APPENDICES

APPENDIX I

EXTRACT FROM PERSIAN MANUSCRIPT

RISALA DAR FALAHAT

Extracts

from

M. Majumdar (1984), "*Risala Dar Falahat", IJHS,* 19 (4), 341-60.

According to the text if the root of the grass growing on the soil is solid and has a strong base, the soil is good. If the grass blades are straight and slender, the soil is to be considered medium. Weak grass roots and bending grass blades indicated that the soil is not so good and not suitable for the cultivation. If Egyptian onion is shown in one year, the next year anything grow well on that land.

It is better to cut the stalk with the grain when the grain is still a little green because at that stage the grains are better and are tastier to eat. It also prescribes iron should not touch the roots.

For manure text prescribes, seeds must be soaked in water with birds droppings especially pigeon is best and stool of donkey is best. Human urine mixed with the urine of animals, if sprayed on leaves, the tree is protected from insects and pests. Seeds of tree, if immersed in cow dung before planted or sown, will keep the tree free from insects and pests. To protect fruits from insects and pests it has been suggested that a scorpion should be put on the plant. The use of magnet is to drive the ants is interesting.

When there are circles of red and yellow in the sky, a strong winter is anticipated. When flees, honey bees, grazing goats run away, the sky is full of inky clouds and small birds come and pick at water, winter and rains are expected. In such seasons, pepper yields good harvest. When hare scratches at land and looks at the west, a prolonged winter is expected.

In order to prevent the effect of cold or heat on the grafting, these should be greased by oil or fat and *Khad* or ash is to be applied and also dry matting is to be applied.

Almond and fig should be planted in the month of *Mehr-man* (Seventh month of Persian year of thirty days). Fertilisers to be applied to these fruits plants during this month. Picking of grapes may commence in this month and continue up to the beginning of the next month. One has to keep watch regarding rains as different plants grow well during this month. This is the proper month for planting even those trees which yield only wood. The cultivation has to take care to remove all loose

leaves and other dirt. The base of the plants should be cleaned. This month is suitable for extraction of wood and timber.

Removal and replanting should be done either at the beginning of the day or at the end of the day, so that the timber may eventually become strong and worms do not affect. One method of avoiding worm is to try the roof moisture.

Almond, peach and apricot should be planted in this month but should be taken to ensure that no north wind or cyclone blows when the cleaning operation is undertaken. Transplanting should be done with two years old. One year old plants should be transplanted as the root is very soft.

Removal of the bark of trees may be done during this month. Cutting and removal of branches should be done by hand and *zaitun* oil (olive oil) is to be applied in this month. Transplanting of figs may be done during this month.

The text prescribes how to find whether the land is near or far away from the water. One method suggested is to dig up the land and then to put bundles of silk thread into a hole. One end of the silk thread should be immersed in oil and then put into the dug up earth and covered by earth. The other end of the silk should be down after some time. If the end of the silk thread outside the soil becomes wet after some time, that would indicate the presence of suitable water.

Suitability of Soil for Cultivation

If the soil does not crack after rain, it is good soil. Other test prescribes is that dry soil to be collected, powdered and then mixed with rain water and then allowed to settle. If the soil shows clearly in the settled condition, it is good soil. If deposits of salt are on the settled clay one should not consider the soil as good. Salty soil is not suitable for any cultivation, except for dates. Soil emitting bad smell is also not suitable. Another test mentioned is that a portion of the soil should dug and put inside a hole in the land. If the dugout portion of the soil becomes swollen, the soil is good. If the portion remains as it is soil is of middle class. Drying up the portion of the soil and its being reduced in quantity would indicate bad soil. Still another test is to throw seeds on the wet and dry land. If the seed becomes green after some time, if green sprout emerges and the seed germinates, the land is good. The same operation is prescribed for the high land and low land to find out whether the seed becomes green or not. After this test selection may be made of the low land and high land for particular seeds and crops.

Wheat, onion and pulse if planted in a very dry land, do not become very strong as the seeds are eaten away by worms. In a good soil, if Egyptian onion is sown on one year, the nest year anything will grow well there.

The best time of cultivation is when the Sun is in the *Mizan* circle. When the wind blows northwards, seeds should not be sown. In all cases the seeds should be sown thrice, so when if the finest and second sowing get damaged, the third one may be successful. Sowing is better when it is done at the beginning of the month.

The grains of wheat are yellowish or reddish should be selected for sowing. Yellowish and big grains are better to eat. Fine grains are not suitable for purpose. Barley should be white, big and hard. Wheat should not be washed before sowing because when the wheat becomes wet, the juice comes out of the grains. All big and hard grains should be selected for the purpose of seed. The best seeds are those which are one year old. Two years old seeds are medium variety. Seeds which are three years old are considered bad while four years old seeds are useless.

Mash and *mansoor* seeds, if those are soaked in the droppings of birds before being sown, will yield green early. Onion seeds should be soaked in water for one day and one night. If they are sown after being kept in water for one day and night, a harvest of big onions can be expected. Onions should be sown in summer. Melon seeds should be soaked in water for three days and then sown. The plants that will germinate from such seeds will yield sweet fruits which will have no bitterness. Pig stool is good for almond. Mixed dung is good for cultivation. Mixed stool of animals and birds is good manure for olives.

Methods of Seed Protection

- Leaf of *sarb* (a plant) and leaf of beet should be mixed with the seed.
- Seed can be saved if mixed with the powder of elephant bone or boil the elephant bone in water and to spray the water on the seed.
- To soak *dhani* (coriander) in water for a day and night and then spray water on the seeds. The seeds should than be covered with a cloth which will help the seeds to absorb the water.
- To get hold of live *zafda* (probably an insect) and put it on a tray. The tray with the *zafda* on it, may be buried under earth for some time afterwards, the tray is to be brought out and kept near the seeds. The smell of the tray will protect the seeds from any harm. If *mansoor* is treated with a similar manner, it will benefit the seeds and the cultivation of *mansoor* will become free from danger.
- A handful of the seed of bamboo *Harzohra*; if thrown on all sides will help the Roman *Deva Neos* (a harmful grass) to die out. A big crying cock may be killed and is sprayed on the land. This will prevent the grass from growing.
- Protection from cold-heaps of all sorts of dung should be made near the cultivation field. On the night of severe cold, these heaps should be put on fire. 3 or 4 such heaps should be put on fire in such a way that the smoke spread all over the cultivated fields. The smoke will protect the plantation from cold.
- Small pieces of bamboo roots and flowers may be broadcast throughout the plantation. This will protect the land from cold. Dry ash may be mixed with seed and kept in a plate. The plate may be buried in the soil and the top covered with a thin fine cloth. This will protect the seed.

Harvesting

Wheat and other grains, when they seem white from a distance, this is the proper time for harvesting. Although the grain should be allowed to be very dry because whenever plant becomes very dry the grain starts falling and the stalk becomes weal. It is better to cut the stalk with the grain when the grain is still a little green because at that stage the grains are better and are tastier. The husks and stalks of the plants when still little green will make better fodder; but not when the grains become very dry.

The threshing floor should be constructed at an elevated place and away from garden and home as the dust is harmful for plants. Threshing floor soil should first break into pieces and watered, the mud mixed with ash should be used to plaster the floor so that grains can be protected from white ants and insects.

While keeping the bundles of cut stalks on the threshing floor, the heads should be kept on the northwardly direction, so that the north wind may dry it up quickly. The grains after being separated from the stalks should be kept for 10 days. On the 11th day it should be removed to the store house before sunrise so that hear of the sun is avoided.

The grain store house should be away from the stable, leather works, kitchen, bathroom and fireworks factory. The mud with which the store house is to be made should be very clean. The mud may be mixed with olive leaves to make it strong and free from insects and worms. The store house should have windows on all sides except south. South wind is generally injurious for grains.

The leaves of *kahu* (a tree), pomegranate and *balut* should be mixed with wheat in the ratio one *man* to 100 *mans*. By this grains can be preserved even if not separated from the stalks and there are in bundles. Another method of preserving wheat is to dig a big hole in the earth like a well; leaves should be kept on the sides of the wall and in between layers of wheat. The grains of wheat can be preserved in the way for a long time. For keeping the grains at home these should not be kept on the earth but on bamboo or need matting.

Ashes of all kinds and wood ash should be mixed with barley for preservation. In the centre may be kept *sirka* (vinegar).

Mansoor, mash and onions should be kept in a big pot, the borders of which should be smeared with oil. The oil should apply inside the pot too. Then ash should be applied on all sides-the seeds thus preserved should be safe from all kinds of pests and diseases.

There is another view that the grains should be kept for some time spread on the ground so that dew may touch them. Thus the grains may be stored. This may be beneficial to the grains.

The best time for the planting of trees is the start of *karif* season when there is not too much of water in the soil. The water could gradually and slowly percolate to the roots. There is another view also that if planted in winter roots become stronger. Transplantation is very necessary for almond, pistachio, peach and apricot. Replantation should be done when green sprouts come out of the seed. While replanting, the plant should be tied so that it may not fall. Replantation is recommended for apple, almond, guava or pear (*amrut*), peach, pomegranate, mulberry, orange and all trees which yield juicy fruits. Apart from replanting cutting of a branch and keeping it on another is also done with these trees. Those that have been planted in autumn-the soil near the root should be hoed away every 20 days. This should be done at least 4 times. The tree must be watered in summer; the tree

should be watered whenever the land becomes dry. The benefit of hoeing is that the soil is kept light and grass and weeds are removed. It should be recommended that for 100 years no iron should be used on the tree and the cutting of branch or removal of grass should be done by hand. If the tree tends to fall, a support should be provided. Manure should be applied on the root.

In the case of beet, the soil on the edge is to be removed and cow dung is to be spread there. Cow dung is to be smeared on the plant also. The beet will grow big even in saline soil. The saline soil will protect it from insects. The turnip (*salgam*) is to be grown on white soil. The seeds may be soaked in honey and milk and kept like that for four hours and then sown. The turnip will be tasty.

