarat was no exception. The sole motive of the British was not only to clean the cotton seeds but also speed up the packing; and to check adulteration. The new instrument saw gin introduced combated with number of problems. First one was to replace native *charkha* which was almost impossible and posed a great challenge to saw gin. If one examines the saw gin technology, "wheels were adjusted very close to the grating to separate the seed. During the process, the staple of the cotton was spoiled. Farmers also would lose 2% in weight if saw gin machine was used."[24] Other issue related to it was the transportation of the heavy cotton with seed from the farm to the ginning site. The transfer was expensive and required more labour. Another disadvantage was that if the cotton was cleaned in factory, fodder was not available for farmer's cattle and seed for oil extraction. The cost of machine was dearer and could not be afforded by the natives. It is noteworthy that the broker was also not interested in buying the cotton cleaned from the machine because cotton was less in weight in comparison to the methods used traditionally.[25] There were high chances that he could mix the adulterant to cotton in order to increase its weight. Besides this, there was shortage of skilled workers who could service the gins. The village artisans did not even know the use of screws and bolts and if they attempted to repair it, there were chances of gin getting ruined.[26]

As per the *Annual Report of the Bombay Presidency*, in due course of time seen for the period 1880s to 1905 and 1910, the gin instruments were adopted at least by the mills in the urban areas. The rural pockets continued with their confidence in native instruments. Cotton from Broach and Surat Farms was ginned at Bamanshah Gin, Surat; Messers Narandas Rajaram & Co. Gin, Sania; Messers Whittle & Co. Gin, Bardoli; Messers Tata & Sons Gin, Navsari; and Messers Dayabhai Ukabhai & Cos Gin, Sisodra.[27]

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[23] *Ibid.*, 50.
[24] *Ibid*., 53.
[25] *Ibid*., 54-55.
[26] *Ibid*., 55.
[27] *Annual Report of Department of Agriculture of the Bombay Presidency* (1922-23), 80-81.

Process to Manufacture Cloth

Manufacturing fabric from cotton is tedious and time consuming exercise. The process required twenty separate stages to transform raw cotton into finished cloth.[28] Yarn was produced mainly by women, using a 'hand-cranked' cotton-gin, a 'carding comb' made from fishbone, a 'bamboo teasing bow' with a silk or catgut string and a 'spindle wheel'. Dressing and making of the cloth was mostly done by the men. It required constant working and it was reported that men worked for hours together. Further, weaved cloth entered into several labour-intensive processes like washing, bleaching, repairing, beetling, dyeing, painting and embroidering.[29] Though the processes for making finished cloth through traditional methods were time consuming, it added greatly to the export value of the cloth.

The establishment of the British rule and introduction of cheap machine made cotton goods did not completely ruined the traditional textile industry of Gujarat.[30] To survive against the challenge posed by the machine made cloths, weavers tried to shift their focus on coarse cloth production which was not manufactured in mills.[31] They also shifted their attention for the manufacture of those products like *dhoti*, *saris*, etc. These cloths were not sought in the international markets, and therefore, did not find attention of the British textiles manufacturers.[32]

Handloom

Handloom industry was the strength of India. The industry was known for variety of fabrics manufactured all over the world. Following is the description of weaving loom available in R. E. Enthoven (1895), *The Cotton Fabrics of the Bombay Presidency*:[33]

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[28] David Arnold (1999), *The New Cambridge History of India: Science, Technology and Medicine in Colonial India*, Vol. III, Part V, Cambridge: CUP, 95.
[29] *Ibid*.
[30] *Ibid.*, 96.
[31] *Ibid*.
[32] *Ibid.*
[33] R. E. Enthoven (1895), *The Cotton Fabrics of the Bombay Presidency*, Bombay, 25-29. The climate in which weavers worked was portrait as the ignorance of the Indian craftsmen. But this is not true. The dark and ill-ventilated houses in fact show the skills of the weaver. It was done to maintain moisture by keeping sunlight away from the room. The mills on the other hand, faced number of problems. When textile mills were opened in Bombay with ventilation facilities, the workers felt uncomfortable. Further, the sun rays made the thread stiff which often led to breakage and disruption

The Bombay weaver loom is from eight to fifteen feet long by forty two inches broad. The weaver sits at one end with his feet in a pit about two and a half feet square. Immediately in front of him is a round beam which supports the warp around which the fabric is rolled as it is woven. About a foot and a half in front of the beam is the reed or *phani* hug from the roof. Between the thin slips of the bamboo of the *phani* the warp thread are passed. This road is set in a frame and forms the shuttle-beam, which, after the shuttle has passed, the weaver pulls back against the cloth beam to force home the threads of the weft. In the pit are the treadles or foot-boards. These are the case of plain cotton-*sari* weaving do not exceed two in number. In the case of silk-boarded *saris* they are four. The weaver generally keeps his left feet for the foremost treadle and works the other by his right, raising and lowering the threads of the warp. The treadles are joined with the heddles by strings. The frames of the heddle are placed close behind the reed. The treadles generally correspond with the heddles in number. Over a loom with four heddles two chords, a foot or two long, hang from the roof. To the end of each cord is fastened one end of a cane or slender rod about two feet which hangs vertically. To the lower end of the rods tied the second cord about six inches long. The lower end of this cord is tied round the middle of a slip of bamboo about six inches long. From each end of bamboo which lies at right angles with the cord hangs another cord about four inches long. This cord holds by the middle a smaller slip of bamboo about the length of a medium sized agar. From each end of these small pieces of bamboo a cord passed a foot in length, each of the four cords being fastened to the heddle frame about four inches inside of the edge of the warp. These cords move up and down with the motion given by the treadles. The heddle frame is filled with couples of loops of twine, interlaced, one fastened to the tap and the other to the bottom of the heddle frame. Through the heddles all the threads of the warp pass, some through the upper and some through the lower loops. Some pass through a loop in the first heddle, while others pass between the loops of the first heddles and through loops in the other heddles also. The working of the treadle moves the heddle and the heddle moves the threads of the warp which it governs, while between each movement of the warp threads the shuttle loaded with weft yarn is passed across the warp. Behind the heddles horizontal roads are thrust between the upper and the lower threads of the warp to keep them for entangling, and ten or twelve feet further is the warping rod, round which the warp is wound. This rod, which is about four feet by a rope passes round a pest and brought back along the side of the loom, being finally fastened to a peg close to the weaver's right. The weaver from time to time looms the rope as the woven fabric is wound the cloth beam.

The shuttle is about eight inch long and is made of buffalo horn. The bobbin holding the thread is fixed on one long pivot; in weaving the shuttle is thrown by the hand through the shed of the warp alternating from one side to another. After it has passed one way the reed is brought up against the thread with a jerk, thus farming the woof.

The cotton yarn first moisture by dipping it in water is then thrown round the large reel. To reduce the size of the skein, it is wound from the large reel on to a middle size one. In re-winding the skein the winder holds in his toes the end of the central road of the larger reel and with this right hand draws off the yarn from the skein to wind it on a smaller reel which he holds in his left hand whirling it in a smooth coconut cup. To reduce the skein to a convenient size the yarn is wound off the middle sized reel on to a small conical spindle. It is then taken to the wheelman, by whom it is wound round the bobbins. Next to prepare the warp women and children pass the yarn two threads at a time in and out

in the weaving process. See Daniel Houston Buchanan (1966), *The Development of Capitalist Enterprise in India*, London, 203-04.

> among rows of bamboo rods about four feet apart. It is then spread on two bamboos stretched tight between two posts and sized with rice paste.
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> The warping machine consists of a pair of beams supported on a trestle of crossed sticks resting on the ground and made fast by a rope to a peg fixed in the ground. This arrangement is known as '*panjani*' and is a familiar sight in every town and village where weaving is carried on. It is rigged up in the streets outside the weaver's houses, sometimes in the gutters, or in an adjacent river bed. The length of thread between the beams is from thirty to fifty yards. The warping is usually done by the women and children of the weaver's family, who are to be seen working away in the streets morning and evening, while the weaver and his loom are hidden away in the interior of the dark and ill-ventilated houses.

This description of Enthoven reveals that the weaving loom was the byproduct of knowledge system of generations which was scientific and technologically sound. It also elaborates on the usage of combination of materials either made by wood, metal, or natural resources like buffalo horn and hemp ropes. These were shaped like circle, cylinder and quadrilateral figures. With the coming of the European technology, this device survived and offered competition to the machine made comparatively less costly goods made on powerlooms. R. D. Choksey estimated that more than 25% of finished cottons were handloom made.[34] Weavers were still in a position to supply the cloth in the interior regions of Gujarat. There were number of factors which could be enumerated for the less demand of traditionally made products in comparison to the mills produce.[35] The most prominent problem with handloom weavers was that they did not receive any cheap financial opportunity, market linkages to sell their products and lack of infrastructure for mass manufacturing facilities of their textile goods.[36] The other limitations were "limited output of finished products", after the end of the weaving process which gave little profit. With meagre income, the weaver was not at all in a position to think about the introduction of new machinery. There was some possibility that if this industry was well organised and supported by the government, handloom could be an important subsistence to agriculture.[37] In one such attempt, Mr. White, Collector of Broach organised Broach Exhibition (1868) and some good specimen of

[34] R. D. Choksey (1968), *Economic Life in the Bombay Gujarat, 1800-1939*, 226.
[35] *Ibid*.
[36] *Ibid*.
[37] *Ibid*.

handicrafts were exhibited. The exhibition of these handicrafts received attention of the natives.[38]

In Surat, the handlooms had to sustain the competition of the Jafarali Mill, but this native industry never vanished as it continued to survive in due course of time for a larger period even during the 20th century. *Saris* made in this district had the usual silk borders.[39] These were of considerable value. *Lungis* were largely exported to Arabia and Burma.[40] The other cloths manufactured in the city of Surat found a ready market in the Deccan and Malwa region.[41] The cotton twist used was made in Bombay and other local mills.[42]

British Introduced Mass Manufacturing Cloth Looms

Kay's fly shuttle[43] was perhaps introduced by the EEIC in 1815 in a textile mill of Broach.[44] Initially, it was kept as monopoly by the EEIC and passed the Act of 1774 which made it an offence to export tools or utensils used in manufacturing cotton or cloth and linen mixed.[45] This Act was further extended in 1781 to include sketches, models or specifications.[46] But the rising demand of the Indian cotton changed their perception and attitude. Finally, it was introduced in the western India to increase fabric production on mass scale.[47]

In continuation, the British government conducted more experiments in the enhancement of textile production. One such experiment was related to Japanese

[38] *Ibid*.
[39] *Ibid*., 228.
[40] *Ibid*.
[41] *Ibid*.
[42] *Ibid*.
[43] John Kaye of Burry in 1733 patented fly shuttle in England. In the fly shuttle technique, 'shuttle was pushed from one end to the other across the sley which was fitted with shuttle box by packers exerting pull by the right hand'. The repeated oscillating motion was affected by hand. See A. K. Bag (1982), "Technology in India in the Eighteenth-Nineteenth Century", *IJHS*, 17 (1), 84.
[44] Sakis Gakes (n. d.), "The Organisation of the Indian Textile Technology Before and After the European Arrival", Unpublished, 11. (www.lse.ac.uk/economicHistory/Research/GEHN/HELSINKIGekas.pdf)
[45] *Ibid*.
[46] *Ibid*.
[47] *Ibid*.

loom.[48] The machines, however, proved to be too expensive for the ordinary weaver. These were complicated because most of artisans were not conversant with the technology and how to repair it.[49] The handling of this loom required extensive training. It was also not suitable to the native cotton. The British were convinced of the utility of the fly shuttle and it became popular and restrictions were removed.[50] With the adoption of new device, the earlier device which the weaver propelled between the two hammers on either side of the loom by pulling a cord; the fly-shuttle improved the rate of weaving from 40% to 70% over the traditional 'Throw-Shuttle' method.[51] Seemingly, it was simple in comparison to complex automatic looms. The capital required for purchasing the fly-shuttle loom accessories was from Rs. 10 to Rs. 25.[52] The new techniques could easily be mastered in a short period of time; one workshop owner claimed that his labourers learnt to work the shuttle at top speed within half a month.[53] Fly-shuttle was not accepted because it could not handle certain kinds of yarn or weave intricate designs. With the fly-shuttle sley, a weaver could increase output if he worked the same amount of time; but this could only be achieved if non-weaving members of the family could prepare yarn from the loom.[54] For this new kinds of warping machines were developed in 1920s, but these were again found expensive.[55]

English mule which was first discovered in 1779 in England and it was the next machine introduced in India to produce fabric.[56] It gradually became popular in India by the mid-1850s. But American 'Ring Spindle' posed a serious threat to this device.[57] It is noteworthy to mention that ring spindle suited to coarse yarn and required less labour; this device also enjoyed the advantage over other counterparts

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48 Douglas Haynes (1999), "The Logic of the Artisan Firm in a Capitalist Economy: Handloom Weavers and Technological Change in Western India, 1880-1947", in Burton Stein and Sanjay Subrahmanyam (eds), *Institutions and Economic Change in South Asia*, New Delhi: OUP, 190.
49 *Ibid.*, 190.
50 *Ibid*.
51 *Ibid*.
52 *Ibid*.
53 *Ibid*.
54 *Ibid*., 190-91.
55 *Ibid*., 192.
56 Dwijendra Tripathi (1996), "Colonialism and Technology Choices in India: A Historical Overview", *The Developing Economies*, 14 (1), 81.
57 *Ibid*.

because Indian mills in majority of cases worked on coarse yarn.[58] The British mills enjoyed monopoly in fine yarn. One observes transformation in the second half of the 20th century as by 1930s, 90% of 'rings' were used in the mills of India. But British mule continued its usage. Due to working capacity on both higher as well as lower counts of yarn, the yarn produced by it was of better quality than the ring could yield. Also the changing the count on the mule was comparatively easier and cheap. Further, it was cheaper to install mule even if the running cost was higher in comparision to the ring".[59]

J. N. Tata bought a 'Derelict Oil Mill' in 1869 and installed spinning machines in it. This combination some how was not productive and he sold it in dissatisfaction.[60] He made another effort as he was not happy with the old machines and went for the purchase of a ring frame, an American invention because it suited the small cotton staple and could be used for the manufacture of fabric. Gradually, this device and machinary became popular. The machinery was accepted in India because it could be handled even by unskilled workers. It also worked well with coarse yarn which was largely produced by the natives of Gujarat. England did not adopt it as they were manufacturing fine yarns compared to coarse one from India. The mule which the British used in India was compatible with fine yarn only.[61]

During the post-World War I, Japanese overpowered the Indian textile manufactured cloths because of advances in management and developed machine industry.[62] The automatic Toyoda looms[63] and new rings frames[64] replaced older models, while new techniques of fiber blending, bleaching, dyeing and printing made Japanese cloth was brought to use, as these were cheap like the Indian versions and fine as that of English variety.[65] Madras is recorded as an exception which had

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[58] Daniel R. Headrick (1988), *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850-1940*, New York: OUP, 364.
[59] Dwijendra Tripathi (1996), "Colonialism and Technology Choices in India: A Historical Overview", 81-83.
[60] Daniel R. Headrick (1988), *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850-1940*, 363.
[61] *Ibid.*, 363-64.
[62] *Ibid.*, 365.
[63] *Ibid*.
[64] *Ibid*.
[65] *Ibid*.

automatic looms; rest of India reported to be wedded with Lancashire methods and machines which used mule.[66]

The credit for the organisation and management of mills goes to both Indians and the British.[67] There were limited numbers of mills in the western India. Bombay was then the hub of cotton mills. In Gujarat, natives took the initiative by establishing mills. With the help of Sir Thomas Fuljames, Ranchhodlal Chhottalal established the first mill in Ahmedabad in 1861.[68] After many difficulties and without support from the British government, he single handedly established cotton mill. The machinery was purchased from England by Dadabhai Naroji.[69] The first consignment was lost in the sea as machinery catched fire on its passage to India via Cape of Good Hope.[70] But he was lucky to have machinery insured. A Fresh consignment landed at the port of Cambay and the mill was once again got started on 30th May, 1861.[71] Later, three more mills were established.[72] In the beginning, thick thread was produced for the local handloom. Afterwards, more improved looms were brought and fine cloth was produced. Variety of cloth produced in these mills was identified here as thick *madar path*, *dhoti*, *sari* and the thread below twenty counts.[73]

Besides, these mills in Gujarat kept producing yarn and coarse cloth, whereas production of finer cloth remained the monopoly of the British factories.[74]

Dr. Gilder, a senior partner of a firm Messers Gilder De Souza & Co., introduced English cloth; which became popular and posed competition to hand spun cloth of Ahmedabad.[75] The explosion of the English cloth and yarn was so severe that within thirty years it almost ruined the traditional textile industry of Ahmedabad.

