M. Pidance's

Report on Lac-Refining

authorised translation

by

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This translation is
gratefully dedicated

to

Dr. Navab Sir Hyder Navaz Jung, Kt., B. A., L. L. D.

Finance Member
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PREFACE OF THE TRANSLATOR.

The Report on lac-refining published in the Bulletin economique de l'Indo-Chine, No. 108, May 1914, by M. Pidance, Director of Agriculture in Indo-China, records observations in a factory established and controlled in the beginning by the French lac-expert, M. Hautefeuille, who, it is interesting to comment, found it convenient for his purpose to import trained labour from India. In return the French, through M. Pidance, have offered us a piece of technical literature which gives the most detailed description of the operations involved in lac-refining. To indicate the value of the present publication a concrete instance may be offered. Through one of the Records of the Indian Forest Department it was announced that stick-lac, extracted with methyl alcohol, on the solvent being distilled, leaves the lac resin or shellac in an ideal pure form. The experiment was verified on a commercial scale at Bedford, in England, but in order to save the copper-still the material had to be chiselled off. Although the scientific part of the work was confirmed the process, as a whole, was nevertheless a failure, for shellac on dehydration becomes transformed into an insoluble product. It thus became pertinent to inquire how and where water is added in the Indian hand-process of lac-refining which prevents dehydration. An expert was thereupon deputed to study this problem at Mirzapore, the centre of the shellac industry in India. As such information, given in the following account, was conspicuos by its absence from all publications existing then, the English expert told me it naturally meant money and time to obtain it first hand. It is hoped at least lesser disasters may be saved by a perusal of the present publication.

Surprisingly, even official publications appearing later than M. Pidance's Report, make no allusion to it, being omitted from the list of references in the Government of India's Report on Lac and Shellac edited by Lindsay and Harlow, 1921. In this connection I am tempted to quote from what the lamented Professor Maxwell-Lefroy wrote on May 5th 1923, "Indian lac-experts seem to be asleep and not to know anything of the development in regard to the use and manufacture of Shellac, on this side and in America." This gains a special importance at the present low prices of shellac on account of the increasing number of shellac substitutes synthetically produced particularly in Germany and in America.

The translation of M. Pidance's Report was undertaken some years ago with the kind assistance of Miss Padmaja Naidu of Hyderabad and was finally corrected by Dr. M. O. Forster, F. R. S., Director of the Indian Institute of Science, Bangalore. To them both it is a duty and a pleasure to express my gratitude.

I have added a few photographs in the hope that the small brochure would be better appreciated. For the opportunities afforded in photographing and permission for reproduction I have to thank Mr. Mc Glouston, Manager of the best shellac factory in Mirzapore, the Rukhar Ghat Lac Factory and Mr. Jaiswal, Manager of the Factory owned by Messrs M. P. Kasi Parshad and Sons. The reader's thanks are also due to my friend Mr. Usuf Imam, Chairman of the Municipality at Mirzapore, for furnishing me with these useful introductions.

M. Hautefeuille in his Monograph on the lac-industry added, by way of appendix to M. Pidance's Report, two plates containing diagrams of appliances and utensils used in lac refining. Having accidentally lost these from my own copy I tried invain to procure a fresh one. Two years of search and correspondence showed me that it is not be found in any of the German public libraries and byond the reach of an ordinary reader, which fact, among others, further justifies the present publication. Dr. Vayssiere, Joint Director of the Entomological Station at Paris, kindly lent me at last the only separate of M. Hautefeuille's Report to be found in the whole of Paris which has ultimately enabled the two plates to be reproduced here. I have therefore much to thank Dr. Vayssiere for his extreme courtesy.

The photographs partly supplement M. Hautefeuille's Report (Btn. 2. Dept. Industries, Hyderabad) and may strike as somewhat unintelligent if one only reads this translation; similarly the copious figure-markings throughout the plates. A second edition of M. Hautefeuille's Report is contemplated where they would be satisfactorily explained.

Dr. Navab Sir Hyder Navaz Jung, Kt., B. A., L. L. D., has kindly permitted me to dedicate this humble work to him as a token of personal gratitude and respect. The publication would not have seen the light of the press but for the generosity of the Senate of the Osmania University, Hyderabad Dn., and I take this oportunity of expressing my sincere thanks.

LAC-REFINING.