Plant Protection

Locusts (*malakh*)

The left horn of a cow should be burnt with cow dung, the cake will drive away the locusts. If some locusts can be caught these may also be burnt, the smoke emitted by the burnt body of the locusts will drive away the other locusts. A tree by the name *habbul-fir* grows in the European countries. It attacks locusts-if a branch of this tree is thrown on the ground, the locusts will go and sit on it. With the help of this tree, the locusts may be enticed to leave the cultivated land. *Narmas* (fruit) and *hanjal* (*datura*) may be soaked in water and that water may be sprayed on land-the locusts will not sit on that land. Then water may be sprayed on sitting locusts-the locusts will drop down. A living mouse may be tied to a tree-the locusts will avoid that tree. Locusts sit on a land if they see people from above, when locusts were noticed, the villages should try to hide inside the huts. Not seeing the people, they are likely to fly over that land which may thus escape their attack. The locusts do not cross water-so when the locusts come and sit on a field; tranches should be dug quickly around and filled with water. They will not cross into the neighbouring field.

Protection Against Insects and Animals

Datura fruit should be boiled in water and that water may be sprayed on seedlings just when they are coming out and vinegar may also be sprayed at different places around; this will save the plant from them. Crabs may be kept in a pot of water for a week, till they are dead. When bad smell comes out of the pot, water many be sprayed around and so insect or animals will attack the plants. Sulphur may be burnt-the smoke will drive away and kill all insects. The smoke will go inside the holes in the trees and kill all ants. The smoke should go inside the holes.

Ants

If grape seeds are soaked in *til* oil and then sown, the ants will not sit on that grape plant. Another method to save plants from ants is to burn silk and to mix the ash with honey, if the seeds are soaked in honey; if the seeds are soaked in before being sown, the plant that will germinate from these seeds will not attract ants. Opium may be soaked in vinegar and it may be lifting smeared on the plant and also spread a little on the ground-it is stated that the ants will never attack that place. Lastly, 5 *datura* seeds may be burnt and the smoke out of these seeds will derive away ants.

Bees

Smear olive oil on grape plant-the honey bees will not throng there. If olive oil is burnt in a lamp (*chirag*), the smoke will drive away those pests. Bees may be caught and burnt-other bees will keep away from the smoke.

Pan and *Kahu* (herbs): Cure coughs and indigestion. *Kahu* bring relief from sleeplessness and cure for jaundice.

Storage of Produce

Adhaka (a wooden receptacle for measuring grains before storing) are to be made from *Slesmantaka* (*Cordia mixa Linn.*), mango, *Punnaga* (*Calophyllum inophylleum Linn.*) but not Kapita, Parkati and *Neem*. The recommended timber do not change size during drying or seasoning while not recommended lose their shape and cause discrepancy while grain is measured.

Source: M. Majumdar (1984), "*Risala Dar Falahat"*, *IJHS,* 19 (4), 342-60.

APPENDIX II

A SHORT SUMMARY OF SUGAR MANUFACTURE FROM SUGARCANE IN BARODA STATE

Extracts

from

"Correspondences Regarding the Manufacture of Sugar" (1876-88), *Huzur* Political Office, Baroda Record Office, Baroda.

How to Extract Juice from Sugarcane

Pull out ripe sugarcane from the field and cut off the *mada* (the top of the sugarcane) as far as three or four joints from the above, divide it into equal parts and strips off the cane of its straw. Put four or five pieces into wooden mill called *charak* or *koloo* and collect the juice thus extracted into a large pot until it was sufficient to fill a kettle or *kudaee*.

The Process of Turning the Juice into *Rab*

Take a flat-bottomed kettle or *kudaee* having a diameter of four or five feet and edges a foot high. It must have two rings attached to it, one opposite the other for the purpose of lifting it up. This kind of kettle generally contains about eight *maunds* of juice.

Dig a pit in the ground three or four feet deep, having its mouth exactly fitting the bottom of the kettle. On one side of the pit underneath the kettle, keep a hole of the diameter of half a foot opening inwards into the pit for ventilation and similar one on the other side of the pit of larger dimension for throwing fuel into the pit and under the cattle for the considerable time. Put the kettle above described over the pit. Throw two poles across the kettle at a distance of a foot from one another and keep a bamboo from basket over them. Line the inner surface of the basket with a rough cotton cloth so as not to allow any impurities to fall down into the kettle through it when the juice is poured into it with great care and there was no room for mistake otherwise it will create problems for sugarmanufacture.

Keep ready at hand the following three mixtures:

(a) Mix one *seer* of milk and three *seers* of water and keep it in a pot.
(b) Take a quarter of a *seer* of quicklime with two *seers* of water and mix them together after the particles of the lime have precipitated, take off the water and keep it in a pot.
(c) Take a quarter of a *seer* of any of the following articles:

Sukhalaee or the bark of *falsa* tree or the juice of the fruit of a *bhindee* tree and rub it in two *seers* of water. The liquids thus obtained, keep it in a separate pot. Bring the sugarcane juice extracted and kept it in a pot and pour it into the basket which allows no impurities to fall through it into the kettle. When the kettle is filled with juice, applies fire under it of the straw of *toor* or cotton trees or of the refuse of the sugarcane after the juice is extracted. The fire should not be too strong. When the juice began to boil sprinkles some of the mixture no. I over it, take off the serum that rises to the top. Repeat this process for two or three times. This is called first *ookala* or the first process of boiling. Afterwards sprinkle the whole of the mixture no. II over the boiling juice and take off the serum again. This is the second process or the second phase of the experiment.
At the third *ookala* sprinkle mixture no. III over the serum, take off the residue of the serum. After the third process of boiling is over, large bubbles began to rise to the surface. It must be understand that the juice is converted into *rab* and was ready for the next process.

To ascertain whether the serum is turned into rab, take a drop of the liquid and press it between the two fingers. Separate the fingers and if there is a thread of liquid seen between the fingers, the juice is converted into *rab* and is ready for the next step. When the juice is converted into *rab*, the process of stirring up the juice must be put a stop otherwise it will break the grains of the *rab*. Then pour the oil of *sesamum* four *tolas* in weight in the syrup. This has a quality of separating the grains from each other. When the kettle is taken off from the pit, put half a *seer* of sugar into it, this process granulates the *rab* very soon. When the *rab* is cool enough, take it out from the kettle, put it into earthen pots and keep flat dishes of earth over their mouths to prevent dust going into it. It must not be filled with the *rab* to the mouth, but a vacuum of about five or six inches deep must be left. Keep these pots in a warm room where there is no moisture for two or three days. During this period, cream gathers at the surface of the *rab*, called *saya*. After a few days the cream dissolves. Then shut up the crevices of the pot at their mouths with mud or any other substance to make them air tight and keep the pots again in a warm room while the *rab* has granulated.

Preparation of *Khanchee* (Sugar Pits)

In a room where there is no ventilation, prepare a cistern of bricks and *chunam* and plaster it well. Its dimension must be according to the quantity of the *rab* to be put into it. From one corner of this cistern at the bottom, led a pipe out into a large vessel to be kept at a distance of two or three feet from the cistern. When all this is prepared and the cistern becomes dry, place long pieces of rafters at the bottom of the cistern at a distance of two or three inches from one another all stopping towards the side into a corner of which the pipe is fixed over there pieces of rafters make a thin bed of the straws of *toor* or cotton tree and over this bed spread blankets. If the cistern is not plastered with *chunam* tie blankets all-round the inner surface of it and over them applies mats of palm tree. This completes the preparation of the *khanchee*.

Putting *Rab* into the *Khanchee*

The pots containing the granulated *rab* must be brought out of the room and poured into the *khanchee* described in Part III. If there were hundred *maund* of *rab*, prepare separate mixture of two *seers* of quicklime and two *sers* of *sajekhar* (impure carbonate of soda) with water five *seers* in each, combined the two mixture, put quarter of a *seer* of *sesamum* oil into the combination and boil it. After the mixture has become luck-warm, sprinkle it over the *rab* that is put into the *khanchee* and spread mats over it. Out of this *rab* syrup will soon begin to ooze out through the pipe and settle itself in the large pots, kept for the purpose at the other end of the pipe. This syrup is called *sheera*. It may be taken out and stored into different earthen pots. This syrup may be allowed to come out for about a week without disturbing the *rab* in the *khanchee* otherwise it will create problems in the process.

Process of Putting Mass Collected from Riverside over the *Rab*

When the *rab* in the *khanchee* is sufficiently burnt, bring mass from the river and spread it in shade so that the water it contains may evaporate, then take off the mats from over the *rab* in the *khanchee* and spread it.

After an interval of about three days, take this mass off from the *rab* and spread now mass over it. Repeat this at the interval of every two or three days taking out at each time from the three operation, that portion of the *rab* in the *khanchee*, which may have become white, continue this process, till the whole of the *rab* becomes white and is ready for the next step.

Process of Kneading the Sugar as a Final Step

At each time that new mass is put, take out as told above, only the white layer of the *rab* (which may be called sugar) and fill it in earthen pots. Take a piece of sack cloth by five by four feet and another piece of common cotton cloth of the same dimension and spread the letter over the former in the Sun. Spread the sugar stored in earthen pots, over this cloth and let two labourers beat it with their feet for four of five hours. Thus, sugar is prepared.

How the Left out from *Sheera* is Utilised

The syrup that has been taken out from the large pot, and stored into different earthen pots, may be utilized in preparing *gudhaku* and liquors. It may also useful for poor people to eat and for cattle.

Source: "Correspondences Regarding the Manufacture of Sugar" (1876-88), *Huzur* Political Office, Baroda Record Office, Baroda.

APPENDIX III

THE SILK WEAVING PROCESS

Extracts

From

S. M. Edwards (1900), *A Monograph Upon the Silk Fabrics of the Bombay Presidency*, Bombay.

The Silk- Weaving Mills

There are in the Bombay Presidency three mills which weave fabrics of silk, two of which, the Sassoon and Alliance Silk Mill and the Chhoi Silk Mill, are situated in the city of Bombay, and the third in the city of Poona. The Sassoon and Alliance Mill is the largest of the three.