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66 *Ibid.*, 366.
67 N. K. G. Parikh (1962), "Cotton Industry in Ahmedabad", Unpub. M. A. Dissertation, The M. S. University, Baroda, 24.
68 *Ibid*.
69 *Ibid*.
70 *Ibid*.
71 *Ibid*.
72 *Ibid*.
73 *Ibid*.
74 Neera Desai (1978), *Social Change in Gujarat*, 199.
75 Makrand J. Mehta (1981), "Business Environment, Urbanisation and Economic Change in India: A Case Study of Ahmedabad in the 19th Century", *Vidya-The Journal of Gujarat University*, 24 (1), 11.

The leading citizens of Ahmedabad, particularly, Ambalal Sakarlal Desai, Ranchhodlal Chottalal and Hargovindas Kantawala began to spread the ideas of economic nationalism.[76] They set an organisation called *Ahmedabad Swadeshi Udoyag Vardhak Mandali* in December, 1875. One of the most important functions of this organisation was to spread technical information on how to start modern industries, through lectures, articles, books and exhibitions. It is significant to record that the government did not, as a matter of rule, provide information on know-how, production, etc., which would probably facilitate the transfer of modern technology from industrially advanced countries to the potential urban-industrial centres like Ahmedabad. The attitude of the government was against the spread of technical education in India at least at this stage, i.e., last quarter of the 19th century. Makrand J. Mehta observes that in the midst of such a cold and unfavourable business environment, the *Mandali* carried on its constructive activities and played a role of information gap filling which again can be recorded as a revolutionary step in the making of the modern India. It was mainly due to the encouragement provided by this organisation that a few small-scale manufacturing units like the leather, carpet, ink, metal, safety match factories, etc., emerged in Ahmedabad in the last quarter of the 19th century.[77]

Powerloom

According to Douglas Haynes, number of modifications was applied to the looms in the first quarter of the 20th century. Looms were designed to work on power like electricity, diesel and petrol. He observed that natives readily adopted looms which worked with power gradually.[78] The Surat Electric Company (then Killick, Nixon & Co.) started electric connections for industrial purposes to artisanal neighbourhood in Surat by the late 1920s. They even requested weavers to use powerloom and did all the electrical fittings.[79] Many workers opted for powerlooms as it required less money, capital, land, etc. It emerged as foot loose unit. In case, there was no electricity, generators are reported to be used for the purpose. For

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[76] *Ibid*.
[77] *Ibid*., 9, 11-12.
[78] Douglas Haynes (2001), "Artisan Cloth Producers and the Emergence of Powerloom Manufacture in Western India, 1920-50", *Past and Present*, 172 (1), 183.
[79] *Ibid*.

instance, in Surat, a number of local artisans simply transformed their Hattersley looms by adding a belt and some other small contrivances which made it possible for electricity to derive the weaving action.[80] A converted Hattersley would cost around Rs. 60. The more common source of cheap machines was the worn out machinery from various mill. Weavers bought used powerlooms from factories in Bombay and Ahmedabad. These were then upgraded. Used powerlooms costed only two to five times the price of a handloom with fly shuttle attachment. Weavers estimated that a powerloom could make only around eight metres per day.[81] These powerlooms were purchased from England and Japan.[82] After the Second World War, it was manufactured in India.[83]

Haynes personal interactions with elderly persons in Surat suggest that the readiness of the weavers to switch over to the modifications was a significant phenomenon. Surat powerlooms users were also ready to adopt new changes, for example they used men-made fibre as rayon, nylon and polyesters.[84] Some powerloom operators began adopting viscose yarn during the 1930s. This was imported from Japan. In Surat, some weavers who installed Hattersley looms in their *karkhanas* worked behind closed doors, fearing objections raised from the various sections of the society. But the introduction of new powerloom did not receive mass opposition and it was gradually accepted and adopted by many of the weaver's family.[85]

Haynes cites number of cases about the native's willingness to adopt powerloom.[86] Hiralal Bachkaniwala, member of a weaving family that had gone bankrupt in the 1920s, took up a skilled position in Surat Silk Mills, where he acquired knowledge of machine loom production. Around 1938, he decided to set off on his own, purchasing three or four converted Hattersley looms at a cost about Rs. 60 per machine. By 1950s, his family developed a small factory with 50 looms. In

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[80] *Ibid*., 184.
[81] *Ibid*., 184-85
[82] *Ibid*.
[83] *Ibid*.
[84] *Ibid*., 189.
[85] *Ibid*., 189-90.
[86] *Ibid*., 187.

another case, Nur Mohammad Peer Mohammad at Surat was a handloom weaver who began as a wage labourer working on a Hattersley loom. He and his wife converted the loom to power during the mid-1930s. At first, the family produced a very coarse cotton cloth. Within a few years, they were making finer kinds of cloth-bordered *saris*, high-quality shirt and suit material, linen, etc. They had begun to use staple cotton and viscose yarns.[87]

Powerlooms were also operated on steam power engines.[88] Some of the instances came from the steam factories of Mr. Jafar Ali Mill (1866) and Mr. Ghaulam Baba Factory (1876). In case of Mr. Jafar Ali Mill, the machine was operated by two engines of 30 Horse Power (HP) and 25 HP and in latter case, the engine was of 60 HP capacities. Mr. Jamaludin Muhammand Bhai (1877) also opened a steam factory for paper manufacture.[89] This unit used two engines, one was of 16 HP and other was 12 HP. In 1875, near Mecca Creek[90] in Surat, Mr. Manekji Dorabji started an iron factory making iron railings, pipes, machinery and other castings in iron and brass.[91]

Dyeing

Gujarat bleachers are reported to be skillful and famous for their excellence in dyeing since antiquity.[92] In 1669, authorities from Bombay requested the English Factory at Surat to send some bleachers. Dyeing cotton fabrics was so important that the English, in 1646, decided to open a dyeing house of their own at Ahmedabad.[93] For this purpose, they purchased land with thirty six vats in working condition. Small workshops in private ownership began to emerge. Workers were hired and the tools belonged to the master.[94] The English send cloth to be bleached in Gujarat

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[87] *Ibid.*, 187-88, 191.
[88] *GBP* (1877), *Surat and Broach*, 178.
[89] *Ibid.*, 178-79.
[90] V. A. Janaki (1974), *Some Aspects of the Historical Geography of Surat*, Plate 7 and Map 10.
[91] *GBP* (1877), *Surat and Broach*, 180.
[92] Surendra Gopal (1975), *Commerce and Crafts of the Gujarat in the Sixteenth and Seventeenth Century*, 210.
[93] *Ibid.*, 210, 221.
[94] *Ibid.*, 210.

because of the result achieved. The presence of *Gujarati* bleachers in Bentham in Indonesia suggests their eminence in the global context.[95]

Extraction of Dyes

Dyes were made from animals and vegetable products. Following is the description of obtaining dye naturally from the soil. These dyes were referred as *hirmaji* and *ramraj* could be classified as mineral dyes.[96] It was obtained by pounding the ochreous clay which in turn was mixed with water.[97]

Dyes of Animal Origin

The dyes of animal origin like lac and cochineal were obtained through different methods.[98] In case of lac the encrusted tugs which were host to the larva of the insect *Coccus lacca* were cut into pieces. These twigs containing nearly 10% colouring matter were further crushed to separate the resins material. This resinous material was thrown into tubs of water and beaten with a wooden pestle or trodden under foot. The real coloured solution was then evaporated to dryness and the residue thus obtained was compressed into the cakes. The second dye known as cochineal was obtained from the insect *Coccus cacti* host on cactus *Nopalea cochinellifera* plant. The insects were carefully brushed from the cactus plant into bags or small wooden bowls. These were then killed either by immersion in scalding water or by long exposure to the hot sun. The dye then obtained can be considered to be of permanent nature.[99]

Vegetable Dyes

Most of the vegetable dyes namely *haldi*, *harsinghar, madder,* catechu, *sappan*, etc., were extracted with water. But *kusum* (Safflower) which are insoluble in water, were extracted with an alkali either *sajji* or wood ashes. From this alkaline solution, the dye was obtained by precipitation with an acid chiefly lime juice. Dyes

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[95] *Ibid.*, 210, 221.
[96] H. C. Bhardwaj and K. Kamal Jain (1982), "Indian Dyes and Dyeing Industry during 18th-19th Centuries", *IJHS*, 17 (1), 70.
[97] *Ibid*.
[98] George Watt (1897), *A Dictionary of the Economic Products of India*, Vol. II, 405-06, 412.
[99] H. C. Bhardwaj and K. Kamal Jain (1982), "Indian Dyes and Dyeing Industry during 18th-19th Centuries", 70-71.

like *dhak* were obtained by steeping the dye containing part in cold water. The winter was then evaporated to make the dye commercially ready. Some other dyes like *haldi*, *harsinghar*, *madder*, *catechu*, *sappan*, pomegranate, myrobalan, *chay*, etc., were extracted by boiling the dye yielding part with water. The infusion, thus obtained, was strained through a fine cloth and then evaporated to dryness and sold in the market either as powder or in the form of cakes.[100] These dyes were also long lasting and bright in shade.

Mordant

H. C. Bhardwaj and K. Kamal Jain provide following information about mordant making. According to them: "Alum is used as a mordant with *madder*, *haldi*, *dhak*, *patang*, *chay*, *kamela* and *dhau* dyes. Myrobalan is used with *bel*, *kulanjan*, *dalcini*, *al*, *manjith*, safflower, *haldi* and *tesu* dyes. *Loth* bark is used with *al*, *patang*, *dhak* and *manjith* dyes. *Imli* is employed as a mordant with *al* dye. For *annotto* dye crude pearl ash, vinegar, lemon juice, lime, etc., are used as mordant. The barks of *annotto* and *dhau* trees are other mordants used with *al* dye. Large scale manufacture of alum is carried out in Kachchh from a pyritious dark-grey or black which is mainly exported to Gujarat and Bombay to be used in dyeing".[101]

Cotton Dyeing

Method of cotton dyeing is as follows: "The cloth was first impregnated in an aqueous solution of dung. The dung contained phosphates, silicate and carbonates of sodium, potassium and aluminum. It helped in fixing the mordant on the fibre. The cloth was then washed and bleached in sun. This was followed by soaking the cloth in oil and alkali which made the fibre soft and helped in removing the dirt particles. Casters oil and *sajjikhar* or *papadkhar* were the commonly used oil and alkali respectively. The cloth was then steeped in the desired dye infusion followed by a dip in the mordant solution. Sometimes, cloth was dipped in different dye solution successively to produce a definite shade. However, to dye with indigo, the natives' dyers used to reduce the dye to indigo-white, temporarily, in a fermentation vat, when it was allowed to permeate the fibres thoroughly. The fabric was then exposed

[100] *Ibid.*, 71.
[101] *Ibid.*, 73.

to air to transfer the indigo-white to indigo-blue. Generally, indigo-dyeing did not require any mordant".[102]

Chintz-Printing

Chintz was the name given to a cloth stained to give a variegated or spotted design. This industry was indigenous to India since the 15th century. The process involved four steps. These are:[103]

- Oiling
- Production of faint lines on the cloth to help the printers
- Making fast the marks previously stamped and
- Production of different colours and shades.

After understanding the methods related to cloth production and its dyeing, it is noteworthy to mention the procedures related to procurement of indigo by the Europeans or the change that happened as a result of the Industrial Revolution and demand of the new industry in England and elsewhere.

For instance, the end of the 18th century, the Britishers received their major supply of indigo from West Indies.[104] There was shift in supply from West Indies because the remunerations were low. They also switched over to the production of coffee and sugar. In this way, the British appear to procure indigo from India. It is well known fact that Indian indigo was of superior quality.

With the discovery of artificial dye 'Alizarin' in Germany, it was introduced in India.[105] In due course of time, the native dyers started using the artificial one. It was adopted because it was cheaper in comparison to indigo. Further, while in process, it had uniformity of shades and demand less time and labour.[106]

The Europeans were better salesmen. Initially, they introduced the dye to the natives at reduced prices and even free of cost at some places.[107] But they made no

[102] *Ibid*., 73-74.
[103] *Ibid*.
[104] *Ibid*., 76.
[105] *Ibid*.
[106] *Ibid*., 78.
[107] *Ibid*.

attempt to install chemical industries in India. Baroda State moved ahead in this regard with the establishment of the *Kala Bhavan* (1890), a technical institute where experiments were carried out for the production of artificial dyes.[108] H. C. Bhardwaj and K. Kamal Jain opined: "The British sometimes used smart managerial skills and not the use of force to persuade the artisans to adopt a particular set of technology".[109]

T. K. Gajjar who was the Principal of *Kala Bhavan* and he put special emphasis for the manufacture of alizarine which was imported from Europe and was a costly affair at the *Kala Bhavan*. Prof. J. W. Jenks from the Department of Political Science, Cornell University, USA visited the campus in 1902, and was impressed by the excellent work on dye.[110] Gajjar adopted German technology for dye in place of British one and appointed Prof. Hugo Schumacker from the giant dye manufacturing concern Farber Fabriken and Dr. Erbehardt from Germany. Schumacker was helped by Maganlal Chottalal Desai from the Baroda College. Dhrub Raina and S. Irfan Habib affirm's that the students of the Baroda College were proficient at producing a Turkish dye.[111] This manufacturing process was kept as trade secret.[112]

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[108] Dhrub Raina and S. Irfan Habib (2004), *Domesticating Modern Science: A Social History of Science and Culture in Colonial India*, 190-91.

[109] H. C. Bhardwaj and K. Kamal Jain (1982), "Indian Dyes and Dyeing Industry during 18th-19th Centuries", 78.

[110] Dhrub Raina and S. Irfan Habib (2004), *Domesticating Modern Science: A Social History of Science and Culture in Colonial India*, 190.

[111] *Ibid.*, 191.

[112] *Ibid*.

Silk

As referred in section three of Chapter Two, silk was not produced either in Sultanate regime or under Mughals. It largely remained an imported category.[113] Our sources are silent for the 18th century regarding its production. However, the raw silk which was imported in the sub-region, i.e., Gujarat was converted to variety of fabrics *kinkhab*, *patola*, *choli*, etc. By the beginning of the 20th century, i.e., *c*. 1900, an important document by S. M. Edwards's '*A Monograph upon the Silk Fabrics of the Bombay Presidency*,' is made available to us.[114] This document refers to production, manufacture, bleaching, dyeing, sizing, weaving, etc.

I offer the description in detail for registering the science behind it and transformation that has taken place in the *long duree*.

Sabyasachi Bhattacharya explains about the separation of soil from the cocoons. According to him: "Silk in India was wound with few primitive implements. In the first step, the silk-worm or the cocoons were placed in boiling water in earthen reeling basins heated with cow-dung fuel; and silk thread was then wound off the cocoons upon reels made of bamboo; the reel was fastened to a wooden spindle which the reeler coiled round with his hands. The main faults of this technique were inequality in the thickness of the skein and frequent breaks which impeded operations in the weaving factory".[115]

Silk worm is claimed to be originated in China but many authors like Max Muller and N. G. Mookerji claim it to be of the Indian origin.[116] Raw silk was then procured from China, Bengal, Persia. *Bohras* from Gujarat, Sindh, and Rajasthan

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[113] Hamida Khatoon Naqvi (1983), "Varieties of Indian Silken Stuffs in Persian Sources, *c*. 1200-1700", *IJHS*, 18 (1), 115.

[114] S. M. Edwards (1900), *A Monograph upon the Silk Fabrics of the Bombay Presidency*, Bombay, 1-66.

[115] Sabyasachi Bhattacharya (1970), "Cultural and Social Constrains on Technological Innovation and Development: Some Case Studies", 46.

[116] S. M. Edwards (1900), *A Monograph upon the Silk Fabrics of the Bombay Presidency*, 1.

were known for importing Chinese silk.[117] Ahmedabad and Surat imported raw Chinese silk from Bombay. Bengal silk was inferior to Chinese silk.[118]

In Surat before 1900, an attempt was made to introduce artificial silk made in France.[119] It was abandoned because the procured material received could not be properly dyed.[120]

According to Edwards, following instruments were employed in the process of sorting, reeling and spinning of raw silk:[121]

- A large cage of string and bamboo called '*parta'*
- A conical reel of split bamboo called parta. Each reel was about fourteen inch high and sixteen inch in diameter, the central reel being thirty inch long
- Reel bobbins
- One small wheel
- The throwing-machine or *rahat*, which included a large wheel called '*charka*', a bobbin-frame called '*sacha*', '*cahatphala*' or '*chowtala*', two sets of glass bangles and a long drum or roller of wood called '*dholi*', '*doli*' or '*sakumba*'.