I went to La-Pho (Tonkin) with the intention of studying on the spot the process of refining lac. As the small factory that had been built some years previously by Mr. Hautefeuille was working almost normally during my visit, I was able to follow one by one the different stages of the operations through which the raw material passes before it is changed into the refined products found on the European markets. My task was greatly facilitated by the copious information imparted and interesting observations made by Mr. Hautefeuille during the course of each of these operations.

I think it would be worth while mentioning here how Mr. Hautefeuille came to introduce the process of lac-refining from India. About ten years ago, during the course of a mission to India with which he had been entrusted, one of the tasks which Mr. Hautefeuille undertook was to make an almost complete study of the lac of that region and also of the method of transforming the product. He succeeded, not without some difficulty, in bringing back a number of Indian workers, specialists at this kind of work, and then with the consent of the Indo-Chinese Commercial Union he built a small factory at La-Pho on the Black River which drains most of the region where lac is collected in Indo-China (North-East of Tonkin and North-West of Laos). This factory was worked in the beginning by Indians and later on by the workmen of La-Pho who are still to be seen actually at work after a lapse of several years. The process described below is therefore the one used in India with a few slight modifications.

Judging from the specimens of lac which Mr. Hautefeuille showed to us on his return, the raw material produced here differs appreciably from that collected in British India. Indo-Chinese stick-lac is found in much larger pieces and the incrustation is much thicker than the Indian lac; this on the contrary, is cultivated on the smaller secondary branches, is less regular, more granular and adheres more tanciously to the wood. The natural state in which the lac occurs therefore results in a marked superiority of our Indo-Chinese product by reason of greater facility in separating the woody portions and the useful commercial product which in India have to be crushed together, thus yielding a finely divided material and necessitating the use of rosin*) in order to facilitate the melting of the lac in the process of refining. Our stick-lac is much darker in colour and consequently gives the refined commercial products a deeper colour than that of the Indian lac. This makes it unsuitable for the European markets which demand as little colour as possible for ordinary varnish.

The operations consist of crushing, sifting, washing, drying and a second sifting to remove any foreign matter after washing, followed by straining and roasting.

Crushing. Stick-lac as bought in the country of its origin is crushed on an iron slab with the help of large and small hammers. During the process of crushing, the workmen aim at removing as much of the woody matter as possible. The pieces of lac thus obtained are then sifted in turn through a wicker-tray with holes of different calibre. Remains of woody or other matter are carefully rejected during the sifting and sorting of the fragments of lac. The largest pieces are then made to pass through the crushing mill which reduces them to granules of the desired size. There is no special machine, at least as far as Mr. Hautefeuille is aware, for this kind of work. The equipment used at La-Pho and with which the proprietor has had perforce to be content so far, consists of simple maize crushing-mills of the Bajac model. These machines although really constructed for material very different from that for which they are used at La-Pho, appear at first sight quite efficient for the purpose required; but unfortunately the crude material to be crushed being relatively hard the working parts, especially the edges of the fluted rollers, easily become worn. After a certain period of use, in spite of the roller being screwed tight and controllable, the work shows defects; the granules are either too fine or else so thick that they have to be crushed a second time. We noticed that the Bajac crushing-mill used during our visit to La-Pho had already been used too long and Mr. Hautefeuille expressed his regret at the unsuitable condition of his factory even for the small experiment he had on hand. The proper yield should not suffer because of any flaws in the machine. In

*) Rosin is by no means generally used and only by manufacturers of inferior T. N. — Mc Glouston.

order properly to maintain his refinery Mr. Hautefeuille proposes to replace at least the working parts of his apparatus if funds will permit this at the close of the year.

The raw material while still in heaps and not being disturbed specially during the hot weather sometimes forms fairly large blocks*) on account of fusion having meanwhile set in. In this condition the material is very hard and cannot be crushed by the above mentioned apparatus.

The Sonnet crushing-mill, used for oil cakes, has shown good results, as the toothed wheels of this instrument are of cast-iron and crush with great facility. If the discs could be made of steel, it would be as perfect an instrument as could be desired for the crushing of the consolidated product to be found in certain cases.

Sorting. The product from the crushing mill is collected by workmen and sorted in round baskets, with holes of different sizes, serving as sieves. There again most of the waste material, woody or otherwise, is removed.

Two grades are made, according to the size of the crushed granules, one in which they are at least as large as beet-root seeds and ultimately producing what is known as shellac; the other, containing smaller particles, will be converted into button-lac. Finally all the larger pieces are again passed through the crushing mill.