Raw Material

Excluding a small quantity of silk from Italy used by the Poona Mill, all the raw material employed conies from China and Bengal; and is of two kinds, raw neat, silk and raw waste silk.

Raw neat silk arrives in the form of hanks and is precisely the same kind as is used by the hand-weaver of the Presidency. China silk is white, and of various qualities, each of which is denoted by a separate name; while Bengal silk is yellow-hued, and varies also in quality according to the season of the year in which it is obtained. For example, of the three main ‘crops' annually gathered in Bengal, silk of the March crop is said to be preferable to that of the November and July crops.

Raw waste silk, which is largely used in the Sassoon and Alliance Mill, comes mainly from Shanghai, Kobi in Japan, and Bengal. The raw waste silk of Italy, imported by the Poona mill, being of inferior quality and comparatively dear, is in little demand. The fibre is, however, tougher than the fibre of China or Bengal silk. All the raw material, both neat and waste, is ordered direct from China and Bengal by the owners of the mills, and is not, except in rare cases, purchased from the traders of Bombay.

Process of Preparing Raw Waste Silk

The steps in the evolution of the fabrics from waste silk are briefly the following:

1. If the silk is to be used in its ‘ungummed’ condition, denuded, that is to say, of the natural protection formed round the fibre, it is boiled in hot water. This renders the colour whiter, but the silk is still matted together in a lump.
2. It is therefore passed over a revolving drum, set with small pins or points of wire, which catch and lay it out Hat upon the surface of the drum, in pieces of

a certain fixed length. The length of the piece is always the same; as the pins are in sets, bounded by the quadrants of the revolving drum's circumference.

3. Each fiat piece of silk is then taken off its respective quadrant by means of two, boards, fitting close together and imprisoning the end of the silk between them.
4. Several pairs of such boards are then placed side by side in a flat frame, the ends in which the silk is imprisoned being uppermost. The boards being tightly packed, form one continuous block, along which the lengths of silk lie, partly overlapping one another. Above them stretches a broad leather band, set at intervals with sharp combs, and drawn tight between two axles, which revolve in the same direction. As soon as motion is imparted to the axles, the leather band moves slowly round over the surface of the boards, and its successive combs pass through the silk and drag out all knots and roughnesses.
5. This operation concluded, the combed silk is passed through a machine which delivers it again in the form of one long skein. An upright tin canister is placed below the passage through which the silk makes its appearance, and catches the skein as it winds downwards.
6. The next step is akin to that described in the last paragraph. Four or five canisters, each containing one long skein of silk, are placed" opposite to a machine, which receives the ends of the five skeins, and winds them all together into one single skein, which in its turn passes into a canister placed on the far side of the frame.
7. The next machine employed corresponds to the 'slubbing-frame' of cotton-spinning mills. The five-fold skein is transformed into a thickish thread wound upon a large reel or bobbin.
8. Prom the large reels the thread is then wound on to smaller reels, and is at the same time formed into a. thinner thread by a machine corresponding to the 'roving-frame' of a cotton-spinning mill.
9. The thread is then transferred, in a still finer condition, from these reels to the bobbins of the spinning-frame.
10. The next process is known as "gassing". Along a flat frame, with a row of small bobbins on either- side of it, are set a number of small gas-jets. The bobbins on one side carry the silk transferred to them by the last-named process; the bobbins on the other side are empty. When the machinery is set in motion the silk thread is rapidly reeled off the one set and passes through the flams- of the gas-jot on to the empty bobbins. The speed, with which the thread passes through the flame, ensure its not being scorched or burnt, but is at the same time so regulated that any roughness or excrescence upon the thread is charred away.
11. The bobbins of thread are then taken to the reeling department of the mill, where the thread is wound off the bobbins on to the large reeling-frames, and is finally tied up into separate hanks.
12. At this stage the silk is ready for the dyer, who stands in a room apart beside the rat and dyebaths, above which the coloured hanks hang drying. Aniline dyes only are used. The most noteworthy object in this department is the Hydro-extractor, by means of which all moisture remaining in the silk after successive immersions is finally removed. The principle underlying the machine is that of 'centrifugal force'. The silk is carefully packed in a round

receptacle with perforated sides. When ready, this receptacle whirls round at a high rate of speed; and the moisture is forced outwards through the perforations, strikes an outer wall of metal, and falls to the ground. The machine will extract a considerable amount of moisture from a hank which has been thoroughly wrung out by the hand, and is to all appearances quite dry.

13. The dried and dyed hanks are then spun again on to small reels, which are subsequently fixed in the warping frame. The number of reels on the frame is determined by the length and size of the warp required. The threads from every reel upon the frame pass simultaneously on to big wooden cages, which revolve upon a crank and handle turned by the warper.
14. Yet one process remains before the silk is ready for the power- loom, viz., stretching and sizing. The threads are taken off the large revolving cages, are stretched upon two rollers, and are moistened with size, applied by a handbrush. The threads, after sizing, are arranged for the warp: and the silk is then ready for the loom.

Process of Preparing Raw Neat Silk

Raw neat silk, being already in the thread condition, does not require to pass through the preliminary processes enumerated above. A great portion is reeled and woven in the 'gummed' state, and does not make the acquaintance of the dyer until it has become a finished fabric. It may be seen by the visitor in the first room which he enters, gleaming in piles of gold and silver. At the far end of the room are the revolving frames, surmounted by rows of red or white reels, on to which the thread from the hanks is cast. Hard by, these same reels are casting their store upon rows of tiny spools, which are long will be flying to and fro through the warp-threads of the power-driven loom. The remainder of the raw neat silk is boiled, denuded of gum and dyed, before being reeled and woven. The same process is followed after dyeing, as in the case of the raw waste silk.

The Weaving-Room

Passing on into the weaving department, one is at once struck by the sombre hue of the surroundings, the dark wheels overhead, the black belting of the shafts, the black-bearded faces of the weavers; in the midst, of which stand out in strong relief, like sheets of multi-coloured flame, the fabrics upon the loom. Light-blue, dark-blue, crimson, orange, green, red, the fabrics, some figured, some gold-bordered, wind slowly round the rollers amid the whirr of the great wheels and the clank of the arm that marks the flight of the shuttle. It is a splendid exhibition of colours. The "kinkhab" loom in the Chhoi silk mill is most interesting, with its array of shuttles, containing silk of different colours, of which two, three, or more may, by a special contrivance, be thrown, before any one of them returns to the common starting point. The designs worked in the body of the fabrics are first punched out in strips of card-board by a specialist in the art, the cardboard being subsequently inserted in the upper part of the loom and revolving up and down by machinery.

The Fabrics

The fabrics woven are of numerous kinds, to suit the markets of Bombay, Bengal, the Punjab, and Burma; and may be roughly classed as (i) Saris for Hindu women, figured or unfigured; (ii) Skirts and Head-gear for Mahommedan women; (iii) Satin piece-goods, which are subsequently cut up into bodices, coats, jackets

&c.; (iv) Handkerchiefs or Scarves for the Burmese, and (v) Dress-lengths for the women of the Punjab.

Source: S. M. Edwards (1900), *A Monograph Upon the Silk Fabrics of the Bombay Presidency*, Bombay, 59-62.

APPENDIX IV

CARPET MAKING WITH SPECIAL REFERENCE TO *DARIS*

Extracts

From

H. J. R. Twigg (1907), ***Art and Practice of Carpet Making in the Bombay Presidency,*** **Bombay.**

Carpets in India are always made by hand on looms of two descriptions- the horizontal and the upright. As a rule the former looms are reserved for *daris*, generally made of cotton; the latter for *galichas* or pile carpets, for the most part made of wool. Whereas no pile carpet is made on a horizontal loom, at times *daris* are made on vertical looms.

With regard to horizontal looms there is no clear line of demarcation between a simple *dari* of transverse stripes and a blanket or piece of thick cloth. As regards mechanism the two are made on the same principle, only the working parts vary in strength and solidity. When a *dari* of over five feet in width is to be made, so inconvenient is it to throw a shuttle from side to side that another plan has to be adopted.

Every carpet, *dari* or *galicha*, consists of two series of threads- one set running from the observer's feet ahead, the other set running laterally. These threads constitute the warp and the weft respectively. For all forms of cloth-weaving these terms hold good. In a *dari*, the weft threads are so applied that a design is formed; with a *galiclia* or pile carpet this is brought about by the entwining of coloured loops of wool around the warp threads, the weft threads being applied from time to time during the process as described later. By such a device the free ends of the loops conjointly form the pile of the carpet, while the weft threads in this case are known as the *poth***.** The frame on which the warp threads are stretched is the loom: the entire set of warp threads stretched and ready for further work is called the *than*, or by some the warp: the arrangement for reversing or tightening the warp threads is called the ratch. These terms-warp, weft, *poth*, *than*, loom, and ratch-are applied to the main parts of the mechanism on which every carpet is made. They will now be described in further detail in connection with *daris* and *galichas*.

In a *dari* the materials commonly used are two only, namely, undyed cotton and dyed cotton. The former is used in the warp, the latter in the weft. For the sake of clear distinction, the former will be referred to as *thread*, the latter as yarn.