S. M. Edwards further informs us about the weaving, bleaching and dyeing of silk at Surat: "For weaving of silk, a flat slab of wood is set with a number of spindles placed in a slanting position on the ground. A narrow trough of water about four feet above the ground is placed at centre. An iron bar and a horizontal bar are set with glass bangles, numbering half of the total number of spindles upon the slanting frame. He refers to a flat wooden stand, containing vertical revolving wooden frames, about four inch square and eight inch long. Small bobbins of thread are placed upon the spindles and the instrument is rotated with a wheel. The threads from two bobbins pass down through the water and under the iron bar, then upwards to the bangles in the horizontal bar. They pass through one of the square wooden frames. The water in the trough helps the threads to unite more closely into one thread. He also reports that for manufacturing other silk cloth, double thread '*dotar*'

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[117] *Ibid.*, 3, 6.
[118] *Ibid.*, 5-6.
[119] *Ibid.*, 6.
[120] *Ibid*.
[121] *Ibid.*, 8.

was used in the same instrument. The author also describes about the bleaching materials used for silk. These materials were rough fire place of bricks and mud, a few large copper pass, a large pot or vat, a stone slab, a grinding-stone and some long iron tipped pestles. Mordanting was followed after bleaching process for all silks except white one. He also reports that artisans used artificial dye aniline or alizarin from Europe. This happened because of its cheapness and demanded less labour and time for its execution. He also informs that though artificial dyes were used, the native's dyes were known for durability and its colour never faded".[122]

The silk products in Gujarat were made on small scale. Unfortunately, there were no mills located in Gujarat which worked on silk. In the Bombay Presidency, there were three silk weaving mills namely Sassoon and Alliance Silk Mill and Chhoi Silk Mill in Bombay, and the third one was in Poona city.[123]

For the process of manufacture of raw silk see **Appendix No. III.**

Dyers

Galiaras and *Ranjrejs* were the dyers. The former imparted a permanent blue colour to the *dhoti* and *khadi* by passing the cloth three or four times through a solution of indigo, lime and dates. The latter dyed the finer kinds of cloths for turbans, scarfs without employing any base or mordant in order to permanently colour the fibre. European dyes were imported for most colours, but the *kasumba* (*Arthamus tinctorius*) flowers crushed in water produce one kind of dye, and a yellow dye was also obtained from a solution of turmeric and carbonate of soda, *sanchoro.* Two families in Navsari went in for a rude kind of calico-printing; the cloth was dipped in a solution of myrobalan and the blocks on which the patterns were designed were dipped in sulphate of iron, *hira kasi.*

[122] *Ibid.*, 10-17.
[123] *Ibid.*, 59.

Thread Work based on Gold and Silver: *Jari*

Skills of *Gujarati* artisans excelled in the manufacture of cotton and silk fabric since time immemorial. Both cotton and silk fabric further got enriched with the use of gold and silver thread. This work is known as *jari* work. *Jari* or twisted silver thread with a golden shine was widely used material on the borders or surface of decorated cloths. It was woven on cotton or silk, or embroidered by hand. The twin cities of Benaras and Surat are popularly identified even today. During the 19th century, this handicraft survived as a small scale industry despite there was tough competition and the presence of European machine made cheaper cloth variety.[124]

Tirthankar Roy refers to the method employed in the *jari* work by the artisans on both cotton and silk fabric.[125]

> *Jari* in a form usable in textile was the outcome of four processes: drawing silver wire from bars; flattening the wire; spinning the flattened wire on silk or cotton; and gold plating this thread. In the first two stages, silver was melted, then the bar shaped metal drawn through a perforated metal plate and the silver flattened by hammering it on an anvil to produce lametta. The tasks were skilled, arduous and, therefore, specialized. Wire-drawing, by hawing to maintain a furnace, required a certain investment and usually functioned in workshops. The holes on a drawing plate were of successfully narrower dimensions. The process was completed when a standard weight of 180 grams (one *tola*) reduced to 600 to 12,00 yards of wire. In recorded history, gold bar is not known to be so transformed mainly, on account of the easier pliability of silver. But until the middle of the twentieth century, the silver was plated with a thin gold leaf which imparted a shine to the wire. In that case, the furnace performed a separate stage, the melting of gold. The outputs of this process, disc-shaped gold plates, were hammered into thin leaves. The entire operation of the furnace, whether in gold or silver, required a great deal of judgment on the extent of heating necessary to yield a ductile, hard and yet not brittle piece of metal. With the development of the final stage, electro-plating of the finished wire, the gold leaf could be dispensed with. In the final stage, the lametta was twisted manually. The spinner suspended a silk thread from a sharp-twisted to remove fast, while the lametta or flattened wire was made to touch delicately on the spinning thread. The outcome was *jari*. Apart from *jari*, silver thread was also used in the making of tinsel. It was bright, metallic, but non-durable ornaments. One common example was garlands made of metal foil. But certain kinds of tinsel usually made by flattening silver wire or after winking it around another wire, had uses in textiles especially in embroidery.

Tirthankar Roy refers to the interest of the French and German manufacturers because we have instances of their keen interest to learn about the techniques

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124 Ceciel L. Burns (1904), *Gold and Silver Work in the Bombay Presidency*, Bombay, 3-25. Also see Tirthankar Roy (1999), *Traditional Industry in the Economy of Colonial India*, New Delhi: CUP, 99-100 and R. D. Choksey (1968), *Economic Life in the Bombay Gujarat, 1800-1939*, 222.

125 Tirthankar Roy (1999), *Traditional Industry in the Economy of Colonial India*, 100-01.

associated with the *jari* work.[126] As a result of German interests their technicians settled in Calcutta and they learnt the process used in the *jari* work.[127]

The artisans showed their willingness to adopt the improved technology which was used in the mills. By 1920s, Surat *jari* manufacturers imported wire plates which enhanced the working capacity and proved better over native methods. Plates of standardised dimensions, with better resistance to wear and tear began to be imported and fitted on to the old frames where the artisans worked. Steel was replaced by firmer metals (hard-coated drawing holes), or by plated steel, which was more likely to have been a brass plate.[128] In this way, the *Gujarati* artisans adopted and switched to the new technology and these were successfully employed in the manufacturing process. Later on, Benaras and Surat because of cheap availability of the electricity by 1930's switched over to electro-plating process which further increased their production capacity.[129]

In the light of the above technical assimilation, the various sub-regions of British Gujarat witnessed the remarkable production with improved quality. The largest factory in Surat was Gauri Gold and Silver Work Company which employed modern methods for manufacture of gold thread. Mr. S. B. Sastri of the same Company and J. K. Kapadia were sent to Europe by the British government to study this art. While the 700 smaller factories specialised in the different processes of manufacture of gold thread started using electricity.[130]

Ahmedabad was important centre and *sonar* caste was associated with the gold and silver work. The goldsmith did not keep the metal with them but used the metal provided by customers in coins or bar shape. Bar metal was bought from an assayer (*Choksi*) who obtained it from Bombay.[131] An early as 20th century, a monograph by Ceciel L. Burns refers to the fraudulent involved in the obtaining of

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[126] *Ibid.*, 111.
[127] *Ibid*.
[128] *Ibid.*, 114.
[129] *Ibid.*, 116.
[130] G. P. Fernendez (1931), *Art-Crafts of the Bombay Presidency*, Bombay, 23. Also see Tirthankar Roy (1999), *Traditional Industry in the Economy of Colonial India*, 118.
[131] Ceciel L. Burns (1904), *Gold and Silver Work in the Bombay Presidency*, 7.

metal because there was no assured authoritative test to verify the quality of gold and silver.[132]

Ceciel L. Burns does provide a detailed account in the monograph titled 'Gold and Silver Work in the Bombay Presidency' about the methods of gold and silver, its dyeing and polishing and tools used in the making of *jari*.[133] According to him, two methods were employed for the purification of gold and silver in British Gujarat as follow:

- European Method: In this method, impure gold was purified by using nitric acid. Gold was mixed with silver in the proportion of about 1:3, according to its impurity and then these two metals being melted together. The molten alloy was gently poured from a height into a basin of water, when it was broken up into small grains. These grains were put into a glass vessel filled with nitric acid and heated on a moderate fire, until the base metals of the alloy had been absorbed by the acid which would not attack gold.
- The second method was practised by the local artisans. The impure gold was beaten into thin leaves and it was smeared with coconut oil. It was then sprinkled with a mixture made of powder of old tiles and salt. The leaves were then piled in layers. The whole layer was then covered with potsherds, all cracks being stopped with clay and cow dung. A fire of dried cow dung cakes was then built round this primitive oven and raised to a great heat.

Purification of Silver: The impure silver was mixed with lead and the whole was melted in a small dish made of clay of cow dung and ashes mixed. The lead and other impurities were burnt out by the use of a blow-pipe.

Process of Working on Gold: This depended on the class of ornaments to be made. If a solid ornament be required, the gold was cast in a mould. For ornaments of the nature of bangles, belts, etc., it was drawn into wire. For hollow ornaments, it was beaten into thin plate. The hollows of such ornaments were stuffed with sealing wax, and the back plates of them were generally of silver. Ornaments of wire were made by twisting the wire with pliers or with weaving two or three wires with a shaft of metal like that used for weaving wool.

[132] *Ibid*.
[133] *Ibid.*, 17-19.

Dyeing and Polishing: An ornament when fashioned had to be polished and dyed. Two parts of common salt and two of nitre and one of alum were made into a paste. This paste was applied with a brush of boar's hair and the ornament heated till the paste dried. Then, the ornament was polished by brushing with a brush; soap-nut water was mixed with yellow sand. Polishing was performed by rubbing with the burnished ends of a stick of bell-metal called *voppi-kaddi*. Green vitriol, nitre and common salt were made into a paste and this paste was applied to the ornament it was heated. This paste was a red dye and the redness was due to sulphate of copper. Solid ornaments were coloured yellow by boiling in a decoction of wild mangosteen rind with red ochre and a little sulphur. Silver ornaments before being polished were cleaned by boiling in a decoction of tamarind mixed with a little salt, or in a weak solution of sulphate acid.

Burns provides the following list of tools which were used in the following methods:[134]

- Anvil Hammers: Double and single, of various shapes and dimensions
- Tongs: In order to arrange coals and rake fire
- Pliers: Small and large (*chimta*). The large kind for twisting wire was called *gavi* in Marathi and *ikkla* in Kanarese.
- Scissors: For cutting plate and leaves of gold
- File
- A plate of steel with holes of various sizes, for drawing wire
- The furnace, which was nothing but coals in the lower half of an earthen water-pot fixed in the upper half of the same inverted, the neck serving as a foot or stand. The fire of such furnaces was blown with the mouth through a tube mostly of a thin kind of bamboo.
- Brushes of wild hog hair called *kulchudi*, which was a handful of boar hair bound together by a thick string of iron wound round in the middle. The parts used for brushing were the hard roots of the hair.

The traditional *jari* industry with the rising demand of the markets successfully adopted and assimilated the foreign methods to make this industry suitable as per the demand of the time. The case shows the readiness of the natives to adopt a new technology with modification to suit the market demands without letting to die the native industry

[134] *Ibid.*, 18-19.

Woollen Products

B. A. Brendon's monograph '*A Monograph on the Woollen Fabrics of the Bombay Presidency*' refers to the woollen fabrics manufactured in the Bombay Presidency.[135] According to him, wool was used in the manufacture of the various articles for the public utility. It was reported in the monograph that in the Bombay Presidency and British Gujarat in particular, the woollen fabrics were largely confined for the manufacture of blankets, carpets, rugs and sacking. Ahmedabad was especially known for carpet making.

Brendon says that the locally procured wool was not good and it became essential to remove unwanted stuffs from the wool. The staple was coarse, short and full of hairs (Kemps). Felting or milling, a process known as shrinking and in this process the threads in a fabric were so closely drawn together that these were particularly undistinguished from one another. Hair, unlike wool, would not shrink, nor had any machinery been yet invented for the separation of these kemps from the wool fibres. In a coarse blanket the presence of hair was an advantage, but in a cloth, it was a great defect, and though it could not be avoided in working with Indian wool, the appearance of hair was removed by passing the cloth made an extremely sharp knife, which shaves off all the projecting hairs.[136]

Therefore, artisans tried to obtain wool from the outside. In this regard, the Australian wool was considered better as compared to local ones. Sheep were stern in May and November. Before shearing, sheep were washed with soap on previous day. In Kaira, sheep was washed once a month in running water, which was supposed to lengthen the staple. White Gujarat wool after cleaning fetched Rs. 175 per candy.[137]

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[135] B. A. Brendon (1899), *A Monograph on the Woollen Fabrics of the Bombay Presidency*, 1-13.
[136] *Ibid.*, 1.
[137] *Ibid.*, 2.

B. A. Brendon refers to the wool spinning process employed in the Bombay Presidency.[138] Raw wool was cleaned by Muslim *Pinjaris* using the bow (*kaman*). The instrument was suspected by a cord attached to the middle of the string with the vibration produced, wool was cleaned. The second instrument employed was spinning machine known as *rahat*. The spindle (*chat*) was turned by a driving wheel with the use of hand. The spinner took in his left hand a quantity of raw wool, which he connected with the point of the spindle by a short length of yarn previously spun or roughly twisted in his hands for the purpose. Thus, he was in a position to weave wool.

He also refers to the shepherds who during leisure time employ spinning. The instrument was of the simplest kind and being small, it could be carried easily. It consisted of a circular disc about two and a half inches in diameter, generally made of a piece of flat tile or stone, with a pointed wooden axis about six inches long. The axis had to be fitted in the middle of the disc and at right angles to its surface. Yarn was wound on the axis, beginning at the end inserted in the disc and running up to the point, where it was tied in a simple loop knot. The end of this length of yarn was then connected with a length of wool drawn out to the requisite fineness from the handful which the shepherd hold, and just sufficiently twisted to enable it to bear the weight of the instrument. The instrument being released continued spinning, and the length of wool up to the point where it was held in the shepherd's left hand was twisted into yarn. The process was repeated until the finished product was made.

Products Made from Wool

In towns, blankets made of wool were used for bed-clothing. Farmers in villages while watching cattle in the fields used woollen blankets. It afforded warmth in the chill of the early morning and protection from the heat and glare of the sun at noon. The labourer winded it round his head and used it as a pad on which to carry weight. The peasantry used it as a protection against rain.

In Gujarat, blankets were woven by *Ravalias*, *Gadaris*, *Dhangars* and *Dheds*. *Dhabli* was the finest *Gujarati* blankets. It was used by Brahmins during the

[138] *Ibid.*, 2-4.

religious ceremony. For such occasions, ritual prescribed a silk or woollen garment, cotton being considered impure. These were made of finest white wool. The ordinary term used in Gujarat for blanket was '*kamlo*' or '*kamal*'. *Kamli* was finest one and *chummalo* was considered very thick and coarse.[139]

The Ahmedabad Carpet Manufacturing Co., the only one mill in Gujarat worked under a contract with Messers Tellery & Co. of Bombay for the supply of woollen products.[140]

Carpet Making

H. J. R. Twiggs in his report on '*Art and Practice of Carpet Making in the Bombay Presidency*' refers to the carpet making in the Bombay Presidency.[141] He reported that carpet making was not lucrative business. For example, Ahmedabad Carpet Manufacturing Company owing to labour cost shifted its weaving branch to Nadiad. At Gogha, Messrs Hathasing opened a woollen carpet factory, but their successor found it unremunerative.

He does provide some information about the centres in south Gujarat and products made there. In Broach, Amod, Jambusar and Vagra made woollen carpets '*athars*' chiefly used to cover loaded carts in wet weather. Balashran Mission maintained a dye-house mainly vegetable dye for carpet making in Surat.[142]

He reported that the government was encouraging this industry. Cotton carpets were made at Cambay by Muslims males. Old looms were replaced by 56 fly-shuttles and was adjusted with a simple mechanism whereby the shuttle was rapidly thrown from side and the comb with almost a synchronous movement advanced or receded. For comparison, it would suffice to add that a man who with an old loom could turn out nine yards of work could in the same time turn out nearly

[139] *Ibid.*, 4-5.
[140] *Ibid.*, 7-8.
[141] H. J. R. Twiggs (1907), *Art and Practice of Carpet Making in the Bombay Presidency*, Bombay, 1-86.
[142] *Ibid.*, 5.

twenty on the improved looms. Artisans were encouraged by the state in fly-shuttle working and a house was also maintained.[143]

Raw materials were mainly cotton; wood or silk were the raw material for the foundation of fabric (warp) sometimes mixed with jute and hemp. At Ahmedabad, wool and indigo in small quantities with *dodam* husk were the only raw materials produced, except that *manjit*, *kismaj* were grown in small extent.[144]

For carpet making process see **Appendix No. IV**

For carpet dyeing, aniline was used in Gujarat except Surat Orphanage[145] which used vegetable dye. Cotton cultivation gradually replaced the acreage under cultivation for the vegetable dyes.[146] *Kasumba, al, morinda* scarcer were used for dye.[147]

Though carpet products did not bring much profit as compared to cotton and silk products, still it had demand in the region. In some limited cases, we observed that natives tried to adopt new technology for its manufacture on large scale, but the output was limited.