Washing. Stick-lac which is crushed into granules for the manufacture of shellac or button-lac is then taken to the wash-room. Each of these products is placed separately in wooden tubs where they are left to soak in ordinary water during the night for about twelve hours. The object of this immersion is (1) to cause the lighter particles of extraneous matter to float to the surface and be skimmed off; (2) to resoften the lac; and above all (3) to remove some of its colour, whence the water in the tub assumes a deep wine-colour. When it has remained in water for twelve hours and after the water has been strained off the solid matter is transferred into vats of hard stone resembling inverted cones and about 100 litres in capacity.

The special feature of these vats is that their inner surface is very rough and thus facilitates effective washing. After having poured a certain quantity of water, which is frequently renewed, on the lumps of lac, the workman, holding fast with both hands to an iron bar fixed horizontally close to the vat and at the required height in order to serve as a support, kneads the mass with his feet and legs, rubbing it gently against the wall of the vat. After this preliminary tratment, which lasts about half an hour, the whole is washed in water in round bulging baskets. The same operation is repeated twice or thrice until the seed-lac has become orange in colour. It is much easier to wash away the dye from freshly gathered lac than from an older material. For this apparently simple work, mechanical washing-appliances have hitherto given poor results.

The workroom should be a cemented area and there should be two or three basins so arranged in tiers that water can be left standing in them and so permit the fine powder washed off by the liquid to settle, as this powdery lac can be utilised.

Drying and Filling into Tubes. The lac that has been thus obtained is placed on an area that is either cemented or tiled and dried in the sun or if there is rain, in the shade. In order to facilitate drying a workman comes from time to time to diturb with his feet the material spread in a layer several centimetres in thickness. In the sun the product can be perfectly dried in a few hours, but in the shade the process will take several days. When thoroughly dry, seed-lac is filled into calico bags seven to eight centimetres in diameter. The material for these tube-like bags should be a cloth that is neither too fine nor too thick, but strong enough to resist the effects of the twisting that takes place during the heating and melting of the lac. There is on the market a calico of local manufacture and of special quality which is perfectly suitable for the manufacture of shellac, whilst for button-lac the cloth used should be stronger and of finer mesh: in this case a single layer of cloth suffices though for shellac two layers are necessary. Usually, for the sake of economy, a bag that has already been used once is used together with a new one.

When being put into the bags the stuff should be lightly compressed, without, however, either the granules being too much crowded or the tube becoming too stiff, in which case lac will not melt sufficiently on account of insufficient air-space.

Shellac. Shellac is lac of good quality which after fusion, roasting and straining has been converted, by the process of manufacture, into thin transparent sheets.

Before going into details on the preparation of this refined product it would perhaps be useful to say a few words on the arrangements of the furnace and the various instruments used.

The furnace consists of the hearth properly speaking, the inside length of which is 1.20 metres and which is semi-elliptical in shape with a slightly over-hanging, convex-hooded chimney above it, made of clay and supported by a plate of soft iron. By the side of the hearth and adjoining it there is a slab of granite 40 cm in width placed 8 cm below the level of the hearth. On the surface of the slab is dug

*) In India the above condition is known as "blocking". — S. M.

a small trough a few millimetres in depth and 30 cm in width, so fashioned that a thin layer of water can be maintained there as long as desirable without interruption. The three other outer edges of the slab are joined, with a slight slope, to the tile-flooring of the workshop by means of cement bricks or square tiles. The sloping part facing the workman in charge of the furnace is made of a piece of marble or any other hard, smooth-polished limestone. It joins the sill of granite to a platform, also cemented, 15 cm above the level of the workshop.

Besides this furnace there is another one very simply built and consisting of a square surrounded on three sides by bricks. This serves to relieve the larger furnace of its surplus of ashes and embers and also to keep water hot on a wood-fire.

The chief workman (in charge of the furnace) has three instruments for melting the lac; (1) a sort of knife with a long straight blade 5 cm wide and (2) two flat iron palette knives 4—5 cm wide by 15--20 cm long.

The apparatus which is used in twisting the bag is extremely simple. It consists of an ordinary board on which the workman sits. At the end, opposite the furnace and fixed perpendicularly to the other, there is a second board 45 cm in height having in the upper part a round hole forming an eye in which turns a cylinderical piece of wood of the same size as the diameter of the tube and on the end of which is carved a small concave groove in order to facilitate the fastening of the bag. To this end is tied the cloth of the bag filled with lac while to the other are fixed perpendicular to the axis of the cylindrical stick two pieces of wood crossing each other to form a handle.