Preparation of Warp Threads in *Dari*-making

The warp threads are prepared as follows. The Bombay mills send all over the Presidency bundles of cotton yarn, or twist as it is often called. Such bundles weigh

ten pounds each and contain twenty twisted skeins of cotton of one half pound each. Each skein is opened out by a peculiar process of elbowing it straight—one of the many little tricks which only the actual worker accomplishes readily. Having straightened out the skein he loosely separates the layers of cotton fibres into strata, and such an opened-out skein he places on a light wooden frame or *chheriki*. The worker, if a novice, arranges two *chherikis* alone in front of himself; if skilled, he loads up three, four, or even more such *chherikis*, which he fixes in the ground ahead of him. He then takes in his right hand a light frame somewhat like a *chheriki*, termed a *lathai*, and from each *chheriki* he takes one cotton fibre. The fibres he twists up into a thread which he loosely applies to the *lathai* with his right hand. Then by a rotary movement of the right wrist he turns the *lathai* round in a circular fashion, thereby unwinding the fibres from the *chherikis*, loading up the *lathai* the while. It should be carefully borne in mind that what happens to the fibres which become wrapped round the *lathai* is that, if two *chherikis* are used, two cotton fibres come to lie in juxta-position; if three *chherikis* are used, then three are thus placed, and so on: what does not occur is any twisting of these threads around each other, they remain side by side and no more. Hence it is clear that from two, three, four skeins of twist, strands of cotton of two, three, four fibres each can be obtained, and by repeating the process, five, six, seven fibred strands and so on are made : the more skilled the labourer the fewer being the times he has to repeat the process. This process is termed the opening up of the twist and is the first process in the preparation of the warp. It is also the first process in the preparation of the weft, the later stages of which are described hereafter. The opened-up twist is then taken to a *rahat*, or country spinning wheel, which is a mechanism too frequently seen to need separate description or illustration. By means of this machine the juxta-posed fibres are twisted up into a cord or true thread. The number of *tars* or fibres thus twisted up into a cord varies and is of no concern at this moment.

The above account refers to the simplest mechanisms. To save labour a simple system of pulleys, piping, and a revolving wheel enables the *lathais* to be mechanically rotated along with twenty or thirty others as required. In the same way a spinning frame can be easily erected whereby all the spindles are rotated by the passing of a continuous rope. This latter mechanism by no means gives the excellent results of separate *rahats*: for opening up the twist the combined method works quite well. At Yeraoda the twist is opened by such a mechanism on to revolving cones termed **asaris**, but the writer has never found these any advantage over the much less expensive device erected at Hyderabad (Sind). The second stage therefore is the twisting of the threads. The *rahat* or spinning wheel twists the threads on to small tubes of bamboo or tin (generally strips of the ubiquitous kerosine oil tin), and from these the threads are wound up into balls either by hand or by a balling machine. The latter does its work far more rapidly and also far more uniformly than the hand method; however in a jail there are always many convicts either physically unfit for harder labour than ball-winding involves, or else having other duties, such as opening and closing a gate, the intervals m such a duty being devoted to winding balls by hand. Hence stage three consists in ' winding the threads into balls.

Description of *Dari* Loom

Here a digression is necessary, for now the loom comes into use. A *dari* or horizontal loom will be first described. It consists merely of two stout beams of

wood, at least wide enough to slightly exceed the width of the *dari* to be made. In length it generally exceeds by about three feet the full length of the *dari*, though it may be twice as long, so that two *daris* can be made at the same time from it. The beams are placed parallel to each other, and raised above the ground to the extent of about six inches. Beyond these beams there are certain pegs driven into the ground to secure ropes whereby the warp threads in a way about to be described can be drawn perfectly taut. Many of the illustrations were modified for the purposes of better demonstration, as in this case, in which a miniature warp was erected on a board. To save space and cost one end only is shown in the figure. In the illustration referred to, miniature rods to represent the beams are shown, and at one end are lashings to keep the beam steady, while at the other end the lashings have sticks, known as *wakr* or *amra*, inserted m the loops so that, after the manner of a Spanish windlass, the whole can be drawn tight. The device is extremely simple and effective. Having fixed the loom, the spreading of the warp follows. Taking a ball of thread in his zinc saucer (a most convenient vehicle for the work), the worker loosely ties a free end round one of the beams at the extreme left or right, and walking to the other beam passes the ball under the beam and replaces it in his saucer. Arriving at the first beam he passes the ball under and then over the beam, back into the saucer again, then under, round, and over the far beam, and so on. In practice three men are engaged in this work: one at each end to pass the ball under or over as needed, one travelling to and fro. While the latter is between the beams, the others are seeing that each thread is properly taut and that its distance from the neighbouring threads is correct. Obviously the whole of the two beams become encircled in a series of very long figures of 8, there being an intervening intersection. Provided the ball of thread is large enough, it is possible to spread the complete warp of a *dari* without a single knot other than that at each end. At the extreme edge on each side a separate figure of 8 is stretched with thread thickened to the dimensions of strong cord. This is to resist side-strain. The fourth stage therefore, assuming a loom has already been provided, is the spreading of the warp. Although easily comprehended, its practice is difficult, as only working experience enables one to draw the threads uniformly and properly taut.

Formation of the *Dari* Loom Ratch

The next process is the formation of the ratch-an appliance not at all easily comprehended and still more difficult to describe. In this figure the ratch is the transverse erection which supports a series of dependent loops, the healds, each of which encircles one of the warp threads. This series of threads is composed of two halves-one half being loops which, encircling, say, the lower warp threads, ascend to the bamboo comparatively near the weavers ; the other half being loops engaging the upper warp threads and passing to the bamboo farther away from the workers than the bamboo just mentioned. These bamboos are attached by ropes to short curved pieces of wood called *makra* or *dhum* which work over the transverse beam so conspicuously seen in the illustration, very much after the manner of a violoncello bow. Such is the ratch in general terms, and as it is an essential part of the mechanism, its details should be studied. A considerable digression is now unavoidable.

Formation of Healds in *Dari*-Weaving

Having spread the warp threads, two spaces are found to exist between the upper and lower layers as two elongated triangles with the beams as their bases.

These are referred to under the name of *ched*, that is hole. Into each *ched* a thin bamboo stick, such as is used for *punkah*-pulling, is inserted, and by attempting to approximate these sticks the intersection is of course the more clearly defined. At the same time by using the sticks after the manner of a sight-line any broken or slack or incorrectly placed thread is at once detected and rectified in time. The vernacular term for the intersection is *joki*.

(a) A piece of wood of hard material, and for preference well-polished, is taken. Seen on end its upper part or back is thick and rounded, the lower edge is keel-like, though also slightly rounded. This is called the *parti*. Through it at one end a large hole is bored capable of taking a cord of fair dimensions.

Again, another piece of wood shaped exactly like a large roughly-made needle, and furnished, like a needle, with a hole, is taken. The *parti* is about seven inches long, the *sewi* or needle being about an inch longer.

(b) The manner in which the *sewi* and *parti* are threaded is a simple and an interesting process, As the same method is adopted fur each, the threading of the *parti* will alone be described. A ball of thread being taken, one of the ends is passed through the hole and carried on till the two pieces held up by the worker's hands, well exceed the width of the *dari* under manufacture. They are then knotted, in which the knot appears near the hole through which it has just passed. The man manipulating the threads is continuously passing his right arm away from his body while his left arm moves in the reverse direction. This pulls more and more thread through the hole and more and more loops are taken up by the left hand. The work will go on till some five or six loops are made. Then, the ball of thread is detached and the loops well pulled out. Then by a movement of the hands, the loops are twisted up into a cord free from knots. This process is the threading of the *parti* and the threading of the *sewi* proceeds in a similar manner. Then the thread attached to the *sewi* is knotted up to that of the *parti*, solely to guarantee that the ends do not go astray in subsequent manipulations.

(c) The subsequent manipulations are not easily followed, but by the help of the plates the reader will possibly be able to follow the ingenious devices about to be described. The 'intersection' having been well defined by the two cross bamboos as mentioned above, the remote rod is replaced by one of stouter dimensions while the proximal rod is pulled out. The stout rod is then pulled near the worker, thereby widening the *ched* and bringing the intersection near the operator. The worker standing at the left edge of the loom (in these figures mounted on a table for photographic conveniences only) holds up the *sewi* and *parti* in his left hand. The following: (a) the *sewi* above the *parti*, each with its cord attached at the end nearer the onlooker: (b) the intersection or *joki*; (c) two threads passing from two balls of thread beyond the photograph and away from the onlooker (each of these threads passes through a *ched*, and of them that nearer the worker clearly passes on to the tip of the *sewi* which is loosely embraced by it). The end of the other thread is at this stage free.

The next follows: (a) the thread formerly at the tip of the *sewi* has been passed along to the end near the onlooker; (b) the thread from the nearer ball of String, has been picked up in the form of a loop as it passes from the first figure of 8 of the warp to the next figure of 8; (c) incidentally there is seen how the cord at the very edge is thicker than the others.

The worker has passed his right hand forwards to the right and slightly upwards, thereby inducing the thread he holds taut to slip in between the *sewi* and the back-edge of the *parti*. Thus the *sewi* projects through the upper loop of the figure of 8 about to be formed. The portion of string grasped by the right hand is allowed to fall, after the loop round the *sewi* has been effected. Then the worker dips his fingers between the two next threads of the warp but on the side hidden by the *partt* from the onlooker. He again picks up the transverse thread running through the proximal *ched* and repeats with it the process described above. By dragging on the thread the figure of 8 previously formed is automatically drawn tight. And so he goes on.

While all this is going on, the *seivi* and *parti* are being gradually advanced from left to right, these two pieces of wood thereby travelling through two tunnels of looped strings, one above the other. As each piece of wood gets clear of the loops, the cords with which they are provided follow on in the rear.

The loops formed have been darkened while an attempt was made to whiten the *parti* and *sewi*, shows excellently (a) the upper and smaller loops, **(**b) the lower elongated loops, (c) a thread passing through each, (d) the *sewi* and *parti* at the end of their task. A bamboo rod is then passed through the lower loops, where upon the *parti* and attached cordare disengaged and withdrawn. The *sewi* is severed from its cord close to the eyelet, but the cord remains in *situ* for further procedure. Often the smaller upper loops are by a double turn re-duplicated.

The above somewhat lengthy account applies onlyto the cord passing through the *ched* near the worker. A precisely similar procedure is then carried out with reference to the other cord traversing the distal *ched*. In this case too a bamboo rod is threaded along the lower tunnel of long loops. But there is an essential difference in this respect. The *joki* has the effect of rendering warp threads which are uppermost on the proximal side of the *joki*, lowermost on the distal side. Consequently, whereas the first set of loops picks up the upper warp threads, the distal set of loops, though still picking up uppermost warp threads, avoids all those engaged by the first set of loops. Hence between them the two sets of loops engages all the warp threads.