Salt Manufacture

Salt was obtained in the British Gujarat territories from the two sources. It was either collected from the evaporation of sea water or collected from the salt pans through digging. Ahmedabad vicinity had been the prime location in Gujarat during the study period.

Evaporation process was based on traditional knowledge practiced by the inhabitants of the coastal region of the British districts. Sea water was allowed to

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143 *Ibid.*, 19-20.
144 *Ibid.*, 24.
145 *Ibid.*, 49.
146 *Ibid*.
147 *Ibid*.

enter into open field near the coast through channels. It was left exposed to the sunlight and the evaporation of water took place. After the complete evaporation of water, salt was obtained as residue.

Monier Williams who was one of the Collectors at Surat in his 'Memoir on the *Zilla* of *Baroche*' refers to the salt making in Broach. Salt pans were constructed by the natives from the villages of Jamree, Malpoor and Doleea of Jambusar. The pans were filled from the sea by little channels cut from different creeks, and the water was evaporated by the heat of the sun.[148] He also refers to the salt making by the evaporation process in the southern Gujarat as well: 'Salt pans are formed out by the government. To make the pans, it demands hard labour. The *pal*, or bank, is first thrown up; then the bottom must be rendered hard by beating it, and treading it down well repeatedly. When all is ready, the salt water is admitted, the tide bringing it, by the little channels and cuts, to the pans. In the cold the salt produced in about a month, the water being let in from time to time; but in hot season, the evaporation being quicker, the salt is ready sooner'.[149]

Second process was different from the first one. Salt was taken out from the salt pans beneath the earth in Ahmedabad. It was not manufactured from the sea water.

Salt was made in the western village of Viramgam bordering *Ran.* Jhinjhuvada pits were noted for white colour and good quality salt. It terms of colour and shape, it looked like sugar. By 1826, there were four places namely Patri, Udu, Fattepur and Jhinjhuvada in Ahmedabad district.[150]

Following information is documented in the *Gazetteer of the Bombay* Presidency, Ahmedabad district about the salt manufacture:[151]

> Salt is made in beds hollowed about a foot below the level of the *Ran*. The pans are filled from brine pits about ten feet deep, the bottom is secured by a rough wooden frame (*kantva*). The water found only a few feet from the surface is

[148] Monier Williams (1855), "Memoir on the *Zilla* of *Baroche*", *SRBG*, No. 3, Old, 9.
[149] *Ibid*., 12.
[150] *GBP* (1879), *Ahmedabad*, 116.
[151] *Ibid.*, 116-17.

without the aid of bullocks can be easily drawn by a lift. The list used is a pole hung on a pivot at about a quarter of its length, with a heavy weight of stones fasten to the longer end, and from the shorter, hanging over the well, a rope with a small earthen pot. Standing on a frame within the well and just above the water, the workmen with great speed fill the pot, let it be drawn up and emptied into a channel leading to the pans. At first about four inches of water are let into the pans and then from day to day enough to make up for evaporation is gradually added. Every third day the hole is raked with an iron to other instrument called *dantali* and after fifteen or twenty days the water is drawn off and a fresh supply let in. At the end of thirty days in cold, and of twenty in the hot season, the salt is completely formed and ready for sale. It is gathered into heaps and during the fair season left till it is bought and taken away. Unsold heaps are at the close of the fair season collect in large conical mounds, the bottom parts, to protect them from water, are cased with earth, reeds and grasses and the tops left uncovered as the salt soon grow hard and close enough to throw off rain. The salt makers called *Agrias* are *Kolis*. The salt formed in cubic crystals joined in large lumps called *kankras*, the best salt having the largest and most regular cubes. This salt called *vadagra* is uncommonly pure and free from the earthy particles found in the ordinary sea side, *ghasia* salt. Of Viramgam salt, the best is made at Fattepur and wrost at Patri. Owing to prejudice for salt trade, it is carried by the *banjaras*. It causes skin disease and diarrhoea due to presence of epson salt or sulphate of magnesium.

The same *Gazetteer* also refers the manner in which salt well was constructed beneath the surface:[152]

Except that as a rule only one crop is taken in one year. The brine, found at a depth of from eighteen to thirty six feet, yields about six times as much salt as ordinary seawater. To reach the brine the first step is to sink a well. Most of the wells are round, about nine feet in diameter. They are dug through a top soil of black clay and an occasional thin layer of sand until water is reached some nine or ten feet below the surface. This water is not the true brine, but a mixture of rain and sea water that during the rainy season has filtered down. The digging then stopped, and to keep the sides falling in, a hollow cylinder (*kantva*) of strong *babul* bough is introduced. Next, the brine lift is prepared, a thirty feet teak rafter working on a strong wooden upright. To the long arm of the lever, a twisted grass rope, with an earthen bucket at the end is fastened and balanced at the shorter end by a weight of sunbaked clay. By scraping, loose earth from the surface into ridges along its four sides, a space is made for a pan and with two lifts at work the water is removed and allowed to run over the pan. As soon as the well is dry, the salt-maker again go for digging, leaving round the pit-bottom as a rest for the wooden cylinder, a narrow wall of solid earth. After digging, some ten feet deeper, a second smaller cylinder is introduced, and like a telescope slide, as the well deepen a third or even a fourth. When at last the brine-bearing stratum is reached a stout stake is driven deep into the soil and drawing out the stake the brine spout up a column, filling the well to within ten or twelve feet of the brim. Three men, one to dig and two other to raise the brine, are usually employed on each well and according to its depth the work takes them from fifteen days to a month.

[152] *Ibid.*, 120.

After the digging of the well, the next process was the preparation of salt pan. Following method was employed in its preparation:[153]

> When the well is ready, the work of preparing the pan started. Three or four inches of the surface soil by the waste well-water is taken away by large wooden mud-scrapers. The soil thus exposed is stiff clay mixed in places with sand. Any bit with too much sand is dug out and replaced with good sound clay. More of mud is then lifted from the well and as it spread over the pan. The outstanding parts are paved off with an iron hoe until only a thin film remained and the work of puddling began. Puddling is a hard and weary task. Three or four workers in a row, like mowers in a hay field, one behind the other, each with his heels close together, stamp the pan in straight lines, first length ways, then across and then diagonally. When in this way the clay has been well worked and pan is allowed to dry. Another film of water is let in, and the process repeated till the bed became through water tight. Its surface is than carefully beaten and leveled with wooden beetles. Some pans need as many as five separate puddling and for others two were enough. The work took four to five men from one to two months or even ten weeks. After the first year a single puddling is generally enough and when the pans have been in use for ten or twelve years, nothing is wanted but to scrape away the loose mud washed into them by the rainy season floods.
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> The puddling lowers the floor of the pan four or five inches below the ground level. A low wall of well-worked clay is then raised round all four sides of the pan and the whole was left to dry. Meanwhile, between the well and the pan a small reservoir has been made to hold the brine as it comes from the well. After standing for a couple of days to clear, the brine is let into the pan four or five inches deep. In about a week's time the whole bottom of the pan is covered with a salt crust from a half to three quarters of an inch thick. The worker step into the pan and with his feet broke the crust into small pieces, and until all the crystals are separated, scratches it with a wooden raked (*dantali*). Then with the wooden mud-scraper, he spreads the crystals evenly over the bed of the pan. A short time is allowed for the brine, disturbed and directed by this process, to settle and more brine is then let in. So long as the salt remains in the pan, it must be thoroughly raked and leveled with the hoe at least every other morning; otherwise the crystals become uneven in size and shape and as brittle as sea salt. Fresh brine must also be let in every day, and the pans must be kept filled to a height of at least three inches above the top layer of crystals.
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> Only one crop of the best salt can be made in a season. If the work is started at the beginning of November, the salt will be ready by the end of the following March. By that time, it covers the pan ten inches to a foot deep. To rake so large a mass of crystals and to keep brine enough in the pan is not an easy task. Two crops are sometimes made. The first ready in January is good in quality though small in quantity. The second is larger but not as good as it too quickly forms hot weather crystals are uneven and hallow. The crystals of the best salt are nearly perfect half-inch or three quarter inch cubes, clear and bright and so close-grained and quarter inch cubes hard that these stand travelling especially well, and would even bear being thrown on a stone-flood with considerable force without breaking. When the salt is ripe, it is scraped into long ridges and water drawn off. After standing for a few days to drain, the salt is carried away in baskets and piled in heaps. If a second crop is to be made, the pan must be thoroughly dried, and the bed levelled before fresh brine is let in. Women and children help in carrying salt and loading it into railway wagons, but only men prepare the pans, wells and make the salt. The tools are very rough but well suited to their purpose. From their form and the way these are fastened to the lift rope the earthen brine buckets, as soon as these touch the troughs leading

[153] *Ibid.*, 121-22.

> to the reservoirs, tilt over of themselves. The spikes of the rakes, tough *babul* twigs, are so arranged that the workman can, to suit the depth of salt in his pan, alter their length at pleasure. The lift is as simple and useful a contrivance for raising brine as can well be devised and the way in which water is used for leveling the pans is very ingenious.

The British government took number of steps for its manufacture on the commercial basis. The method adopted by them was similar to the process which was practiced by the local manufacturers in Ahmedabad. The British government purchased lands in the salt pans and hired labours. Their main noticeable attempt was their managerial skills employed in the process. The area was connected with railways and depots were made in Ahmedabad for salt storage and its distribution.

Manufacture of salt was very arduous and time consuming process. The British authorities witnessed problems during the salt making. It was observed that brine or rather brine springs were not spread over the whole *Ran.* Further, the black clay and sand of the *Ran's* upper crust and yellowish red clay, locally known as *marud* added another short of difficulty. It was decided to introduce Norton's tube-well to remove this, but with limited output. Besides these issues, there was risk of loss from blight *raich.* The disease was caused by over concentration of brine and deposition of magnesia. Gypsum, chloride of sodium, epsom salt made the salt intensely bitter and very unpalatable in taste. In the first season of the works (1872-73), it was reported that blight caused much damage. It was found to be due to the neglect of some of the workers to feed their pans regularly. The authorities decided for careful supervision to control the problem. Where it did appear, the pan was at once thoroughly drained, and the salt allowed drying. Dust storms were another source of danger which often resulted in the loss of clean salt. [154]

There were five workshops on *Ran* and fourteen between Cambay and Bassein. Mr. Dalzell (Deputy Commissioner of Customs) proposed that railway lines should be extended as far as Parti and salt to be brought to a great store in Ahmedabad. The proposal led to the establishment of salt store at Ahmedabad, Broach and Surat. A large store was built at Kharaghoda. It was a desert and,

[154] *Ibid.*, 122-23.

therefore, trees were planted, a lake dug and a village was built. In summer, water was carried by the Railway from Viramgam. Workers were provided loans from the government.[155]

The British authorities were convinced with the usefulness of the native methods for the manufacture of salt. They happily accepted the native knowledge. They tried to harmonise the disorganised salt making pockets into a well-connected chain for its proper distribution. Therefore, these sub-regions were connected with railways and various salt depots were established.

Saltpetre

Ahmedabad, besides salt, was also known for saltpeter manufacture which is well testified by the European travellers in pre-colonial Gujarat.[156] For instance, the following description is provided by Pelsaert about saltpetre manufacture: "Two shallow reservoirs like salt-pans are made on the ground, one much larger than the other. The larger is fitted with the salt earth and flooded with water from a channel in the ground; the earth is then thoroughly trodden by number of labourers till it is pulverised and forms a thin paste, then it is allowed to stand for two days, so that the water may absorb all the substance. The water is then run off by a large outlet into the other reservoir, where a deposit settles, which is crude saltpeter. This is evaporated in iron pans once or twice according to degree of whiteness and purity desired, being skimmed continuously until scarcely impurities arise. It is then placed in large earthen jars, 25-30 lbs., a crust forms in the dew during the night and if any impurities are still left, they sink to the bottom, the pots are then broken and the saltpeter is dried in the sun".[157]

The *Gazetteer of the Bombay* Presidency, Ahmedabad does provide the following information about the manufacture of saltpeter during the colonial

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[155] *Ibid.*, 118.

[156] Surendra Gopal (1975), *Commerce and Crafts of the Gujarat in the Sixteenth and Seventeenth Century*, 225.

[157] W. H. Moreland, and P. Geyl (tr.) (1925), *Jahangir's India: The Remonstrantie of Francisco Pelsaert*, 46.

period:[158] "The suitable time for the manufacture of saltpeter is the winter season. It is collected by digging the earth containing saltpeter. The first step in the process is to scrap off and gather the surface soil. The collected soil is placed in large pierced earthen vessels called *gola*. Fresh water is then poured into the vessel and the salt water is collected into smaller pots (*moria*) placed below. These are again emptied into deep iron pans (*karav*), holding about ten to twenty five *morias* of the strained liquor. These iron pans are boiled to crystallise it into jelly. It is then poured into shallow earthen vessels (*kunda*) and allowed to stand all night. In the morning, the crystallized nitrate is taken away and put into bags". The *Gazetteer* also provides information about the refining of saltpeter. Saltpetre is washed and purified in clean fresh water. It is at least twice washed called *bevda*. After the third washing (*tevda*), the obtained saltpetre is pronounced best. It is used in the making of finest gunpowder called *ranjki*. Special saltpetre mixed with alum called *kalmi* is used for firework.

Bohra community was chiefly associated with the manufacture of saltpeter in Gujarat. English sought to set up their establishment for refining raw saltpeter obtained from Malpur near Ahmedabad. They hired labourers and provided them with copper pans. The initiative was economically profitable and the quality of saltpeter was very good. Encouraged by the result, they tried to refine it at Surat also. But they had to give up these efforts on account of obstacles placed by the local bureaucracy.[159]

Large tract of Viramgam especially Jhinjhuvada and Parti were known for saltpeter manufacture. These sub-regions soil were suited for its manufacture. It was also made in Jhalavad, Lambdi and Patan villages. By 1825, *Banias* stopped making of saltpetre for its use for gunpowder, except few *Bohra* class. *Banias* even discouraged *Bohras* for its manufacture. Therefore, this community discarded its

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[158] *GBP* (1879), *Ahmedabad*, 125-26.

[159] Surendra Gopal (1975), *Commerce and Crafts of the Gujarat in the Sixteenth and Seventeenth Century*, 226. It was logical to prevent foreign merchants to manufacture saltpetre as it was used for manufacture of gunpowder used in artillery by the army. Even it was monopoly of the many of the kingdoms in medieval India. So the statement does not mean that the Indians were adverse to the adoption and promotion of technology. Environment plays an important role in the spread or rejection of modified / new technology.

manufacture. Even a Parsi who came to Dholera with pots in the hope of its manufacture failed owing to lack of knowledge and virtual absence of the local experts. It was chiefly used in warfare which led to the killing of the soldiers. The British government was in great need of saltpatre largely used in the making of gunpowder for the military requirements. The traditional manufacturing process was on the verge of collapse. In the said context, a British agent named Mr. Dunlop was made to report its manufacturing secrets. With the help of a local gentleman named Mr. Vaupell, he made a full account of its manufacture. I tried to trace this report in Maharashtra State Archives, but could not get hold of the report.