In order that it may not be dragged on the ground, as it would not only wear away and soil the cloth but would also interfere with the working, the tube turns on several semi-cylindrical wooden-supports standing flat on the ground and placed at a distance of one metre from each other. It is kept in place by two tiny pieces of wood perpendicular to the concave support and forming a passage as it were.

Then there is a receptacle of earthenware shaped like a large-necked bottle with a volume of twenty-five to thirty litres which holds hot water. The outer side of this bottle is covered with a special glaze to prevent the lac from adhering to the surface during fusion. The object of the hot water in the bottle is to maintain an even temperature of the smooth surface of the receptacle as a very sudden cooling would render the later manipulations impossible.

In India three or four workmen are necessary for each shellac furnace, one head workman to melt and dehydrate the lac, one or two to spread out the stuff that has been already melted and a fourth to turn the tube. The last is usually performed by either a woman or a child.

The chief operator watches over the fusion, filtration and the roasting of the crude material. It is a delicate operation requiring skill and experience as the roasting has to be continued to a certain point. Standing on the platform beside his furnace and facing the tube, which is near him, the workman, having within reach of his right hand a basin of cold water and the earthenware bottle mentioned, holds in his left hand the end of the tube that has been left empty, the other end being attached to the tourniquet held by the workman. A slow regular movement of transverse rotation to the right is given to the tube so that the portion to be heated is warmed almost continuously on the whole cylindrical surface presented to the fire. Under the influence of the heat from a charcoal-fire which is not too brisk, the lac within the tube begins to melt and flows through the cloth, forming a coating which agglomerates round the tube and turns with it. The lac softens more and more becoming not only gradually lighter in tint but also more shining and viscous in appearance, finally dropping on the granite slab at the foot of the furnace which, as already mentioned, is always covered by a thin stream of water renewed in proportion to the evaporation caused by the heat of the furnace.

The workman armed with his iron blade somewhat resembling a knife, scrapes off the melted mass that collects round the tube. Heating is continued without interruption and a fresh quantity of material flows through the cloth. Meanwhile, he works up the first mass of melted lac on the marble stone by picking it up on the knifeblade. As soon as he thinks there is enough lac to dehydrate, he transfers it all to the tube, rubbing the semi-fluid material on the cloth with the flat of his blade by a series of quickly repeated, alternative backward and forward movements. When the mass of lac, well melted and viscous, becomes chestnut in colour and shining in appearance it is ready and the workman removes it.

With the help of an iron knife without a handle, which he uses like a spatula, he scrapes the tube, raises the heated lac and with a rapid movement puts it on the surface of the bottle, just below the neck. This receptacle, resting on its upper part on a tiny brick wall which for better support, slopes at an incline of about thirty degrees. It has been mentioned already that the surface of the bottle is kept at a constant temperature of about 60° C by hot water, which is renewed from time to time as it cools. If the surface is too hot, lac adheres, and if it is not warm enough the material cannot be spread and becomes hard. An

expert headworkman removes all the heated lac that has collected round the tube with two or three strokes of his knife.

Now begins the responsibility of the workman in charge of stretching the material. Provided with a thong made from the margin of a fresh unexpanded leaf of the Latania palm he seizes this in both hands held on either side of the hot water bottle and slightly below its level; he then slides the thong with a downward movement thus spreading the semifluid material on the side of the receptacle. The lac that adheres to the thong is put back a second time on the bottle and the operation is repeated. There is thus obtained a layer several millimetres thick, over 60 cm in length and 30 cm in breadth. This ensures the successful production of a uniform sheet without any flaws in continuity. If, however, for any reason there should be a spot not covered by lac the workman borrowing a piece from the edges, patches the sheet and immediately flattens it. If any portion of the melted lac remains on the thong it is removed, and either replaced on the slab of granite, or added by the chief workman to the fresh quantity of matarial undergoing fusion.