Each set of tunnels will therefore have a rod, running along the lower part, and a cord, formerly attached to the *sewi*, along each upper part. The cords are in each case drawn taut and then secured to the extremities of the rods. Then by rope each rod is suspended to the curved stick referred to previously. Obviously, if one of these sticks is pulled by the worker towards him the transverse bamboo rod near him drops and the threads which the loops embrace tend to fall or at least are slackened. Simultaneously the lower warp threads tend to rise owing to the raising up of the other end of the stick.

These curved sticks or *dhums* are mounted over a stout transverse rod which rests by its ends on *kutcha* supports. This support is called the *ghoro*, the transverse beam is the *dhum-ki-lakhri*; the bamboo rod running through the loops is the *ratch-ki-lakhri*; the cord along the upper surface of the latter is termed the *ratch-ki-dhori*.

Thus are prepared the loom, the warp threads, and the ratch for *dari*- making. The preparation of the *galicha* loom is a very different matter; its description is deferred till *dari*-making has been disposed of.

Tools in *Dari*-Making

The only tool of any importance used by the *dari*-maker is the *kanga* or fork, an instrument consisting of a wooden handle about six inches long, into the broadened end of which about eight stout steel blades are evenly inserted. Each blade is shaped, after the manner of a penknife blade with the tips all level and the curves filed flush. The edges however are not sharp. The instrument should be well balanced, so that when held in the hand after the manner of a dagger about to be struck downwards the worker is easily able to give to the pronged end short, light, downward strokes familiar to all who play that form of instrument known to nigger minstrel troupes as the bones.

Preparation of Yarn for *Dari*-Making

The opening of the twist has already been described. In preparing the yarn as contrasted with the thread for a cotton carpet of the *dari* type, the process called the twisting of the thread is not followed. After five or six fibres have been placed loosely side by side in the opening process, the fibres thus prepared are taken to the dye-shed where processes go on which need not be considered now. On returning from the dye-shed the fibres will of necessity have been much dishevelled, especially if the dyeing processes have been tedious. It will therefore be necessary to once more open up the twist-in this case it will be an opening of dyed twist or yarn. When this is over it is wound up into little loops just long enough to be reached by the thumb and little finger of an expanded hand. In this compact form it is most conveniently handled by those who have to do the actual weaving.

Condition of Loom at the Commencement of *Dari*-Weaving

Let it be assumed that the weaving is about to commence. This means that the entire dan has been scanned for broken or slack threads; that the beams at the end have been properly adjusted; that each of the two sets of healds has no broken or faulty loops but that all are of equal depth and embrace the proper threads. It pre-supposes too that the transverse beam and the entire ratch have been drawn forwards towards the worker to such an extent that by actuating the wooden bows just the requisite amount of movement is conveyed to the warp threads. If the *dan* is to be two feet wide only (a very narrow *dari*), one worker will squat so as to overhang the beam, which is remote from the system of *wakr* or Spanish windlasses previously referred to. If the *dari* be wider, a weaver for every two feet is customary. The small bundles of coloured yarn are conveniently suspended, till wanted, from the transverse beam of the ratch. The observer will understand that if the curved sticks be in any position other than midway between up and down, there will exist a gap or *ched* between the upper and lower warp threads. This in section will have the form of an elongated triangle with the tip towards the squatting weaver.

Initial Steps in Weaving

Across this *ched* he passes a stoutish cord which he lashes at each end to the adjacent beam. Then he reverses the warp threads and again passes a cord. These

cords are driven home with the *kanga* as near to the beam as possible. These, the *dhori* and *chiri* respectively, are inserted in some form or other in every kind of carpet, and in *dari*-making the two make a kind of bulwark against which the worker may continue to beat, well aware that he runs no risk of driving the weft threads too far. The *dhori* and *chiri* then, commence the end at which work starts. They are not however an integral part of the *dari*, as will be seen later. In nearly every *dari* the first inch or so is generally undyed, and then follows an inch or so of plain red or plain blue or so on. Sometimes a third strip of plain colour exists. Each of these strips is termed a *patti* or band as each traverses the full width of the *dari*. They are woven in as an integral part of the *dari*.

The weaving in of the *patti* is effected thus. Taking, say, a bundle of white yarn the worker passes it across the *ched*, unwinding the bundle as needed till the yarn traverses the whole. At one edge will be a free inch or so of yarn; at the other the balance of the bundle of yarn. If the *dari* is a wide one, the yarn is passed along from hand to hand. Then the forks beat the yarn well home, whereupon the entire ratch is reversed and the bundle of yarn once more traverses the *ched*, though this 'time in an opposite direction. This process is repeated some eight or nine times according to the width of the *patti* or the fineness of the yarn. It constitutes *dari*-weaving in its simplest form, and for it a shuttle could be used which could be thrown across mechanically. The reader is asked to note that in this process the ratch, which in a wide *dari* may have as many as ten curved pieces of wood or *makra*, is throughout its full width wholly reversed after each passage of the yarn. This does not occur when the weaving of most forms of designed figures is in progress. To a modified extent it does occur when certain regular geometrical figures are being woven.

Let it be assumed that after the *patti* stage has been reached a chess-board style of pattern is to be woven in black and red. If each transverse row of squares as the work advances be lettered A, B, C, D, etc., while a square at the edge is I and that to its right 2 and the next to the right 3, it will be easy to follow what occurs.

The worker knowing that each square is to be, say, eight warp threads wide (a piece of knowledge gained by counting the threads in the pattern or design), picks up with his fingers four warp threads, and holding these well up with the left hand he inserts below them a strand of red yarn. Then going to square 3 he does the same thing with a separate bundle of red yarn. And then he does the same at square 5. Or if he has fellow-workers, they are doing the same at Nos. 7, 9, etc. Then all turn their attention to the black squares Nos. 2, 4, 6, etc. After that all reverse the ratch after having beaten home the yarn with the *kangas*. The process is repeated till the requisite numbers of threads of yarn have been woven in. In this case too, at least theoretically the workers weave in such unison that all are ready at the same time, and without delaying work, to have the ratch reversed. In practice such does not often occur, for workers weave at far from uniform speed. Hence each must be able to work his portion of ratch apart from his neighbours. As a matter of fact the actual change effected by the ratch and the use to which it is put in practice is not at all a mere raising and lowering of threads.

Use of the Ratch in *Dari*-Weaving

So long as the weaver has to deal with parallel lines, that is to say, lines parallel to the ends or sides of the *dari*, no great difficulty is met with; only when the lines become diagonals or curves, a different problem is presented. The way in which the ratch is made use of in actual practice is as follows. The weaver has passed, say, red yarn under five of the upper warp threads; he now wants to pass red yarn on the under side of the lower warp threads: how will he do it? The simplest plan will be to reverse the ratch, though by so doing he will almost certainly inconvenience his neighbours, or perhaps the very next piece of weaving that awaits himself is to pass certain colours to the immediate right or left for which he would once again have to reverse the ratch. Hence the mere reversal of ratch will not do, for he would be constantly altering it and wearing out the threads. Therefore to get under the lower threads, he passes his ieft hand fingers below the lower threads, slips the hand thus employed up along as far as the corresponding loops, and to these he gives a short upward pull towards his own body. This momentarily raises the warp threads above the general level, and underneath them with the other hand he rapidly inserts coloured yarn. So conspicuous is this pulling up of the warp threads, and so rapidly is the coloured yarn passed underneath, that the latter process, to- which the former is really subordinate, is apt to be overlooked by the casual observer. The real use of the ratch is to keep the threads tight and not to reverse the warp. There is for every stage of the work a proper distance intervening between the ratch and the line of work, and the shorter this distance the greater will be the tightening power of the *dhums*. Hence each worker has in his charge so many warp threads, and for these he has his own *dhum* which he actuates independently of his neighbours. It is only when transverse stripes free from any figuring are being done that the entire set of *dhums* is reversed at the same moment. Having inserted the yarn, the warp threads is released from the fingers, and the upper and lower sets of warp threads resume their former positions, a few sweeps with the back of the hand across the threads accelerating this resumption of place. Then the *kanga* is used to drive the weft well home, and so the work proceeds.

Progress of Work in a Simple *Dari*

How does the worker know whether he is proceeding aright or not? The answer to this question is that either he has near at hand a sample from which he counts so many threads whereby he knows how many threads he should use in the work in hand, or else he has by practice learned all the essential parts. This is by no means as difficult as might be imagined, for most *daris* have a simple geometrical configuration and having started the first inch or so correctly, the mere identification of the leading warp threads is all that is needed for a correct result.

Procedure in More Difficult Cases

When complicated designs have to be worked out a weaver of totally superior resources is needed. To keep correctly to the figure by a mere counting of threads would be difficult and tedious. In such cases good work is the more likely if all the main figures in the design are first of all chalked out in red or other colour over the entire surface of the warp. To facilitate this, and indeed for all kinds of carpet- work, it is customary to mark on the warp threads with lamp-black clear straight lines running at right angles to the line on work. If these lines be drawn by releasing with accuracy a blackened taut cord on to the than (a common way of marking straight

lines in many crafts), they with the warp threads can be used as guiding lines when the mapping out of the main figures is to be done, much as the average school-boy uses his lines of latitude and longitude for guides in map-drawing rather than for any more recondite purpose. Any attempt to describe in detail the exact manner in which the leading figures, such as squares, rectangles, triangles, or curves, are finished off, would probably lead to confusion only. A visit to a factory is needed for such information. In general, it can be said that when any mass of colour has been filled in, for example a triangle in green, the green yarn is broken off very short and the tag tucked away among the weaving as neatly as possible. Moreover, the appearance on one side is identical with that underneath. In tapestry the upper part is the counterpart of the reverse. In Baluch carpets, such as are made in Sind, the end would not be broken off, but the bundle of yarn would be continued underneath unbroken to a part where such yarn had to appear on the surface. Hence in these *daris* an approach to tapestry is seen and the two sides are not identical.

In order to keep the surface flat and to avoid cockling a bent piece of flat bamboo with a nail at each end and termed a *panak* is fastened at each edge of the *dari* just near the line of work. The tendency the bamboo has to straighten keeps the *dari* taut laterally. The coloured yarn at the extreme edgeis interwoven in the thick cord previously referred to as existing at each edge to withstand side-strain.