Wood Carving Work

J. A. G. Walls refers to the wood carving works in the Bombay Presidency in monograph '*A Monograph on Wood Carving in the Bombay Presidency*'. According to the document, wood-carving as an indigenous art was carried chiefly in Ahmedabad, Surat and Kanara in the Bombay Presidency. Sandalwood, Blackwood and teak were largely used as materials for the manufacture of varieties of finished articles. In Ahmedabad, boxwood from the northern India and in Surat '*sevan*' wood (*Gmelina Arorea)* was used to a small extent for wooden made products.[160]

He does provide the following description about the methods which was employed at Surat by the artisans to make products from wood. According to him: "Long narrow strips of ivory, ebony, tin, bone and '*pattan'* (Indian Redwood) are cut into a triangular shape and are fitted together in the cross section. The stick so made is lozenge-shaped. It is cut into pieces of about six inch in length and placed side by side. Strips are cut off about 1/16th of an inch thick and kept ready for use. The tin is shaped from tin wire by being pressed between two metal rollers, in one of which a triangular groove is cut; the other components are shaped with a plane of the necessary form. This *sadeli* can only be made in the rains as the glues (*saras*) made of hides can not be kept sufficiently most at any other time of the year. The tools used this process are simple and primitive in character. These consist chiefly of

[160] J. A. G. Walls (1902), *A Monograph on Wood Carving in the Bombay Presidency*, Bombay, 1-2.

handle-less chisels and gouges. It is also reported in the monograph that Surat artisans uses other tools such as planes, saws, etc. The same document also informs us about the leading artist of Surat having ten carving chisels (*pania*), the finest being little more than a sharpened needle, the coarsest about ¼ inch, eight pattern chisels and gouges (*Chitarvana Tankna*), and three venting chisels (*ar*). The pattern chisels and gouges are punches; these are used to decorate the plain spaces between the carvings in relief; one made a cut like a cross and gives a diapered effect, another made a circle, another a dotted segment of a circle and so on. The veining chisels are angular gouges, shaped like a 'V' are used to cut the veins of the leaves in floral designs. All the tools, with the exception of the saw which is of English origin are local production. Saw is manufactured from the English steel The another tool used is mallet which is a piece of heavy dark wood about nine inch long and a little over an inch square".[161]

Messers Mulchandbhai Hathising & Brothers were famous for wood carving in Ahmedabad. The farm had certificates from Antwerp and other exhibitions, and their work was known both in Europe and America. At one time, as many as one hundred and twenty five men were employed by the firm, but business was reported to be very slack at present and only about dozen find work. Most of the work now being turned out was for an American gentleman who was apparently furnishing a house with Ahmedabad wood-work.

Suthars of Surat were well known for working in wood. Besides *Suthars*, Parsis, *Ghanchis*, *Kachhias* and *Kumbhars* were also reported in Surat as wood carvers. As per the estimate of Walls, there were about forty wood carvers in Surat. He also informs us that the trade in wood was in the hands of the five small capitalists:- two Parsis, two *Brahma Kshatris* and one *Chippa*. It is reported that the two brothers, Ambaram and Bhukan Punja, *Suthars* by caste, became famous for making sandalwood boxes for sale. They did not share the secrets and worked behind the closed doors to exclude the local carver's competition. But over the period of time, artisans came to know about their secrets and gradually the technique was used by the artisans. *Suthars* in Surat were famous for toys. These consisted of models in

[161] *Ibid.*, 3-4.

wood of bullock's carts, *nautch* girls, elephants, etc., and were coloured by the *Mochis*.[162]

British Interest in Wood Carving: Lukewarm Response

British government was partially interested in this industry. They were not happy with the tools employed and shape of the articles manufactured. A European or Japanese workmen would often get an excellent effect with a few rapid cuts of a chiseler gauge, but for such work the force must be given by the muscles of the lower arm and play of the wrist and not by blows of a mallet. It was absolutely essential that the tools were handling less and more like sharpened nails than the chisels in use in Europe.

Mr. Wimbridge of Bombay introduced a style of furniture which depended more on good proportions and fine joinery for its beauty than on elaborate carving, and it had driven out of the fields, the florid ornament associated with the Indian furniture of former days. His example had been largely copied by the native furniture makers and simplicity of design was the characteristic of the most of the furniture now manufactured in Bombay.[163]

[162] *Ibid.*, 5.
[163] *Ibid.*, 9.

Ivory Work

Ceciel L. Burns refers to the ivory carving works in the Bombay Presidency in monograph '*A Monograph on Ivory Carving*'.[164] Ivory based products were made in Gujarat. It can be obtained from the tusks of elephants, walrus, narwhal and hippopotamus. It is a dental part which lies between bone and horn. It is used for knife-handles, billiard balls, key of musical instruments, mathematical scales, chess-men, for inlaying work, etc.[165]

It was renowned traditional industry of Gujarat. Ivory made products were sold in the markets in Gujarat and abroad. In India, it was used for making small round boxed for holding powder of sweetmeats, handles of sword, dagger and knives, brushes, combs, small figure, balls, button, etc.[166]

According to Burns, African elephants tusk was preferred over Asians ones. Former tusk was known for its whiteness, while latter turned yellow. He also provides information about the process used in the cutting, dyeing, bleaching and carving of ivory in order to make varieties of articles.[167] Cutting of ivory was done with saw which was basically a blade of fifteen to thirty inches in length and about an inch thick. It was set in a steel frame to make a very straight cut. The cutting of ivory depended on its uses or size. The mode of cutting the ivory must of course depend on the uses, to which it was to be applied, but in any case, it was desirable to mark out in some way before head, and also to pencil out the end of the piece before the saw was used longitudinally. The ivory contracted in the direction of the length, as well as in the width, but much less in the former than in the latter direction.[168] He further furnishes information about dyeing and bleaching of ivory. As per his reference, it was dyed with crimson red colour by dipping it into mordant of nitromuriate of tin and plunging it into a bath of Brazil wood, cochineal or mixture of both. A scarlet tint was produced by lac. If the scarlet ivory was plunged into a

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[164] Ceciel L. Burns (1900), *A Monograph on Ivory Carving*, Bombay, 1-10.
[165] *Ibid.*, 1.
[166] *Ibid.*, 3-4.
[167] *Ibid.*, 2-5.
[168] *Ibid.*, 2.

solution of potash, its colour turned to cherry red. To obtain yellow colour, the ivory was heated with tin mordant. A black dye might be given by boiling the ivory in a strained decoction of logwood and then stepping it in a solution of red sulphate or red acetate of iron. In dyeing process, the surface of ivory should not be polished until the dye was set. As soon as the ivory was taken out of the hot dye bath, it should be plunged in cold water to prevent the cracking. To avoid dark spots or patches, ivory should be rubbed down with chalk, and dyed once more. For bleaching, it was recommended that it should be scrubbed with sand and water. Articles made in ivory decomposed by exposure to air and moisture. It could be prevented by boiling it in a solution of gelatin.[169] Regarding the ivory carving technique, he reports that it was different from wood carving. Ivory was wrapped in wet cloths and continually re-damped for several days to make it soft. All the deep parts of the black-ground were drilled out of the required depth with small drills such as were used by goldsmiths, set in a revolving handle to which motion was given by means of a bow worked with the operator's right hand, while the drill handle was held with his left. The fretted portions of the designs, if such there be, were first drilled and cut into shape with a small fret-saw. Great care should be taken owing to brittle nature of ivory during the carving process.[170]

Burns reports that important ivory carving centres in the Bombay Presidency were located at Hala (Sindh), Kanara, Karachi, Poona and Surat.

He also vividly furnishes information about Surat as an ivory centre. In Surat, bangles of ivory were made with the help of ordinary wooden lathe. These were either coloured deep red or are covered outside with thin sheets of gold or silver. The ornamental boxes used for *hinghratia* for preserving '*kankoo*' a mixture of turmeric and carbonate of soda or vermillion invariably employed by natives; especially the women, when engaged in sacred duties or marriage festivals. He reports that it was applied in a wet or dry condition to the arms chest, ears and foreheads by means of the fingers or small round sticks. Even on ordinary days, women of almost all the classes had '*chanlas*' or small red circular spots or marks in the middle of their

[169] *Ibid.*, 3-4.
[170] *Ibid.*, 4.

foreheads, which were not only taken as signs of good omen, but were considered to add to the beauty of their faces. Snuff-boxes, buttons, dice, combs for dressing hair, paper-knives, English alphabets, small pictures carried in relief and ribbons for carved sandalwood boxes, etc., were also made. Amongst toys made were *kayels* (humming tops), *gughras* (jingling bells), chess boards, checkmates and *chakardis*, etc. Some of the vegetables shapes like radish, chilly, brinjal, etc., were also made.[171]

Stone Work

J. E. H. Tupper in the monograph '*Stone Carving and Inlaying in the Bombay Presidency*' estimates that stone industry was on the verge of decline in British Gujarat region. Only in Ahmedabad, it showed some sign of survival and continuity.

The following reason was offered by him for the decline of this industry. The executive officers trained by the colonial administrative system did not focus on the importance of the heritage. Therefore, its preservation was largely ignored by these officers. For example, *Mamlatdar,* a local officer based at *taluka* level was not interested or even educated for the love of art and architecture. It was obvious that old surviving building could not get the adequate attention from these administrators. Even surviving one did not documented in the official records. In one such interesting case, one of the *Mamlatdar* posted in Ahmedabad noticed only one temple constructed in twenty years. On survey, it was estimated that two more buildings existed![172]

In Surat, the only inlaid work was found in Jain temples. He observes that it was not worked on local pattern and experts including workers were employed from Agra.[173]

According to him: "Following tools are employed for stone carving. Two-handed saw for stone and marble cutting with the knife with considerable worn. A

[171] *Ibid.*, 10.
[172] J. E. H. Tupper (1906), *Stone Carving and Inlaying in the Bombay Presidency*, Bombay, 2-3.
[173] *Ibid.*, 8.

groove is chiseled in the stone to guide the blade and coarse sand from the river bed and water is applied. Set-square and measures, compasses, rasp, circular file, broad square are the other instruments. Edged chisel for chipping and smoothing, pointed chisel of four angles for soft stone work, round pointed chisel for hard stone and marble work, broad square-edged chisel for carving, small angle-edged chisel are used for making smooth stone surface. Drill, iron-headed mallet, template and leaf shape are used in the inlaying".[174]

Pottery Work

E. Maconochie in his monograph '*A Monograph on the Pottery and Glass Ware of the Bombay Presidency*' furnishes information about the pottery making, products and centres in the Bombay Presidency. According to him, pottery making was an ancient Indian industry. Cooking utensils, water storage vessels, toys, figurines of gods and goddesses, etc., were made with the traditional methods.

For making of pottery, selection of clay was very important task. White clay of Kachchh was considered good. Black mud of Narmada River was used for Broach pottery making. Natural clay of Ahmedabad and Patan were the other important one. Yellow earth of Sankheda and Bahadurpur in the Gaekwad territory were widely used in the pottery manufacture. Red earth of Mujlao in the Mandvi *taluka* of Surat was freely employed for pottery manufacture.

Pottery was made in the following manner. Clay was first dried and powered. It was mix with horse dung or husks to increase the binding capacity of the clay. The finished pottery vessel was thoroughly tapped with the flat mallet, a convex stone shaped sometimes like a dumb bell to support inside. It consolidated the clay and modified the shape. Tapping was performed early in the morning as it was less liable to crack. After backed in the fire, it was rubbed with a string of glass and a little of *sesamum* oil. Berries of the *Ritha* (soap-nut tree, *Sapindus trifoliatus*) were employed for the same purpose.

[174] *Ibid.*, 18.

The *Kumbhar* of Ahmedabad and Katargam near Surat had a method of coating toddy pots. Before tapping the toddy, vessels were heated before fire and the ash was rubbed on inside and out. *Sindur* (oxide of lead) was used to give red colour to the wax, *hartal* (sulphuret of arsenic) for yellow and oxide of copper for green. Little earthenware whistlers were made in Gujarat. At Katargam, flat bowls were manufactured to be used as kettle drums. An indigenous little toy consisting of a little drum of the sort, two earthenware wheels and an arrangement of sticks and catgut which beat the drum as it was drawn by a string was hawked about Surat at *Muharram*. Very good ordinary pottery was made at Ahmedabad. To colour the clay, red ochre (*geru*), white earth (*khadi*) and tale (*abhrak*) were used. Pipe bowls for smoking purpose were in great demand.[175]

Tools and Accessories of Potter's Craft

Vernacular Name	**Use**
Thalu or *Puthin*	Nave of wheel
Khil	Pivot
A'ra	Spokes
Tipani	Wooden mallet for tapping
Pindo	Convex stone used with mallet
Aritha seed	Ritha nuts used for polishing
Bhatthi	Kiln
Chak	Wheel

Source: E. Maconochie (1895), *A Monograph on the Pottery and Glass Ware of the Bombay Presidency*, 13.

[175] E. Maconochie (1895), *A Monograph on the Pottery and Glass Ware of the Bombay Presidency*, Bombay, 3-5.

Glass Manufacture

E. Maconochie in the same *monograph* furnishes information about the glass making in Kaira District. As per his best understanding, Kapadvanj in Kaira district was the only centre in the Bombay Presidency where the manufacture of glass was carried on as an indigenous industry. The *taluka* was rich in alkaline deposits, which had long been utilised in the manufacture of glass. The industry was on verge of decline in the wake of the European competition.

He also refers to the glass making process at Kapadvanj. Glass was made in the following way. Alkali (*us*) and impure carbonate of soda (*sajji khar*) and a dark-coloured flinty was procured from Jaipur. These materials were mixed and melted in large earthen furnaces shaped like huge slipper baths. When ready, the molten mass was allowed to run into a trench where it remained until it became cool. It was then broken up into small pieces and remitted as required. Bangles and glasses were made from it. Glass fragments intended for embroidery work was a favourite article. A lump of molten glass was taken from the furnace and blown into the form of a globe of thin glass. At one pole of the globe, a small hole was made and a small quantity of molten lead was poured in. The globe was revolved rapidly and the lead ran over the glass leaving a slight film of metal as it went and producing the appearance of looking glass. The globe was then broken into fragments which were ready for use in the embroidery.

Ranchhodlal Chhotalal from Ahmedabad started manufacture of glass vessels and lamp chimneys. Chimneys were in great demand especially from municipality. The service of a skilled European with a practical knowledge of glass work was hired by him. It was hoped that under his instruction, the native workmen would be able to turn out simple articles into specialised one; so that these would be able to compete with the European articles of the same grade. An attempt was made to utilise Kapadvanj ingredients, but the glass produced was so brittle and pronounced useless. The factory procured the materials from England. But it was hoped that in future, all the ingredients would be made locally.[176]

Iron Work

In pre-colonial era, Kachchh in Gujarat was known for excellent quality of iron manufactured products. Korij (Koteshwar in Kachchh) swords were high in demand. Here, ironsmiths first heated two bars of steeled iron. It was then put in charcoal within a crucible heated by a constant working of the bellows until the two bars melted and merged with each other. The merged metal was shaped into a sword and put under the wheel presumably to sharpen the sword's edges. Vinegar was, finally, applied to its surface; where after a fine damascened surface emerged.[177] The above example shows the potentiality of Gujarat in terms of iron manufactured articles.

Impure iron ore was cleaned into pure iron with the help of furnace which was based on traditional skill. Following description is provided by Sabyasachi Bhattacharya about the native furnace for iron manufacture: "The indigenous furnace for iron smelting is made of mud and stone with five to six feet in height. The furnace is thick at the base and tapered towards the top. The inside of the furnace is a truncated cone measuring about fourteen inches in diameter at the base and four inches at the top. The inside wall of the crucible is lined with cow dung and mud. The iron ore is broken up into very small pieces, mixed with charcoal in the ratio of 1:5 and poured into the heated furnace from the top. The blast produced with the action of the bellows worked manually is continued for twelve hours without break. After closing the holes the furnace is topped to let off the slag. The wall of the furnace broken and the metal in the form of lump of cinder is removed and hammered, and roundabout on the earth. The entire operation produces only twenty to twenty five pounds of impure iron".[178]

[176] *Ibid*, 8-9.
[177] Irfan Habib (2008), *A People History of India: Technology in Medieval India, c. 650-1750,* 49.
[178] Sabyasachi Bhattacharya (1970), "Cultural and Social Constrains on Technological Innovation and Development: Some Case Studies", 55-56.