Finishing-Off in *Dari*-Weaving

When the weaving is about to finish, *pattis* are inserted at the finishing end generally to correspond with those at the beginning, but the *dhori* and *chiri*, or two thick cords used as bulwarks, are not needed. To take the *dari* off the loom, the beams of the loom are slightly approximated, and with a pair of scissors the warp threads are cut along the narrow space existing between the *dhori* and *chiri*, while at the other end the cut is made just near the beam of the loom. Then workers plait up the loose ends of the warp threads into plaits of five threads each. These plaits tell certain information to anyone examining a *dari*. After plaiting, cleaning follows, whereby all tags and knots are trimmed up or removed and the *dari* is well swept. It is then ready for sale.

***Galicha* or Pile Carpet Making**

Although *daris* and *galichas* are both called carpets, to most people carpet means only a pile-covered woollen fabric. In construction as in other respects *daris* and *galichas* differ very much. Opening the Twist, Spinning the Thread, Spreading the Warp. The opening of the twist and the spinning of the thread in order to prepare the warp threads are identical with the processes described for *daris*. The spreading of the warp is however different. Just as in *daris*, the warp threads form figures of 8 in which the beams of the loom are encircled by the loops; so in the *galicha* loom, the warp threads are in figures of 8, though in this case they encircle not the main beams of the loom but secondary bamboo rods which are lashed to the loom beams proper.

The *Galicha* Loom

The *galicha* loom consists of two very stout wooden rollers supported on massive uprights, the whole being erected over a pit, preferably of masonry. The upper roller is about ten feet from the ground-*level*, the lower edge of the lower

roller is about a foot above ground-level, while the pit is about two feet deep and as wide. The length of the rollers, in other words, the width of the loom, varies between four and forty feet as extreme limits. The width of the loom limits the width of the carpet that can be made on it. Along each roller is a slot, and at intervals along the edges, if the roller be square in section, are holes to enable ropes to securely retain any rod or other object pressed into the slot. At the ends of the upper roller are large holes through which levers can be inserted with which the rollers are rotated even against great resistance.

The Preparation of the Loom

The preparation of the loom consists in the fixing up of the warp threads in a uniform manner and properly crossed and with the ratch affixed. In essentials, it agrees with the objects aimed at in the preparation of a *dari* loom. In this case however the warp threads are vertical; the ratch being at right angles thereto must be horizontal, while the work advances with an unrolling of the warp at intervals.

Spreading the Warp in Pile Carpets

In the spreading of the warp threads, two pegs are driven vertically into the ground, to which the reader is referred throughout this description. Going through the manipulations, the workers contrive to make a series of figures of 8, the full length of which slightly exceeds that of the carpet to be made. By the various manipulations shown, they also manage to interlace the figure of 8 loops along a cord which runs at the back of each rod. The reader is asked to carefully note the word 'interlace' as it well suits the effect arrived at. The loops are drawn taut, the wooden pegs, which are for temporary use only for driving into the ground, are taken out, and smooth round rods used in their place. Holding these well apart the cord at the back of each side awn tight and secured to the end of each rod. At the same time the interlacing is well scanned and the windings so adjusted that the warp threads are evenly spaced. The object of the interlacing is obviously to prevent any lateral slipping of the warp threads when once they have been accurately spaced. One of the rods is then placed in the slot in the lower beam or roller (or, in carpets of moderate size, mere lashing with rope to the roller suffices). The other rod is then secured to the upper roller. If the carpet be only seven feet long, as is often the case, and if the distance from roller to roller be about eight feet, the intervening space is bridged over by rope strands. This figure, in common with many others, had to be made-up, as insufficient sunlight entered the workshops for photograph purposes. In this case the wooden frame belongs to an ordinary weighing apparatus at Yeraoda. In many cases however the threads will hang in festoons from the upper roller. The turning of this roller soon renders the threads straight and a little final tightening brings about the correct degree of tautness to the warp as a whole. But thanks to uneven twisting or slight errors in the process of making the figures of 8, or to unequal stretching properties in the cotton, certain threads are sure to be looser than others, and as this is a fatal defect in a *galicha* warp, it has to be rectified. This is done by the insertion of thin flat wedges of wood under the threads requiring tightening as they encircle the upper roller. It brings about a local tightening as contrasted with the general tightening effected by the rotation of the roller.

Fixing the Pile Carpet Ratch and Healds

There remains for description the fixing of the ratch and healds—an ingenious proceeding very difficult to follow away from the factory. It constitutes however an essential part of the whole procedure. The reader will perhaps be better able to follow the account if the object, in view is clearly demonstrated. A pile carpet is prevented from falling to pieces because it consists of a mass of short V-shaped loops, of which in each loop the tip of the V winds in and out among certain of the threads which run throughout the length of the fabric. It is this winding round the warp threads which not only prevents the pile loop from pulling out but also from slipping up and down the length of the carpet. Now these warp threads lie in two rows, a front and a back row, as looked at by the worker. If he were to insert say one pile loop, all the way from the right to the left, and beat this series down with his fork, and did no more before repeating the process, the pile would fall out in a day. He must provide an apparatus whereby that row of warp threads which at one time was forward at the next passing of pile loops is changed to the rear. This is what the ratch is to effect, and this it does, as well as two or three other important functions.

Firstly, thin canes are inserted in the upper and lower *ched* on each side of the *joki*-terms which, being applied in the same way as for *dari*-making, need no further explanation. The two canes defining the *joki* are there shown with their ends tied together to keep them in position. This constitutes the *sikari*. These canes with the *joki* are lowered till they are about the height of the worker's head. Then two horizontal stout bamboo rods are fixed up as shown in the same figure. They are about two inches apart, and the actual method of suspension is not of importance. Together with the vertical sticks which separate their ends, they enclose a long narrow rectangle through which the warp threads pass. Two workmen now take up their places, one on each side of the erection. The chief worker stands on the side at the right edge of the warp. (a) a cord fixed at each end of the rod near the worker; (b) a ball of thread which he fastens by an ordinary knot to the string referred to at its right end; (c) he is about to pass the ball to his fellow-workman over the two wooden cross-pieces, going at this first essay to the outside of the outermost warp thread. Simultaneously he slips his left hand through the loop momentarily formed. With that left hand he will subsequently receive the ball of thread from underneath the crosspieces. While this is going on it is the duty of the assistant to (i) detect any slack or broken thread, (ii) to see that by pushing each thread in turn a trifle towards the chief worker's right, the gap between the proper threads is at once evident to each of them in order to expedite work. This care of the threads is much facilitated by keeping an eye on either of the thin canes tied up above. They serve as sight-lines for faulty threads. By looking closely it will be seen that, on its return below the bar, the ball passes between the first warp thread and the next. The thread which is thus surrounded by a loop is that which is nearer to the assistant. In all these manipulations only the threads on the assistant's side are referred to when looping goes on. It represents however how, when the chief worker receives the ball from underneath, he has to withdraw it with a loop of loose thread hanging below it. He then pulls aside with the fingers of the left hand the cord attached to the cross-piece and slips the ball of thread through the gap thus made. When this is over, he is in a position to start afresh, this time passing the ball between threads Nos. 1 and 2 of the back row as he passes over the bar. As the ball is returned under the bar, it emerges between Nos. 2 and 3, and is then interlaced round the transverse cord; then over the

bar between Nos. 2 and 3 and under between 3 and 4. Thus it comes about that the two workers are wrapping round the wooden cross-pieces a continuous spiral of string, which in its course encircles one by one each of the warp threads near the assistant—the interlacing being only introduced to prevent side-slipping.

The next process is the withdrawal of the rear cross-piece. This bar being withdrawn, it follows that any forward pull on the front bar will drag forward all the rear warp threads, for each of these has been looped up to the front bar. (a) the two canes tied by their ends to define the *joki* or intersection; **(**b) the ratch appearing as the lower transverse rod drawn out by cords so that the series of loops rests in a horizontal position; (c) between (a) and (b) is a third rod, while below it can be traced a secondary intersection of threads or *joki*. This intersection is merely the result of the traction on the lower cross-bar in the direction of the observer. The loops surround warp threads which originally were on the other side but which by traction have been pulled into the front row. If the intermediate stick or *dhum* be raised, the loops will tend to advance still more: if the upper *joki* be raised to the top of the frame and the *dhum* be raised up to it, still more will the loops advance and wider will the *ched* be that exists between the front and rear warp threads below the level of the ratch. If the opposite movements be made, namely, if the upper *joki* be lowered and with it the *dhum*, then the bulging of the *dhum*-stick will tend to drag the loops so far back as to cause the front threads to become rear threads. It is often stated that the object of the ratch and *dhum* is to procure equal traction on the two rows of warp threads. This seems hardly to be the case. As a matter of actual fact, the tension in practice is not equal, though both sets of threads are always taut. However it is true that the *dhum* does tend to lessen whatever difference in tautness might exist. The main object is to procure an arrangement for the reversal of the threads.

Method of Proceeding with the Weaving

Let it be assumed that *than* and warp are in the state. For such a loom two-weavers would certainly suffice and they would work on the proximal side of the warp. The instructor or reader stands on the other side, controlling possibly some three or four looms. Unless the pattern be quite familiar to him, he has near at hand a small sample or a design on squared paper. His duty is to see that the weavers affix the proper loops of wool in the proper places, and for their guidance he calls out what practically amounts to this:-Worker No. so-and-so, commencing three threads from your left margin put in two blues, omit three, four blacks, two reds, omit twelve, four reds, stop, fill in back-ground. All this will be explained later. He calls this out in vernacular and then rushes off to another worker and calls out to him a similar jargon. Possibly if the carpet be a wide one another instructor is calling out at another part of the carpet. Most certainly there will be other carpets in process of manufacture elsewhere in the workshop, so that altogether, what with the general volume of sound, the peculiar terms often used, the quaint vernacular of some weavers, and the general hurry and scurry of fingers, it is little wonder that visitors are apt to regard the scene inside a pile carpet factory as run on jail methods a most extraordinary sight.