When the British established their rule in India, they were very keen for the improvement in the iron manufacture on large scale for their colonial demands. There were two schools of thought about the means to improve the iron manufacture in India. One view was to introduce the western technology. Other opinion was to introduce it in the indigenous system of iron making and remove the defects. Naturally, first view prevailed and was adopted by the British government.[179]

Bhattacharya cites one interesting example of superiority of native technology in the field of iron manufacture.[180] An English Engineer named W. Olpherts suggested improvement in bellows. Bellows should be connected with a fan worked by a ten HP engine to provide powerful and constant blast. It should also fit with simultaneously to sixteen furnaces which would be placed in a row along the air-channel from fan. He also suggested to introduce imported steam powered double-acting hammers in place of manual hammering. Further, it was suggested that the iron bloom might be produced from the natural iron smelters. These should be worked in the government workshops for the manufacture of simple agriculture implements and household utensils. But the experiment failed. The long established traditional process of making iron could not be displacing by foreign innovation if latter was not well executed. For its success, experiments should be applied on wider scale with full financial support. The understanding of local conditions was taken into account with the view to fulfill the demands of the people. Natives would accept this innovation only if it would suit them and be able to compensate the then existing technology.[181]

W. V. Schudamore refers to the iron making at Surat in his monograph '*Iron and Steel Work in the Bombay Presidency*'. According to him, at Surat, there were four foundries. Parekh School of Art used some thirty five tons or iron per year in the first half of the 20th century. It supplied the local municipality, the PWD and private purchases with iron railings, brackets, piping, garden seats, etc. The three other foundries were private enterprises. The largest forms the part of Ghulam Baba

[179] *Ibid.*, 56.
[180] *Ibid.*, 57.
[181] *Ibid.*

Mills, where ginning, spinning and weaving were carried on. The out-turn was roughly the same as that of the Art School Foundry of Bombay. It was started in order to supply parts of machinery which required replacing and to avoid delay in procuring such parts from Bombay. He informs us that pillars and brackets for structural purposes were made. Private purchases were supplied with articles such as railings, garden-seats, school desks, hangers, etc. As per his estimate, the approximate value of the annual out-turn was Rs. 6,000. He also furnishes information about another foundry which was started at Mr. Motibhai Raghoji's ginning factory. Its operations were similar to those at Ghulam Baba Mills, but on a smaller scale. The fourth foundry was on the Varachha Road.[182]

Leather

A. Guthrie compiled a monograph '*Report on Leather Industries of the Bombay Presidency*' on the leather manufacturing industry in the Bombay Presidency.[183] According to him, raw material for leather was obtained from buffaloes, cow's sheep, goats, camel, *sambhar*, *nilgai*, etc., when they were slaughtered for food or else died.[184]

Leather was chiefly taken from dead animals. Prejudice regarding eating of beef by the Hindu and pig by the Muslim restricted the use of leather manufacture from cow and pig. The green hide or the hide in its raw state, if not curved within a few hours of death became irretrievable as leather. The risk was so great that even in the age of the railways, the green hides was never transported. This necessitated the tanner, who was usually the curer, to stay in close to the cattle population. The tanning substances, moreover, grew in the wild, were collected by the craftsmen and were rarely traded. The back of the ubiquitous *babul* (*Acacia arabica*), the nuts of *myrobalan* (*Terminalia chebula*) and the south's *avaram* bark (*Cassia auriculata*) also well-known as *tarwad* in western India and its tanner's were the best known tannin, whereas curing was usually done with saline earth. The raw material

182 W. V. Schudamore (1907), *Iron and Steel Work in the Bombay Presidency*, Bombay, 7.
183 A. Guthrie (1910), *Report on Leather Industries of the Bombay Presidency*, Bombay, 1-28.
184 *Ibid.*, 1.

frequently drew tanning into the neighbourhood of forests, which in turn led to the somewhat, more delicate industry in skins of wild animals. Large numbers of portable water bags (*mot* or *charsa*) in the western India were made from this.[185]

Mahars (*Dheds*) were the tanner worker in Gujarat. They were also associated with as village musicians performing at festivals. The making of drums and several other instruments, involved tanning skins or working with guts. It was, therefore, possible that tanners tended to make instruments and then became musicians themselves.[186]

Tirthankar Roy refers to the following information about the tanning process.[187] According to him: "The tanning process is simple. Flaying is usually done with a short and sharp knife called *rampi.* Next step is curing of hide. Curing is done by either sun-drying or salting the hide. In sun-drying, hide is left exposed to sun for several days to remove moisture and bacteria. During the exposure, hide becomes hard and developed crumpets. In this process, soaking and softening of the hide becomes difficult and hazardous. Another method is air drying. In this method, the hides are stretched on a frame and keep shade. Generally, the method most preferred by tanners is salt-cure where salt solutions are repeatedly painted on the flesh side of hide. The process is also often known as pickling in salt. In villages, in the unavailability of salt, the average village curer follow sun dried method for hides known as *sukties* or sun dried. The final step is tanning of hide. Tanning began with a preliminary soaking in water to de-salt the skin. It is then soaked in lime solution to remove hair. This process can either happen in a pit, or the skin is sewn up in a bag containing the solution that is repeatedly changed. Finally, the leather is smoothed and scoured (a process known as currying), oiled and sometimes dyed. The longer the soaking the better will be the hide. But in villages, the skin is merely wrapped in bark and soaked in water and almost never finished. It takes thirty to fifty days to finish the task".

[185] Tirthankar Roy (1999), *Traditional Industry in the Economy of Colonial India*, 158-59.
[186] *Ibid.*, 159.
[187] *Ibid.*, 163-64.

A. Guthrie who was appointed to survey traditional leather works provides following description about leather making in *Report on Leather Industries of the Bombay Presidency*: "Hides are cleaned by salt and then soften in water. Dried hide is infused of lime and water for few days to a month. In other process hides are put into a strong solution of salt and *dood* (milk plant- *akara*- *Calatropis gigantean*). Sheep skin are soaked in water for some period of time and then dried so that wool can be removed. Unhairing is carried by beam and scraping it with curved knife. *Rampi* and *shimpi* are other tools. After this, hide is again put in depilitants (solution of water and lime). *Vakal* knife is used to remove flesh from the hide. It is again cleaned with water to remove the depilitant effect. After this treatment, the *petts* are ready to be tanned and are thrown into water with a certain amount of the tanning agent used and left in this for from one to eight days, being moved every day. The liquor after this time is usually thrown away and the *petts* treated in similar liquor. Hides are then, usually, sewn into bags and the tonnage completed by filling these bags with tanning materials and water so that the liquor forces its way through the hides and so quickens the process. After the leather is supposed to be tanned, the bags are cut open and leather thrown into the liquor for a day or two to brighten the colour, etc., and then dried out, by spreading grain down on dry spent back".[188]

Another important monograph by J. R. Martin '*A Monograph on Tanning and Working in Leather in the Bombay Presidency*' refers to the different methods used in Ahmedabad. According to him: "Lime or *adka* and *jevasi* are used. The lime tanneries are substantial buildings with separate parts properly arranged and equipped for the several stages in preparing and tanning the hides. In case of poorer tanneries, the work is carried on a flimsy sheds whose chief equipment consists in a few earthen pots. No tools beyond the ordinary knife are used in the smaller established in the other carved shaving knives and beams and softening knives fixed on upright posts are found".[189]

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[188] A. Guthrie (1910), *Report on Leather Industries of the Bombay Presidency*, 6-8.
[189] J. R. Martin (1903), *A Monograph on Tanning and Working in Leather in the Bombay Presidency*, Bombay, 33.

Tanning Materials

Babul (*Acacia arabica*) especially bark of long trees, *Tarwar* (*Cassia auriculata*), *Myrabolans* (*Hurra, Hurdas*- fruit of *Terminalia chebula*), *Gottahar* (fruit of *Zizyphus xylopyrus*), *Sein* (*Terminalia tomentosa*), *Sachu*, *Jambul* (*Xylia dolabrifomis*), *Amli* leaves (*Phvllantus emblica*), *Behara* (*Terminalia belerica*), Pomegranate, Mangrove, Lime, oil of *til*, groundnut or safflower were used during the tanning process.[190]

British Initiative and Tannery

In India, Alfred Chatterton, Director of Industries, Madras Government introduced chrome-tanning, an USA invention.[191] The introduced technology enabled fast tanning of leather in comparison to traditional methods employed by the natives. It was not accepted as it was dearer and could be appointed only by big investor or large size factories.

It is noteworthy that according to contemporary estimate, India possessed the largest cattle population and probably was the world's largest suppliers of hides and skins. But religious biases of the people hindered the potentiality for the growth of leather industry in India.[192] Municipal slaughter-houses were set up by the end of the 19th century and it was understood that slaughtered cattle supplied better hides in comparison to dead cattle in terms of the quality. The hides of deceased cattle were not good because these were collected from starved and diseased animals.[193]

Centres of Leather Manufacture

Leather industry could be located on small scale in villages in Gujarat. In urban sub-regions of Ahmedabad, Surat and Panch Mahals, it is reported that leather products were made on large scale. The industry was not well organised and tanner or shoemaker worked for himself with his limited resources and output was limited. Only in a few places, there were factories and large tanneries. With financial crunch,

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[190] A. Guthrie (1910), *Report on Leather Industries of the Bombay Presidency*, 3-6.
[191] Tirthankar Roy (1999), *Traditional Industry in the Economy of Colonial India*, 164.
[192] *Ibid.*, 164-65.
[193] *Ibid.*, 166-67.

it is also reported that there was slow adoption of advanced process in manufacture by these traditional leather workers.

In large centers of trade like Bombay, Ahmedabad, Godhra, etc., the local tanners worked in factories either on a monthly wage or price-work according to the work performed. The tannery at Vegalpur in Surat turned out almost every class of leather required in India. It was perhaps the only place which employed the new and quicker American process of chemical tanning instead of the bark method. A large market was found in Bombay for its products and exports were also sent to England. Leather from Panch Mahals was sent to Indore and other centres of the central India. In Broach, by far the most important branch of the leather trade was the manufacture of the gin rollers. During the ginning season, the cutting of leather washes alone was noticeable. The remainder of the year was spent in tanning a few hides for local consumption. Next to Bombay, Ahmedabad was the most important center of this industry in the Presidency. In or near the city were tanners of considerable size. Besides satisfying local needs, there was a large export trade in and outside India.[194]

Tanning on a commercial scale was carried on in two places in Surat-Vejalpore and Katargam. At Vejalpore, there was a factory in which the new and quicker American processes of chemical tanning had replaced the bark method. Varieties of coloured and leather products were prepared in this factory. The factory was turning out finished leather of various classes for boot and factory use. Amongst other classes might be mentioned Russian leather, Moroccos, book binding skins, roller skins, belting and harness leather. At one time, these made a small amount of chrome leather but due to conservative attitude of *mochis*, it was given up. At Katargam, the factory turned out each year dyed and polished leather .[195]

Leather Products

Footwear, sandals, shoes, *sapat* (half-shoe), *mots* or *kos*, gin rollers, *pakhals*, water bucket, account book, saddler, harness, etc., were the products made from

[194] R. D. Choksey (1968), *Economic Life in the Bombay Gujarat, 1800-1939*, 222-23.
[195] A. Guthrie (1910), *Report on Leather Industries of the Bombay Presidency*, 16; J. R. Martin (1903), *A Monograph on Tanning and Working in Leather in the Bombay Presidency*, 33.

leather for public utility. Broach was famous for gin rollers making.[196] Whips, bell belts for cattle, straps for yoking oxen, ropes for strapping up the carts were made for agricultural purposes.[197]

Felt

It was made in the Bombay Presidency and used as a pad to be strapped on a horse's back as a saddle, or as a '*numdah*' underneath as saddle. When used for this purpose, it was called '*dali*' in Gujarat. The '*burnus*' whenever felt was called by that name, was also used as mattress. In Gujarat, felt cap called '*ghumti*', '*mochra*', etc., were worn during the monsoon as a protection from the rain. Felt making appeared to be almost confined to the Muslims butchers and *Pinjaras,* though in Ahmedabad *mochis* were also reported for its manufacture.[198]

Decline of Traditional Leather Industry

The water bag for irrigation was going out of use whenever newer and more centralised systems of water distribution became available. This was mentioned as one of the chief reasons for the decline of rural tanning in Gujarat. The peasants, moreover, preferred chrome-tanned leather in irrigation where he had the option, for the country made *mot* was notorious for its short life and frequent repairs, leaving the *ryot* at the mercy of the chuckler.[199]

All attempts to manufacture of glace goat in India were either failure or with partial success as its demand were high in the international market. The butcher indiscriminate cut of skins during slaughtering created problems for hides, and therefore, its price is lowered by the dealers.[200]

Old uses for leather were in decline. The oil and perfume contains, the water bay, saddler and embroidered shoes were essential ingredients of urban life in the early 19th century but quickly faded away. Glass and ceramics replaced leather in

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[196] *Ibid.*, 10-12.
[197] *Ibid.*, 13.
[198] B. A. Brendon (1899), *A Monograph on the Woollen Fabrics of the Bombay Presidency*, 12-13.
[199] Tirthankar Roy (1999), *Traditional Industry in the Economy of Colonial India*, 172.
[200] A. Guthrie (1910), *Report on Leather Industries of the Bombay Presidency*, 2.

some of its uses. Foreign shoes became popular among rich class owing to good quality and finish as a status symbol.[201]

From the above discussion, it can be fairly stated that there was gradual decline of traditional leather industry and developing urban centres especially in Surat adopted latest and advanced methods for leather products manufacture. Natives showed their willingness if they were in a position to do so. The traditional tanners and *mochis* under limited resources continued with native methods.

Paper Manufacture

R. T. F. Kirk in his monograph '*A Monograph on Paper Making in the Bombay Presidency*' provides information about the centres of paper manufacture, varieties of paper manufactures and process employed in the its manufacture.[202] According to him, during pre-British period, chief centres for paper manufacture were Roje, Ahmedabad, Erandol, Junnar, Nasik, Poona, Bijapur, Bagalkot, Gokak and Tilakot in the Bombay Presidency.[203]

In the Bombay Presidency, papers were made either by the native method or were machine made. The former was divided into two classes namely made from jute or old gunny bags and latter one remade from the old waste paper.

H. G. Briggs, traveller, merchant and minor civil servant in Bombay has given a vivid description of the entire process as he witnessed at Ahmedabad in 1847.[204] He writes: "The article (paper) manufactured is of rather a primitive features, but is strong and glazed, resembling similar material manipulation in Persia and North-West Provinces of India. From a thousand to fifteen heads are daily employed in saturating the bleached and putrescent Bengal hemp, *ganni* thread, etc., for the final preparation; with which at a subsequent stage it is mixed with quantity

[201] Tirthankar Roy (1999), *Traditional Industry in the Economy of Colonial India*, 187-88.
[202] R. T. F. Kirk (1908), *A Monograph on Paper Making in the Bombay Presidency*, Bombay, 1-9.
[203] *Ibid.*, 1.
[204] Cf. Makrand J. Mehta (1982), "Indigenous Paper Industry and Muslim Entrepreneurship: Case Study of Paper Technology and Trade of Ahmedabad with Special Reference to the 19th Century", *IJHS*, 17 (1), 55.

of wheat starch; the gelatinous mass is then received upon close matting drawn upon a frame very like that used by ladies in Berlin work. Sheet after sheet is thus taken off at the rate of forty an hour; when the day's labour is introduced between two stout boards, over which a couple of heavy stones are placed to wring off the superfluous water. So, soon as weight and heavy effected what is believed to be the desired result. Women are employed to separate the sheets, which are then secured to the walls of habitations of people engaged in this particular business. Upon being dried, the paper is removed and undergoes the operation of receiving that highly glazed appearance which it possessed by a marble roller smartly drawn over an angular concave surface".

Kirk in his monograph informs us that Ahmedabad was the main centre known for paper manufacture. To the north of Ahmedabad, ruins of old vats used for soaking jute rags were known as *Kagdi Pith.* These could be traced in Paldi Kochrab, a village on the side of the Sabarmati River.[205]

Kocharab village, now a part of Ahmedabad city emerged as paper manufacturing centre in medieval period, but it declined over the period of time. Though the traditional manufacturing of paper had gradually disappeared in Ahmedabad now, it is significant to note that a number of *kadgi* families still inhibit the Kocharab area. It is also noticeable that the local Muslims still believe in the tradition that the Arabs had their settlement at Kochrab on the banks of the Sabarmati River. It can be well understood that the term Kochrab is a corruption of the word *Kuck-i-Arab*, which means the settlement of the Arabs.

The paper manufactured here was exceedingly white and was one of the best in the country. Papers made in Ahmedabad were superior in quality to those of Kashmir and Daulatabad before the advent of the British in Gujarat.[206] It is also reported that Ahmedabad region was known for producing different varieties of papers. The papers used for the accounts and the legal purpose were thick, coarse

[205] R. T. F. Kirk (1908), *A Monograph on Paper Making in the Bombay Presidency*, 2.
[206] Makrand J. Mehta (1982), "Indigenous Paper Industry and Muslim Entrepreneurship: Case Study of Paper Technology and Trade of Ahmedabad with Special Reference to the 19th Century", 47.

and durable, the proportion of *san* as a raw material being greater than the other materials in the manufacturing process. The papers used for writing letters were rather thin and glossy and were mostly made out of paper and *san* clipping. The local manufactures used discarded san cloth, hemp, papers, fishermen's net and such other fibres substances as contained good amount of cellulose.[207]

The *Boharas* completely dominated the marketing of the paper products of Ahmedabad. They were wholesale paper merchants having about fifteen large warehouses in Kalupur area within the city. They exported the paper products to the north as far as Palanpur, to the west as far as Bhuj and Mandavi and also to the whole of Kathiwad and in south to Bombay.

The papers which Ahmedabad manufactured and exported were of different varieties distinctly known as *sahebkhani*, *mahmudshai*, *khambati*, *barigoria*, *karchi* and *gosia.* The *barigoria* which were of inferior quality fetched only three *annas* per quire. Ahmedabad also produced thick white papers ornaments with gold. These were used for writing complementary letters and invitation by persons in rank and wealth.[208]

Raw Material

For manufacture of paper raw materials used were paper cutting, old banks accounts, discarded newspaper and journals. In spite of higher cellulose value of cotton and a number of cotton mills, it was not used for paper manufacture at all.[209]

For process of paper manufacture in the 19th century Gujarat see **Appendix No. V**.

The local customers often complained that the Ahmedabad paper varieties were not only more costly but also inferior in quality as compared to the papers imported from Britain. These papers contained the particles of sand on account of

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[207] *Ibid.*, 48.
[208] *Ibid.*, 50.
[209] *Ibid.*, 51.

carelessness of the *kagdis*. During the process of manufacture, particles of sand got into the pulp; these came out while the paper was being burnished. This damaged the paper by making imperceptible holes in it.[210]

Around 1873, the paper manufacturers of Ahmedabad took up a challenge by setting up a steam operated paper mill, the first paper concern on modern lines ever floated, managed and expertise.[211] In 1877, Jamaludin Muhammadbhai set up a paper mill with two steam-factories and two engines employing about fifty persons daily. The paper mill used the same raw materials as were in other places.[212]

The Ahmedabad Mill witnessed flood (23rd September, 1875), swept off the plant and machinery from Shahpur area where it was located. The machinery was rescued and set up at the Shahi Bag area of the city, but finally in the same year, it was closed.[213] Reasons were unknown for its closure.

Role of the British Government

Charles Wood, Secretary of State for India (1859-66) during his tenure ordered that all paper used in the government offices should be purchased from England.[214] This decision gave set back to the traditional paper industry of India. But rising demand of paper forced the government to start a number of paper manufacturing plants in the western India.

Kirk refers the following details about the techniques used in the paper making: "For the manufacture of paper in Ahmedabad gunny bags and sometimes waste paper are used. Muslims of Shahpur area in Ahmedabad known as Kagdi Muslim are reported for its manufacture. The bags are cut with an instrument *saggars* mostly by the Hindus. When cut into small pieces, these are washed in the river to separate the fibres. It is mixed with quicklime and left in tanks for two to four days. When the jute soaks sufficient solution, it is send to the beater (*dhegi*).

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210 *Ibid.*, 55-56.
211 *Ibid.*, 56.
212 *Ibid*.
213 *Ibid*.
214 Irfan Habib (2007), *A People's History of India: Indian Economy, 1858-1914*, 98.

The instrument used for beating consists of a heavy wooden beam levered over a cross-bar about two feet above the ground. To the long arm of the lever, beam is attached with a heavy cone of wood with its apex to the end of the beam, and this acts as beater. The shorter arm of the lever beam is let into a space in the *ota*, which is raised one foot above the last of the stone floor of the well in which the fibre is beaten. On this *ota*, two men stand to each *dhegi*, holding on to ropes which hang down the short arm, and then slipping their feet off at the same moment, they let the heavy long arm fall on the pulp, which is heaped on the stone floor. A third man squats in the well to push pulp under the cone at each stroke, and to see that each portions of the mass is probably beaten. The above process requires great precision. A workman can lose his finger if there is slightest mistake under the cone. Jute is then beaten into pulp. It is again washed and mixed with *sajikhar* (a black mineral, chiefly carbonate of soda obtained from Bikaner) and quicklime (*chunam*). After fifteen days, it is washed with *parantij* (vegetable oil soap) and again beaten. Beating of pulp is done at least five to six times. It is reported that soap is used for pulp washing. The pulp is again beaten for two days in water in order to reduce it into thin gruel. Water is removed and the residue obtained is washed once more in the river. The next step is paper making. The cleaned residue is brought to the houses of the paper makers. It is put into cemented vats six feet square and four feet deep, stirred carefully in water and allowed all night to settle. Next morning, the paper maker takes a wooden plate (*sacha*) about four feet by three feet, rectangular in shape, with six or weight cross-bars, over which is stretched a fine screen (*chhapri*) of grass stalk (*mir*), sewn together with vertical horse hairs about one inch apart and kept by a stick made to fit in at each side. These sticks are used to stir up the liquid. The paper-maker leans over the vats and takes the frame containing the screen in both hands, dipped into the water and draws the screen, which acts as a sieve, slowly and evenly to the top, and smartly manipulats it so that a uniform filament of pulp is left upon the screen as it emerges from the water. Water is drained off. To obtain thick paper, two layers are taken, or even more. The workmen removes the screen from the frame after draining it, inverted it on a flat board with the paper face downwards. The paper is rolled by leaving the wet sheet behind on the board. The next sheet is put over this one and the process repeated until twenty four sheets are rolled on one board. Another board is used over it to with a heavy weight to squeeze out the water. Each sheet is carefully skinned off and pasted separately on the *chunam*-covered wall usually done by the women. The dry sheets are cut in uniform size and sent to *serghars* who are generally Muslims. Kirk estimates that about a dozen families of *Serghars* were residing in Kalupur locality. They spread the rough paper on a size made of finely ground wheat boiled in water. After one side is sized, the sheet is hung on a string to dry before the other side can be treated. When both sides are dried, the paper is handed over to the *Morkhus*, also Muslims, who roll it with heavy wooden rollers like pastry rollers on a wooden pillow, till it takes a polish".[215]

Five kinds of paper were made:- *dolatabadi*, *aahebhkani*, *nana khambati*, *nana murasi* and *vala* or *gajia*.[216]

Plants of fibrous nature used for the paper manufacture were compiled in *The Dictionary of Economic Products of India* by George Watt; paper was made from these plants in the Indian jails by the prisoners. Steam boilers and manufactories were fitted with pounder, treading vats and polishing implements were introduced. Over a period of time, the British government started manufacturing paper from the bamboo, but in the process a large amount of alkali was required to remove the starchy carbohydrates. In 1931, new machines were further introduced to solve the technical issues in this process.[217]

Kirk also furnishes information about machine made paper in the Bombay Presidency. According to him: "There are three paper mills in the Bombay Presidency. The mill at Bombay gets closed in the last decade of the 19th century. In Surat, the mill is reported to operate only for two months. The last one known as Deccan Mills Co. Ltd, Poona is in working state. The author does provide the details about the paper manufacture in this mill. The mill is equipped with ordinary machines. A willow and a duster, five boilers, five washing engines, five beating engines, a four drainer machine capable of producing at a speed of about two hundred feet per minute, besides paper cutters and single sheet cullers, constitute the

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[215] R. T. F. Kirk (1908), *A Monograph on Paper Making in the Bombay Presidency*, 3-5.
[216] *Ibid.*, 5.
[217] Sita Ramaseshan (1989), "The History of Paper in India Upto 1948", *IJHS*, 24 (2), 114 & 118.

plant. Further, a plate calendar is used for glazing high class papers. It is reported that the paper machine is procured in 1883-84. Ordinary papers are made here. Other varieties of paper like blotting paper, newspaper, art paper or card board are not generally manufactured. The materials used are rags (mostly cotton), grass, wood pulp chemically isolated by the sulphite process and imported from Sweden, fragments of old tent-cloth and gunny bags, old waste paper and mechanical wood pulp. He notes that in Europe, rag-collection is a separate industry. The mills in Europe are supplied with pure material and the output is excellent and of good quality. In contrast in India, mills are supplied with impure materials and quality is pronounced moderate. He estimates that only 50% of supplied material is found useful for paper making.[218]

In the course of time, some of the paper manufacturing mills were established in the Bombay Presidency. These were:

Year	Name of the Paper Mill	Location	Details
1862	Girgaum Paper Mill	Bombay	Run by a Parsi named Framji Byramji
1878	Not named	Ahmedabad	Steam paper mill run by a *Bohra* named Jamaludin Muhammadbhai
1878	Not named	Surat	Steam paper mill run by an unknown Muslim

Sources: Sita Ramaseshan (1989), "The History of Paper in India Upto 1948", 117 and Makrand J. Mehta (1982), 'Indigenous Paper Industry and Muslim Entrepreneurship: Case Study of Paper Technology and Trade of Ahmedabad with Special Reference to the 19th Century', 56.

[218] R. T. F. Kirk (1908), *A Monograph on Paper Making in the Bombay Presidency*, 8.

Liquor

In Gujarat, toddy and *mahua* were used as liquors. These beverages were made by traditional methods and had nutritional values against diseases. Inhabitants, especially, of forest areas used liquors for drinking purpose without any side-effects. Parsis when they settled in south Gujarat and became its part and parcel emerged instrumental in its commercial manufacture. They, further, harmonised with the English Government for the manufacture of liquor and sprit through distillation process.

In Dangs, liquor was distilled in the villages as a base the *sugaryi* flower of the *mahua* tree. Another was toddy which was fermented palm juice similar in strength to beer. Parsi distillers of Surat manufactured fine *mahua* based liquor which were flavoured such delicious as Mozambique lemons, pineapples, mangoes, *falsa* fruits, roses, jasmine, *mogra* flowers, cardamoms, currants and aniseed. In some cases they allowed these drinks to mature for over forty years before consumption.[219]

According to David Hardiman: "Toddy has nutritional values. It is full of calories and also contains many vitamins important for good health. It provids both a substitute for more solid foods and acts also as an acid in the digestion of coarse and heavy unleavened breads which these classes eat. It is taken as a medicine during illness, provids protection against malaria, cholera and plague. In nutritional terms, distilled liquor provides calories but lacks vitamins, minerals and proteins as these are destroyed in the process of distillation. Toddy is fermented juice of any kind of palm tree such as coconut, brab, palmya or date palm. In south Gujarat, the date-palm (*khajuri*) is the tree used chiefly for toddy production. The sap of the palm is collected in earthen pots. When collected in cleaned and lime-washed pots, there is no immediate fermentation and a non-alcoholic drink called *nira* is the result. The poor and landless peasants of south Gujarat do not, however, relish *nira*. They prefer to draw the palm-sap in old pots in which little old toddy is left. This causes the sap

[219] David Hardiman (2006), *Histories for the Subordinated*, 63, 189.

to ferment in a matter of hours. After about four hours, sweet toddy is produced with 5% alcohol. After twenty four hours, much stronger sour toddy is produced with 8% alcohol. Further, fermentation does not make the drink any stronger, but by now very sour liquid can be heated a spiced to make better toddy which is deemed to be used by the heavy drinkers".[220]

The first step in starting a plantation of date palm trees was to have the land ploughed and done before the rainy season. Two years old plants were taken off and planted about eleven feet apart. After the rainy season, plants should be watered and land must be cleared of weeds and grass. During the second rainy season, the plants required no watering. It began to yield juice when it was about eight years old, and it could be productive for about twenty years or more. The juice could only be taken for a limited period each year, a total of about three months being the maximum duration which a single tree could bear. Within this period, the tree had in addition to be given regular rests from tapping. It was also considered advisable to allow a tree to keep fallow every two year. The most productive period for a tree was between November and March each year but a lot of toddy was tapped from April to June when the need for the toddy as a food substitute was greatest. The toddy tapping season could be continued from November to June each year. Yields differed considerably according to the quality of the tree. The yield of a wild date without watering from ten to five pints average about 7 ½ pints of liquor a day; or a yield of forty gallons during fifty five days of the total average yearly number of tapping days. If the tree was watered before the juice was extracted, it would yield ¼ more than the above estimate. The *mahua* tree flowered in the March-April periods, and the sweet, sugary flowers were collected and stored until required. In years of scarcity, it was a valuable food for both the peasants and their cattle. The surplus was either made into liquor or sold. Liquor was made first by soaking flowers in a big earthen pot for a week or more. Fermentation occurred and a mash was produced. This was then boiled in an earthen pot, the neck of which was joined to a tube of bamboo with a seal of earth. The vapour from the boiling mash passed through this tube into another pot, which was immersed in water so as to cool and thus liquefy the vapour which became liquor. Country liquor of this sort was a fairly mild spirit

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[220] *Ibid.*, 194.

containing about 15% to 30% alcohol. As the equipment for this process was extremely simple and cheap, country liquor could be made by peasants with ease. In south Gujarat, *mahua* trees grew on large scale only in the hilly regions, inhabited largely by *adivasis* and it was only in this area that *daru* revealed toddy as a popular drink. Most of the *daru* made by professional liquor manufacturers (mostly Parsis) was made from *mahua* imported into the area from north Gujarat, Khandesh, Central Provinces and Konkan. Even before the colonial periods, *daru* was to some extent a marketed commodity because of Parsis.[221]

With the double object of introducing a new industry and for checking the manufacture of liquor, the government of Bombay in 25th November, 1874 authorised the Collector of Surat to spend a sum of Rs. 1,500 in an attempt to introduce the Bengal system of manufacturing sugar from the juice of wild date palms. Skilled workmen were called from Jessore in Bengal (now in Bangladesh) succeeded in making sugar. Experiments had been repeated for more satisfactory results, but still it was hardly possible to replace toddy.[222]

After the Distillery Act of 1878, distilleries were established in various *talukas* of Surat and soon pressure was brought to adopt this system by the princely states. By 1888, Navsari *taluka* of Baroda and the states of Sachin, Bansda, Dharampur, Surgana and Rajpipla were all covered by the central distilleries. Some Parsis were allowed to operate distillery in Surat and they made both the renowned *Surti masala daru* as well as cheap unspiced *daru* for mass consumption. Pritchard, the first *Abkari* Commissioner for Bombay Presidency gave monopoly in liquor manufactured to a well-known Parsi Dababhai Dubash (held monopoly in liquor for Poona, a coal mafia and dockyard contractor for Bombay) for Surat on contract basis for three years. Opposition came from Parsis community because of destruction of *Surti masala daru* which was banned by government and also because Dubash and Company liquor tasted bad, sugary and weak. Displaced local manufactured formed a company and brought up all of the liquor farms of Navsari *taluka* of Baroda State.

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[221] *GBP* (1877), *Surat and Broach*, 39-40; David Hardiman (2006), *Histories for the Subordinated*, 195, 196-98.
[222] *GBP* (1877), *Surat and Broach*, 41.

They proceeded to sell cheap liquor at shops along the border with Surat, thus were able to destroy the trade of the Surat monopolist. As these two areas were much intermingled, this strategy proved extremely effective. Dubash & Co. had to lower their prices and finally ended in loss.[223]

The alcohol trade in the Bombay Presidency was dominated by the Parsis. Though, it was taboo for them as per their religious scriptures, the practice was well justified in the *Dadistan-i-Dinik* as those who drink wine in moderation was not sin but good work to be promoted. The question of rigidity and flexibility is quite interesting in this regard. For Muslims, Hindus (excluding lower caste or say tribals) and Parsis taking or manufacturing of liquor is considered as sin; but Parsis were able to overcome this hurdle by giving a new interpretation to the teaching of the Holy Scriptures in context of liquor manufacture to their survival.[224]

Mr. Sorabji Patel Experiments to Manufacture *Gul* (or *Gool*) from Date Palm

In Umbergaon (now part of south Gujarat) *Peta* of Thana district, some of the Parsis families occasionally prepare *gul* from the date palm. An enterprising Parsi landlord named Mr. Sorabji B. Patel of the same area owned large number of date palms on his estate. He submitted a petition in 1914 to the Collector of Thana for being allowed to tap 1,000 trees free of excise tax for the jiggery manufacture. He also obtained a memoir on '*Date Sugar Industry in Bengal*' written by Annett. He was granted permission to tap date palm trees free of excise tax for *gool* manufacture. Indigenous technology to collect sap was followed. Along with this, Bengal technique was tried for the sake of increasing the production of *gool*. The pots were limed as per the license of the Excise Department of the Bombay Presidency. His tappers were quite new, unaccustomed, and moreover, unwilling to take the extra trouble and care required in maintaining the cuts at the required degree of cleanliness; that they were not allowed to drink fresh toddy which was their common practice while drawing fermented toddy; put them in strain so much that he had to provide them with their drink by issuing for the purpose domestic

[223] David Hardiman (2006), *Histories for the Subordinated*, 204-06.
[224] Eckehard Kulke (1974), *The Parsees in India: A Minority as Social Change*, Delhi: Vikas Pub., 54-55.

consumption license of ten trees for twenty tappers; his inexperience in *gool* making was another disadvantage and the departmental *gool* maker who were supplied being unable to negotiate with the juice. As a result the product was very poor and consisting of large portion of sticky molasses. He suffered a huge financial loss. To prevent fermentation, three cubic centimetre of 10% formalin per pot was tried on a fairly large scale the first, second and third days of a tapping period; the juice obtained on all the days was quite clear and unfermented and produced good hard solid and granular *gool*. The result was encouraging but too late for Sorabji to apply to his ongoing experiments. He did not lose his heart and determined to hit the bull's eye. For the said purpose, he even visited Bengal and undertook the experiment second time with three hundred date trees. Tapping the juice, period was shortened and his tappers also got somewhat used to better care and cleanliness in operating the cuts; liming of the pot was regularly followed as required by the condition of the license. As a result, large quantities of juice with less molasses were obtained and fetched good profit. He, even, allowed Bombay Agriculture Department to conduct experiments at his firm, placed five hundred date palms at their disposal. Side by side, he went for his ongoing experiments to increase the yield of the sap from the date palms. Government entirely followed the Bengal method of *gool* manufacture. Sorabji went ahead with indigenous method of incision, but with shorter periods of tapping and rest of he followed the Bengal method. Government hired tappers from Bengal, but they decided to go back owing to difficulty in language and habits of the new climate and many of them suffered from malaria. Sorabji after finding in the Departmental experiments that smoking of the pots was simple, inexpensive and more efficient that liming; he obtained permission to resort to the smoking process. Another cultivator of the area, *Koli* by caste started the *gool* manufacture inspired by Sorabji experiment, but the quality was inferior as compared to Sorabji.[225]

[225] V. G. Gokhale (1920), "Palm Gul Manufacture in the Bombay Presidency (Principally Date Palm)", *Bulletin No. 93 of 1919*, Department of Agriculture, Bombay, 3, 7-8 & 12-14.