Having seen that all the threads are taut, that they are properly spaced, that the loops of the ratch are correct, that the *dhum* works well, the weavers commence by hanging above their heads but within reach balls of wool dyed in the requisite

shades. Each man will from time to time break off from such a bundle some fifteen inches or less of wool. With a dexterous manipulation of fingers he loops about two inches round certain warp threads, and then with a single downward sweep of a peculiarly shaped knife he cuts free the rest of the wool he holds in his hand. A few taps with the flat of the blade of the knife beats the loop well down. The first six or seven rows of wool are generally of uniform colour, so that the worker has merely to insert a row of, say, white all across the warp and beat it down and after that add the *poth*, then reverse the warp, again beat, add more *poth*, then beat, reverse the warp once more, and proceed all over again some six or seven times till the entire initial band is completed. However it is necessary that the nature and use of *poth* should be made clear.

On the Nature and Use of Poth

Theoretically, the warp threads are in two rows, a front and a rear. At the line of healds such is actually the case, even to the extent of two inches, but at the very line along which work is proceeding the defining of a rear and front row is apt to be difficult. Now the reader will understand that if the weaving were to proceed without any such appliance as a ratch, there would certainly be, even at the line of work, or the fell, a certain narrow chink between the front and rear rows. If however any reversing arrangement, for example a ratch, be used, then on reversing the threads, although theoretically a chink would still exist between the two rows, in the latter case ii would be much narrower. And being narrower, any thread introduced into it would be extricated with much more difficulty than in the case of the wider chink. For similar reasons such a thread would be held much more tightly in the smaller than in the wider chink. Therefore, there are two forms of *poth*- a *kutcha poth*, that is a strand of thread laid transversely along the *ched* of wider dimension, and a *pucca poth* or similar thread introduced into the narrower *ched*.

To return to the penultimate paragraph. A row of woollen loops is inserted across the full width of the warp and then with a *kanga* these loops are driven towards the bottom of the warp. (An omission-a *ahori* and *chiri* are introduced as in *dari*-making.) What is to prevent these loops from working loose in an upward direction? Each worker takes a strand of cotton yarn generally dyed in indigo and of about 3-5 fibres lying side by side, and this strand he inserts between the front and rear rows of the warp, the strand resting in the narrow chink as far as the mid-line of the warp. At that spot the unused portion of the bundle of yarn passes out from among the threads and hangs free for further use. From the other edge of the warp the fellow-worker has similarly passed his strand of yarn, but not till it has reached that passed by the first worker is it in its turn allowed to drop out from among the threads. This transverse strand of yarn, in two halves, one from the right and one from the left, is what is known as *poth*, or in other words, the weft. In this case it is *kutcha poth*, for its capacity for resisting dragging is less than that of the other sort of *poth*. On this *kutcha poth* being beaten home, the *dhum* is raised, with the result that the threads are reversed, and now a narrower *ched* exists than at the previous effort. The bundles of yarn left hanging after the passing of the *kutcha poth* are now picked up and each bundle is passed on in the direction formerly taken. Hence if A is working at the right of the carpet, he has passed his yarn as *kutcha poth* from the right edge to the centre. Then after reversal, B takes up A's yarn and passes it on from the centre to the left edge in the form of *pucca poth*, while **A** picks up B's yarn and

works it in from the centre to the right as *pucca poth*.

The above description may seem tedious and unnecessary, but the correct laying of the *poth* being of great importance in a carpet, and the strength of a carpet more a matter of *poth* than anything else, the matter has been deemed deserving of full description. Mechanically, it would be difficult to conceive of any other plan of equal simplicity and efficiency, for what is *kutcha poth* on one side finishes up as *pucca poth* in the other half, and since it is securely interwoven into the sides of the carpet and passes from edge to edge, any tendency for the carpet to slit parallel to its length is well resisted. Nor can any piece of pile slip upwards or downwards, for there are two rows of *poth* above and two below.

In any carpet of undoubted excellence, the presence of *poth* in the finished article can only be made out after careful searching, while the plainer the *poth*, the coarser as a rule is the carpet.

On the Weaving in of Designs

Having woven in the initial *patti* or band, the workers are eventually confronted with the task of making a pattern. With ninety-nine weavers out of a hundred this is a very mechanical matter, but for the one-hundredth the case is very different. With regard to him, the master in his art and craft, no verbal description will explain how he gets effects of which he himself is quite ignorant, perhaps, as to means, but is fully appreciative of results.

For the man who stands on the other side of the fabric, and calls out the pattern, the matter is somewhat the same, though his work should never be quite mechanical. Even for him, if he be provided with a pattern which he has neither to modify in colour nor alter in dimensions, no special skill is needed. There are two methods of making carpets from designs or patterns in vogue- the squared paper method and the direct copying from another specimen. Of these, the former is generally practised outside jails, the latter method is with few exceptions that followed in all the Bombay prisons. The first is well adapted for all cases in which any alteration in relative dimensions is called for, and indeed is, in the opinion of the writer, the only safe method for ordinary workers under such circumstances. Assuming the squared paper method is being followed, the procedure is somewhat as follows.

Weaving from Squared Paper

Squared papers having been mapped out for all the various parts of the design which are not mere repetitions, the foreman divides up the width of the carpet into two, three, four workers, as the case may be. As a rule one man is allotted two linear feet. The squared paper being merely a series of vertical and horizontal lines in which each vertical line has its counterpart in a certain warp thread and in which each horizontal line is represented in the actual work as a row of woollen loops, it is evident that the foreman has only to decide which of the main warp threads shall represent certain vertical lines in the paper design and where the corresponding rows of wool and horizontal lines shall be to enable each worker to proceed. Examples will possibly make this clear.

The foreman marks in red ink on the squared paper the vertical line bisecting the design. On the warp he finds which is the mesial thread and this he blackens. Then suppose three weavers are needed for the work, A, B, C. He will then ink off on the paper the line which separates **A's** work from B, and B's from C. Similarly he will ink corresponding threads in the warp. A, B, and C therefore clearly know the limits within which they are to work.

Now let attention be paid to the horizontal lines. Row No. i will be for the *dhori*, the next row is for *chiri*, then may follow five or six rows of uniform tint for the weaving of the *patti*. Now comes the actual weaving. The extreme edge of the border consists perhaps of a simple alternation in two colours, for example red and black. A's first row will possibly read thus: three reds, four blues, three reds, four blues, and so on till the whole of A's first line is completed. In this case too B will have similar work to do, and so would C. All three having conjointly finished the first row, the loops are beaten home with *kangas*, as used for *dans*, the *poth* is applied and beaten home, the ratch reversed, *poth* (*pucca*) applied, the *kangas* used, the ratch again reversed, and the warp is ready for the next row of loops No. 2. Now in this case possibly there is no mere simple alternation. In the paper design possibly A's second row starting from the left reads thus: two blacks, three greens, two whites, two blacks, eight reds, two blacks, and so on. In such a case one of three things may happen, (a) If A is unable to read directly from a paper pattern, he will be given a slip of paper in which the design has been written out for him just after the manner in which a learner not knowing that a mark on the third line of the treble clef in music denotes b has his notes (b included) written out for him. (b) If he is able to read the paper pattern, no such copying out is required, (c) If he is illiterate and cannot read in the ordinary sense at all, it will be necessary for the foreman or a fellow-worker to call out to him the requisite colours.

Now let it be supposed that A, B, and C are all quite illiterate, and that all they, know is the naming of colours and the method of twisting the loops. Further, let the colour of the back-ground in the case under consideration be black. Now as B is engaged in the central part of the carpet, A and C have corresponding work on the left and right. In such a case the foreman will call out somewhat as follows to **A** and C: "Commencing from the outer edge, three reds, two blues, omit three, four reds, omit one," etc. That means that A and C commencing from their respective edges insert loops according to direction, omitting what is the back-ground or any colours which are present in unbroken masses. While A and C are so engaged, B has been filling in his back-ground or large masses of uniform colour. The foreman now turns to B and calls out the requisite directions for him, A and C filling in their back-ground as this is going on. Then when the whole row is completed *kangas* are used and *poth* passed and the next row is got ready.

Suppose however the carpet is wider and A, B, C, D**,** E, F, and G are employed. Of these A and G will probably have the border and a lateral strip of the field to attend to. B, D, and F will possibly have corresponding fields to work on, and so will C and E. Proceeding on the same lines, these men will either have their own pieces of squared paper for direct reading, or the slips will be transliterated for them, or else the foreman will have to call out for A and G, for B, D, and E, and for C and E in groups. The same plan will be adopted no matter how numerous the workers.

After about three rows of woollen loops have been passed the uneven ends are trimmed off to a common level with scissors, which work much more efficiently if the shanks are so bent that the handles remain parallel with the cutting edges although on a level about one inch and a quarter away from and in advance of their plane. The fingers which hold the scissors are thus just touching but not pressing into the part of the pile already cut. Dr. Bocarro of Shikarpur adopted this plan at the local jail and it has since been adopted elsewhere.

Passing of the Loops, or Methods of Knotting

The method of passing the loops is a matter that many writers lay much stress upon, especially as it is often asserted that by examining the manner in which the pile projects through the warp the origin and general value of the carpet can be arrived at. The writer after examining many carpets is inclined to consider such evidence of little practical value. As a rule, if a carpet is really good and closely woven, it is no easy matter to differentiate with certainty the warp, weft, and pile in the depths of such a closely spun carpet. On the other hand, if the pile is loose enough to admit of an immediate recognition of how the wool emerges from warp and weft, the mediocrity of the carpet is established. It is usual to state that there are two methods of passing the loops. Most accounts of how the fingers are manipulated are confusing or incorrect, but the final results are always clearly affirmed. With a Ghiordes or Turkish knot two woollen ends are met with, then a warp thread, then another warp thread, and then two woollen ends. Thus the sequence is two wrool, two warp, two wool, two warp, and so on. On the contrary, in the Persian or Sehna knot the result is such that one warp thread alternates with a woollen end, so that between every pair of warp threads there is a single woollen end.

The actual mode of passing the knot, as witnessed by the writer, will be best followed if the following assumption be made. Suppose the reader is looking over the shoulder of the weaver as the latter sits at his work with the warp in front of him, in nine cases out of ten the worker will act as follows. He will take in his left hand a piece of dyed wool about seven inches long, holding it about two inches short of the advanced end. With the right hand he will take hold of not two warp threads but four. Of these two are in the front row, while the other two will be corresponding rear threads. As a matter of fact, warp threads do not fall exactly into corresponding front and back rows though such is almost the case. For clearness, let the threads be lettered. Thus, A, B, C, D, of which A and B are to the front with A to the left of B, while C is behind A and a little to its left. D is similarly related to B. As regards any further quartets of threads, for example, E, F, G, H, or I, J, K, L, similar relations would hold good.

The usual procedure for the bulk of Indian carpets would be as follows: the free end of the woollen strand is pushed behind A and B passing A to its left side: the wool then comes to the front between B and E, then across the front of B and A and across to D where the wool passes between D and G, then behind C, after which it comes to the front on the extreme left alongside the remainder of the woollen strand. The clipping of the excess wool in front of A clearly leaves two pile ends. It is important to note that the figure depicts only the appearance of the woollen loop as it lies loosely among the warp threads. In practice a certain amount of pulling on the free ends by the fingers is effected before the knife leaves the pile ends free, and in

addition, the presence of the *poth*, together with the reversing action of the *dhum*, leads to a permanent position very different from the appearance shown in the figure quoted. Latter figures show with fair accuracy the final position taken up by the woollen strand.This procedure is known as double knotting, or working with *jhuthi bharni* or false filling. Large uniform masses of colour and the general back-ground are often filled in after this method to save labour.

The other procedure adopted is as follows A loop of wool is passed from the left of A completely around it, then obliquely across to the right of C, behind C to its left, and then forward to the starting point. The next woollen loop similarly engages B and D. Hence each front warp thread is 'encircled,' while each rear thread is only 'backed'.

This procedure is 'single knotting,' and is the only correct method. To adopt it profitably the wool must be spun in a bulky cylinder, and to do this loosely and evenly by hand actually require years of practice. Only by machinery can loose bulky though light woollen strands be evenly spun. In the end the hand- spun fibre is far better, as it proves more lasting, the initial even fluffiness of the machine-spun wool giving place in a comparatively brief time to a shreddy appearance. Text-books refer to Ghiordes or Turkish knotting and Sehna or Persian knotting, the latter falling under a right-handed and a left-handed system. It is said that in the Turkish system if the pile be examined it will be seen that two pile ends emerge between two warp threads, but that before the next pile end is found two warp threads are to be seen. Then come two pile ends and two warp threads and so on. In the other method the sequence is said to be one pile one warp, one pile one warp. In practice not many people could convince themselves of these facts. A reference to the figures will show how very similar are the final appearances. Over and above the procedures described there is another device which can be applied to either of them, namely, what is known as ' double threading,' Just as when a button is to be sewn on lightly a single thread of cotton is used, whereas if the sewing is to be strong the cotton is doubled. In a similar way in order to get over the ground quickly the woollen loop is re-duplicated by folding it back on itself just as a hair-pin is bent back. With the wool thus doubled, the work proceeds as above Generally double threading goes with double knotting alone, the adoption of the method with single knotting depends to some extent on the pattern under consideration.

At *Bhubak* this double threading is carried much farther, even to six strands of wool, while the *poth* is extremely thick.

Plainly under the double threading system four pile ends are freed at each sweep of the knife.

Source: H. J. R. Twigg (1907), *Art and Practice of Carpet Making in the Bombay Presidency*, Bombay, 28-45.

APPENDIX V

PROCESS OF PAPER MANUFACTURE IN THE 19TH CENTURY GUJARAT

Extracts
From

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), 46-62.

The first step was the cutting of the raw materials such as *san,* fishing nets, hemp, and paper clipping from the book-binding establishments. The fibres from the cut raw material were loosened by thrashing them with a mallet and were shaken to remove dust. These fragments were then sorted out in different sacks and soaked in the various proportion in a *kundi* (a stone structure for storing water) in order to be fermented in the fresh water. In the case of the rough *san* products *chunam* and *sajji khar* were mixed with water. These mild alkaline agents gave a chemical treatment and easily separated cellulose from the non-cellulose matters such as resins, gums and waxes. After this disintegration process the raw pulps made from the different raw materials were brought to the stamper where they were beaten into pulp. This action separated the fibres. The *kagdis* then took the pulps covered in sacks to be washed in the Sabarmati River, less than a furlong from the factory. The washing was done in the following manner. Two persons stood facing each other. Around each of their waists two of the four corners of a large coarsely-woven cloth were tied. This formed a good-sized bag hanging between the two men, a hammock-like receptacle in which the partially-beaten pulp was placed. Holding the bag under the water of the river the persons agitated the pulp in the bag until considerable dirt and alkaline residual was eliminated. In order to clean the pulp perfectly the workers placed the bags containing pulp on a nearby bed and rubbed the bags against the matted coir ropes of the bed, adding the river water containing to the requirements. The fibres were then squeezed and pressed into the cakes (*joli* process) by tightening the cloth about the mass, the water discharging through the meshes of the fabric. The mass was then pounded under the stamper till it was reduced to pulp. The pulp underwent a test to check whether any unnecessary particles containing non-cellulose matters were not left in it. For this the pulp was poured into a clay *lota*, and shaken vigorously. A sample of pulp was then taken in the palm. If it showed any particles, it went again to a stamper to be reduced to the proper pulp. The country soap, which the *kadgis* imported from Prantij (then in Ahmedabad) was finally mixed with pulp. This served as a bleaching agent and removed whatever dust was left in the pulp. The pulp was now made into cakes and kept in heaps.

The cakes were next put in a small cylindrical reservoir (*kundi*) which was close to the vat and mixed with water to have the consistency of gruel and trodden

with feet so as to separate the lumps. This was transferred to the adjoining vat containing water. It was then stirred with a stick by a worker and left at rest overnight.

The process of paper lifting from pulp which required skill started the next morning. The vatman sat at a place facing the vat and placed two bamboo sticks (deckles) across the length and breadth and at right angles to each other. Next he took the mould-frame and placed it in such a way that the horizontal side rested on the ridged brim of the vat while the other side rested on the bamboo. He then placed the mould-cover on the frame in such a way that the grass stalks were at right angles to the ribs of the frame, the horse hair or chain lines parallel to them. The vatman then took two wooden bars and stir the water in the vat just to bring some of the pulp to the surface. The bars were now quickly placed on the mat in such a way that with the round bars they formed a rectangular shallow basin or deckle in which the pulp was taken to form the sheet. Afterwards he raised the frame from the opposite side and quickly removed the bamboo and placed it aside, so that it would not obstruct the operation of lifting the paper. The vatman next held the frame in his hands in such a way that his thumbs and fore-fingers pressed against the two loose rectangular bars with the rests of the fingers pressed the frame from underneath.

Next he dipped the frame almost vertically into the vat and turning it horizontally in his hands, took some of the pulp on the mat and brought it to the surface of the water and immediately began to level it on the mat by shaking it to and fro. Any excess pulp was allowed to flow away from the opposite side of the frame. This required judgment on the part of the vatman. While the water was draining away from the pulp he gave to and fro vibrating motions to the frame. At the same time the two thumbs gently struck against the two loose rectangular *pattis*. This vibrating of the frame was done from all sides of direction. This helped to felt or intertwine the individual fibres in the pulp, making the paper strong. The vatman then carefully lowered the frame in its horizontal position just a little into the water. He floated the pulp layer on the mat from all sides and, by giving jerking motion here and there, adjusted the uniform thickness of the paper layer. If he wanted a thicker paper he repeated the process of taking out another layer of pulp over the first one and all the subsequent operation of vibrating done as before. This was called the double layering of pulp, or in the *kadgis's* language *do panika kagaz*. This double layering gave additional strength to the paper.

Afterwards the vatman raised the frame, and raised the frame; it on the brim of the vat quickly replaced the bamboo in its original position, and placed the opposite side of the frame resting on this bamboo. The two rectangular *pattis* were then removed and the wet sheet was given a fold from the opposites side by turning the mat by about $1/4^{th}$ of an inch and pressing it with the round bar. This facilitated the easy separation of the wet sheet from the mat. The vatman raised the mat with the pulp layer on, from the side in front of him with its right hand and holding the opposite side with the left hand couched the wet sheet on a piece of cloth or a mat over a wooden board. After placing the wet paper on the wooden board the vatman replaced the frame and the mat over the vat as before and repeated the operation of paper-lifting and couched this second paper over the first time. The papers were formed into the piles, each pile consisting of twenty four sheets.

These piles were carefully taken out and placed between the wooden boards to be pressed. The heavy stones, as already pointed out, drenched the water from the paper. To give extra pressure children were made to tread on stones. After the papers dried the workers applied some alum and lime water to give whiteness and then stuck them on the walls for drying. Brushes were used in applying paper to the walls which were especially plastered with a coating of lime mortar. The wall pasting not only helped the paper to dry but also to bleach; the Sun rays wiped off whatever scares were left on the surface of the paper. The next operation was sizing. This was very necessary as it would prevent the spread of ink while writing. The degree of sizing depended upon the purpose for which the paper was used. The size was prepared by soaking wheat for about two days and extracting the milk which was boiled with the required amount of water, alum and copper sulphate. The paste was applied to sheets by a soft brush or a piece of cloth. The sizing process made the paper non-absorbent to inks. The blotting papers did not require any sizing as they functioned as absorbents.

Even after the paper was dried and sized, it was not fit enough for writing as the surface was rough and uneven. The paper required to be polished and made even for smooth and easy writing. Before polishing the sheets were cleaned by rubbing the surface with pumic stone or by rough cloth to remove the particles of wood, dust, and sand. A marble stone or a conch shell was used to give a strong rub to the paper. The paper was placed on the concave board and rubbed lengthwise by means of a stone or a conch shell. This gave a polishing.

Source: 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), 52-55.

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