Oil Making Industry

The British government was interested in the methods employed by the natives to extract the oil from seeds. In the process, Y. G. Pandit was deputed to report about the traditional methods used in oil extraction, instruments used by the people and necessary recommendation and suggestion to the government. During his tour in the various sub-regions of the Bombay Presidency, he compiled a monograph '*Report on the Oil-Pressing Industry of the Bombay Presidency*' to the government. According to him, oil pressing was an ancient industry in India. During the colonial period in Gujarat, the same process was in existence. Oil was extracted with a native instrument called *ghani* similar to the sugarcane crushing instrument. Oil was used for cooking purpose. Its refuse was used as fodder for animals. It was already discussed under the section 'Animal Husbandry' of Chapter Three that oil cakes were provided as fodder to milch animal which increased the *ghee* making quality of the milk obtained. It was also used as manure for agricultural purposes. Some of the communities, especially *telis* did not use oil cake for manuring. They also pronounced that it was not suitable for animal feeding. It is also reported that refuse obtained from the iron crusher mills introduced by the British government was also not used by these groups. The reason for its refusal was that the oil extracted in the mills was dark in colour and taste was slightly bitter. Unfortunately, the cake which could be of great importance was exported to Germany, France, UK and Belgium.[226]

With the establishment of the British rule in Gujarat, gradually oil pressing industries were established. These mills used European methods and equipped with latest instruments. The author claims that biases of the natives were slowly faded away when they came to know about its advantages. He also informs us that still in villages; *ghanis* were used for oil extraction employing traditional method.

Y. G. Pandit in his *Report on the Oil-Pressing Industry of the Bombay Presidency* refers to the traditional and European machinery to extract oil. Following methods for oil-pressing is described in the monograph:[227] "A native instrument

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[226] Y. G. Pandit (1910), *Report on the Oil-Pressing Industry of the Bombay Presidency*, Bombay, 7.
[227] *Ibid.*, 13-15.

called *ghani* consists of a wooden mortal with a long wooden pestle. It is based on the principle of lever and fulcrum. A bullock or a camel is used to rotate it in circular fashion. There are two types of *ghanis.* The first one known as *Wantagana* is drawn by one bullock. Oil is collected through the hole in the bottom and heated. The next one called *jodgana* is rotated by two bullocks. With the action of the pestle, the oil is collected at the bottom. The instrument can be used to extract oil from seed, except castor one. He also reports about Rotary *ghani* which works on the mortar and pestle, but it is made of iron and rotated by an oil engine. As per his estimate, the output of oil in the rotary *ghani* is high. But owing to the high cost in its repair, traditional *ghani* is preferred. Screw press is another instrument consists of twenty five plates arranged in vertical position on a long horizontal iron rod operated by a lever. With the heating action of plates, oil is let to enter into a tank. Deposited oil is filtered to get it in clean condition. Premier press is another one where cold process is applied. Seeds are pressed and crushing in the shape of the cake. It is ground in a roller. It is subjected to steam for the second expression. The cold drawn oil is used for edible purpose and also for commercial demand. He also refers to the Anglo-American method in which the crushed seeds are put into a kettle with the help of elevators from the roller mill and the seed heated by means of steam. The author observes that in place of 'Cold-pressed Method', the 'Cage Process' is preferred. In this method, a circular box or cage with slides on the top and bottom to control its opening. It is used to minimize the loss of oil. All the above described methods are based on physical procedure. Chemical method is the next process which can be based either on hot or cold extractions. Solvents like carbon bi-sulphate petroleum, petroleum ether and tetrachloride of carbon are used to extract oil. Its refuse can be used as manure. It is pronounced not suitable as cattle food".

Following oil pressing industries were opened in the British Gujarat districts. The Indian Cotton Oil Company Lt., Vejalpur, Navsari had complete hydraulic plant, linters, hullas, separating machinery, rolls, etc., along with refinery. Cake received from this was exported to Europe for cattle food and refined oil for the Bombay Presidency. Hulls were used up locally mostly by dairy cattle as a fodder. Soap-stock, a waste product left after refining crude oil was used for soap making. Shri Narmada Cotton Seed Oil Company Limited, Broach in 1908 had linting and decorticating machinery and also a refinery attached to it. Shri Sayaji Cottonseed Oil Company Limited, Baroda (1908) had machinery on the English style to work on whole cottonseed. This factory was closed because of poor refining and high transportation charge owing to its distance from road and railway. These tried to work on castor seed, *til* seed and groundnut but of no avail. Thasra Oil Mill of Govindlal Desai had two small presses and castor and *mawra* seeds were crushed. The Rajnagar Oil and Manufacturing Company Limited, Ahmedabad worked on castor seed oil and cake. Oil was used locally for lubricating and cake was shipped to Poona as manure for sugarcane plantation. They attempted to curb *til* seed, but could not do it successfully owing to steam in the kettle being slight, colouring matter precipitated from the finer seed-shell. Their oil was inferior in quality to *ghani* which entailed always a 'Cold drawn' process. The Gujarat Oil Mill and Manufacturing Company Lt. had six presses in all, four Anglo-American presses and two Premier presses and machinery was by Messer Rose Downs and Thompson Lt. The Vishnu Rice and Oil Mills got one expeller and about half a dozen rotary *ghanis*. The Bombay, Baroda and Central Indian Railway had big mill at Sabarmati to crush castor seed for lubricating purpose. Mahomedan Flour & Oil Mill and Abdur Husain, Mulla Ahmedji & Company Oil Mill at Sidhpur were other ones.[228]

Navigation

India was known for its navigational skills since antiquity and this was also accepted by the British government when they established their rule in India as referred in Chapter Two.

The importance of Indian rivers was well understood by the Europeans. Indian rivers which were used for navigation by the natives were surveyed by the British appointed experts. Ganga River was surveyed extensively followed by the Indus River. This objective could be well understood in case of the western India. In the western India, coal was imported from Madhya Pradesh through Narmada River to Broach and Surat and reached England via Bombay. The project was dropped

[228] *Ibid.*, 3-4.

owing to high cost in the transportation process.[229] The navigational rivers were used for transportation and ships of different sizes were freely used for this.

Timber and Other Woods Used in Ship Construction

England's strength was based on its naval fleet. Its trade was largely done via oceans with the use of ships which were made of wood. This led to excessive exploitation of forest in England for the manufacture of vessels led to wood scarcity. Depletion of its oak forest and loss of American colonies made the situation worse.[230] In this case of emergency, the obvious choice was Indian forest and Gujarat played vital role in this regard. Large quantities of teak could be obtained in many parts of the sub-continent:- at Canara, Malabar, Bombay, Surat, etc.[231] These woods were known for durability, lightness and its cost in India was about half the price of oak in England. Besides, teak which was best and largely used in ship construction, there were other Indian timbers which were also employed. Saul timber was suitable for hulls and dock planking, while the *morang saul* was useful for keels, stern posts, beams and other parts where straight timber was required.[232] *Sissoo,* a hardwood was suitable for the parts which could be dry or where toughness was required, as in caps and drum heads of cap stands. With respect to cordage, India produced coir, *ejoo,* plantain. Coir was highly prized for its elasticity and lightness and *ejoo* for durability, plantain for strength.[233] The British were convinced with the superiority of Indian made vessels from locally procured woods.

See-Saw Struggle: Indian Rabbeting Vs. European Caulking

Indian craftsmen used rabbeting process (one plank fixed with into other plank cut mark) for the ship construction. Europeans mostly used caulking, a technology of making joints or seams tight or leak-proof by oakum between that were not tightly fitted. Indian craftsmen knew about caulking but did not adopt it. The advantage of rabbeting method was acknowledged by the British. Indian ship

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229 David Arnold (1999), *The New Cambridge History of India: Science, Technology and Medicine in Colonial India,* 20.

230 Satpal Sangwan (1995), "The Sinking Ships: Colonial Policy and Decline of Indian Shipping, 1735-1835", in Roy Macleod and Deepak Kumar (eds), *Technology and the Raj, Western Technology and Technical Transfers to India, 1700-1947,* 140.

231 *Ibid.*, 141.

232 *Ibid*.

233 *Ibid.*, 140-41.

was cheap in comparison to the British one. When British settled in India, they adopted rabbeting technique for ship building. The case shows the superiority of Indian vessel making technique. Indians joined the planks by stitching or sewing them with ropes, the Europeans did so by using nail. It was reported that Chinese used nail prior to Europeans for the ships. In this regard, gradually iron nails were adopted and used in the Indian ships. Indians learned the use of nail for the construction of ships when Portuguese entered into the Indian Ocean. It is well known fact that why Indian did not used iron in ships. The iron would attract towards submerged stones with magnetic property to avoid any accident. Indians used stone anchors for the same reason. Later, they adopted the use of iron anchors particularly under the European influence and partly through their own efforts. The seasonal attachment of layers of fresh planks to the hull of a ship as protection against sea-worms and leakages was known in China and Europeans. It was in the 16th century that Indians used lime to protect timber against pests.[234] The above discussion shows the superiority of Indian ship making techniques. The natives even adopted the European skills as per the requirement of the time.

Water Storage in Ship: British Had Upper Edge

Information regarding the techniques used for the water storage is furnished by A. J. Qaiser. Indian seamen stored fresh water in one or two big wooden cistern. It was well-pitched and placed by the main reaching from the lower deck to the bottom. Europeans used casks, jars or pipes. European ships used pipe system to store water. The advantage of this apparatus was that during cannon shots, all the pipes were not damaged. But these pipes frequently needed repairs for which the constant service of a cooper was necessary. Sometimes, when European built a caulked ship in India, they adopted the Indian method of storing water. In case of leak or stream usually, water was taken out with buckets by the Indians. On the other hand, Europeans ships were fitted with pumps. They used piston-pumps before the opening of 17th century, but shifted to iron chain-pumps perhaps inspired by the

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[234] A. J. Qaiser (1982), *Indian Response to European Technology and Culture, 1498-1707*, 20-28, 33-34. Also see Lotika Vardharajan (ed.) (2012), *Gujarat and Sea*, Vadodara: Darsak Itihas Nidhi; Irfan Habib (ed.) (1997), *Akbar and His India*, New Delhi: OUP; Paul Lunde (2010), "Joao de Castro's Hydrographic Survey of the West Coast of India", Paper Presented at 'Gujarat and Sea' Seminar, 1st-3rd October, 2010 at Ahmedabad.

Chinese who were reported to have employed wooden chain-pumps. Muqarab Khan, in charge of the Surat and Cambay port asked in 1612 to English to provide a model of a Chinese pump. Regarding Indian response to this sources are very scarce. We cannot assertion any inference that Indian system was defective or they disliked pipe system.[235]

Natives were keen to adopt the European innovation in the field of navigation. In 1903, when a number of glassware items including telescope were offered for sale at Surat by English factors telescopes were purchased. It can be assumed that there was consciousness among the Indian sailors to use European made instruments as per the requirement and their purchasing capacity.[236]

Indian Ships and Its Care-Takers

Boats and ships of different sizes for different purposes were built in various parts of India. The local boats ranged from small crafts of five tons burthen to fair-sized scows of sixty tons. Some drew as little as eighteen inches of water and others as much as five feet. Ships were built at Surat, Bombay and Daman. Surat was famous for the construction of fine ships of all sizes and capacities over one thousand tons. In fact, the carpenters of Surat ship wrights had become experts and many of their ships exceeded in shape compared to England or Holland one. Indian ships were also superior on account of their durability. Ships made of Malabar teak in the Bombay dockyard were seaworthy even after fifty years of service, while English ships made of oak and elm, seldom lasted more than three voyages.[237]

About the care-takers of the ships and their methods following information is provided by Monier Williams:[238]

> Vessels are without decks and are rigged with a single mast and a large square-sail, with a small mizzen and jib, all made of coarse cotton cloth which is very light. The men who navigate them are called Kharwas of whom about ½ are Hindu and others Muslims; they are the natives of Surat. The crew of the largest of the above vessels commonly consists of fourteen and of the smallest, eleven men, including the Tindal gets Rs. 8 and the lascars Rs. 4 each besides

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[235] *Ibid.*, 30-32.
[236] *Ibid.*, 35.
[237] Satpal Sangwan (1991), *Science, Technology and Colonisation: An Indian Experience, 1757-1857*, 6-7.
[238] Monier Williams (1855), "Memoir on the *Zilla* of *Baroche*", 57-58.

> provisions for a trip to Bombay to sea. The average of a passage to Bombay from the Broach may be five days and of the return eight days. No compass is used, or reckoning kept, in this navigation; but sounding is much attended to. The provisions of these men consists of *Kidjeree* and salt fish with ghee, a little seasoning, and sometimes concerned vegetables but nothing else.

British Were Forced to Acknowledge Indian Mastery in Ship Manufacture: Parsis as Master Ship Builders

In the field of ship manufacture, the whole plan was executed by the Indian master builder with the help of local workmen and labourers who worked under him. The superiority of Indian-built ship its excellency in techniques employed. The British did not accept this fact for a long time. They floated the myth that it was due to the superiority of Indian teak alone that India-built ships lasted more than a century.[239] But the situation over the period of time changed. The British impressed with the skills of Indian ship-carpenters and employed one Khurshedji, a Parsi, as their chief carpenter at Surat in 1672, to advice on shipbuilding.[240] Over the period of time a number of Indian ship makers were employed. In the western India and especially at Surat, the Parsis Wadia family played very significant role. They constructed good number of vessels for the British Government and were highly liked. Even some of them received high technical education in ship building abroad.

British Introduced Steam Powered Ships

Iron steamers were introduced in Indian rivers which proved better than earlier with heavy engine which fastened the speed and with using tug system in which one main engine ship is attached to other carrier ship with a wooden or iron rod.[241] Later on with advancement in technology and perfection in steam engine, it was fitted in the same ship rather than a separate ship to pull the other main ship.

Steam navigation was successfully launched in India because of its advantages regarding movement of troops with heavy arsenals, trading activity and transfer of treasury from time to time. It was a safe mode. Introduction of steam ship

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[239] Satpal Sangwan (1991), *Science, Technology and Colonisation: An Indian Experience, 1757-1857*, 80-81.
[240] *Ibid.*, 139.
[241] *Ibid.*, 84.

totally gave setback to the traditional shipping in India is largely true, but the process of its decline was not very fast. Natives still had confidence with Indian ships at least in small coastal regions. This can be better understood with cotton textile mills which ruled big cities but urban centres still worked in traditional manner.[242]

The agrarian sectors showed potentiality for its development with continuity and change. This was also applicable for the non-agrarian sectors. Various areas of commodities manufacture discussed in this chapter clearly show the strength of its continuity. Many of these areas adopted foreign technology if it was required by the demand of the time. Natives actively showed the seriousness and understanding of the indigenous and the usefulness of the foreign imported technology. *Monographs* and *reports* which are consulted refelect upon the attitude of the British government. This is some times misleading. Howecer, it can be speculated that the Britishers were able to continue with the traditional methods by induction of modification in mechanism and import of devices. These are few noted cases where they could be held responsible for complete decline of existing traditional method of mode of production.

[242] *Ibid.*, 79-82. The statement of the Sangwan is radical when he says that advent of the steamers completely ruined the Indian ships. Here I would like to refer K. S. Vaidya book (*The Sailing Vessels Traffic on the Coast of Western India and Its Future,* Popular Book Depot, Bombay, 1935) which shows the wide scale use of country made ships for trade and commerce in the ports of western India. He says that steamers introduced in the western Indian water were not successful in replacing the native ships. These were costly and were used for long distance trade by the government.