Now it is necessary to remove the skin adhering to the surface of the bottle without being absolutely stuck to it. With the thumb and first finger of each hand the workman begins to lift the side parts which he stretches a little, then later the upper and lower parts, which he raises and stretches as much as possible. He then takes up the side portions which have already been lifted, and loosens three-fourths of their length, meanwhile continuing his efforts at stretching. Finally seizing the lower part with both hands he pulls off the skin-like sheet thus obtained, with a quick upward movement and immediately holds it in front of the furnace. This sheet is now about 40 cm long and 70 cm high and the central portion adhering longest to the bottle, is a little thicker than the ends, which have by this time been more or less extended; but this is all the better because later efforts at traction are always exerted on the centre. In front of the fire the workman begins to stretch the sheet sideways, making lateral pulls with both hands, then longitudenally using his feet and even his mouth to help him. By making use of all these methods of extension which he must know exactly when to use and which he accompanies with a peculiar twist of the body, the workman eventually obtains a fine, transparent sheet almost uniform in colour and without any break, measuring about 1.50 metres sideways and having the appearance of an animal skin. As soon as it reaches this stage the sheet is spread on a cloth. The borders, where the tension has been less are always much thicker and of a deeper colour. As these parts would only produce material of poor appearance and hence diminish the commercial value of the entire lot, they are detached and immediately returned to the head-workman at the furnace who puts them back to undergo fresh fusion. The object of the workman's peculiar contortions of the body is to prevent the material being over-heated. The sheet is held in front of the fire, but is moved about in a way such as will give the desired effect; as soon as it is placed on the ground the sheet cools and becomes brittle and can only with difficulty be manipulated without fracture.

By giving the tube a rotatory movement and at the same time offering limited resistance, the workman, holding in his left hand the empty end of the tube, sets up a natural torsion of the cloth which drives the material forwards in proportion to the fusion and produces an exudation of the contents. Fragments of molten lac of good quality left on the tube are removed by hand in spite of the high temperature. To avoid burns, the workman carefully wets his fingers beforehand and works as quickly as possible.

It sometimes happens that during the operations the fabric of the tube gets torn in which case the cloth should be mended at once with a needle and thread. Any material that escapes is set aside because it consists of lac which, although subjected to heat, is yet crude and full of impurities. These leakages should be flattened and reduced in size for mingling with stick-lac, or button-lac, or the dabugala powder, according to the size obtained.

It also happens sometimes that in the course of the work some quantity of foreign matter, comprising the unfilterable residue, accumulates and prevents to a large extent the commercially valuable material from oozing out of the enveloping tube. When this happens the workman himself slits open the tube and removes these impurities which form what is known in India as Kiri or Khiree. This product is pulverised and mixed with the dabugala powder.

The skin-like sheets of shellac prepared during the day are piled one on top of the other according to their size, and after being weighed are taken to the sorting-room. Sorting, which is generally carried out by women, should be done in as short a time as possible, especially during the hot season, as the sheets stick to each other when the temperature is high. For this reason the manufacture of shellac during the summer or in very hot regions is almost impossible and in any case is always disadvantageous and defective. Sorting consists in removing the parts that are too thick and of very deep colour, as they would otherwise lower the value of the product. Shellac of good quality should consist of clear, transparent lamellae or scales easily soluble in alcohol. The parts that are rejected during sorting are either put back amongst the raw material or returned direct to the head-workman at the furnace.

The sheets of shellac having been sorted are spread out in a thin layer to await packing. The layer should be carefully turned over every day with a rake, or a bamboo, or by the feet, so as to allow the product to dry well and thus help to preserve it almost perfectly. Unless this necessary precaution is taken the lamellae stick to each other and become matted or blocked, thus losing much of their market value.

During one working day, each shellac furnace can treat 40 kilos of material that has been already sorted and washed, and can produce 35 to 37·5 kilos of refined product.

Button-lac. Button-lac is another equally pure product of stick-lac. Instead of being in fine pellicles like shellac it is in small, irregularly formed macaroons or biscuits 4 to 5 millimetres in thickness.

The furnace for button-lac is similar to the one used for shellac but it is of slightly smaller dimensions and the tube is also smaller in diameter. The work of the chief operator at the furnace and the necessary precautions to be taken during the melting and heating are the same. The only difference is in the material to be treated, which is finer in grain and in the method of treating the lac after it has been melted. After it has undergone, as already described, the various manipulations from washing to melting which stick-lac undergoes, the chief operator, instead of spreading the melted lac over the bottle in order to stretch it, simply puts it in small lumps or biscuits with his hands on the back of a foliaceous case made from the trunk or bark of a special kind of banana plant.

Emphasis is laid on the word special, because all species of the banana (Musa) plant do not serve the purpose equally well. Certain varieties are too watery and hence their cases dry up at the high temperature of the molten lac and lose their shape. At La-Pho, Mr. Hautefeuille makes use of the banana that is grown locally as fodder for pigs. The wild banana which has also been tried at La-Pho gives equally good results. The lac, before it cools, spreads into a uniform layer, the upper part of which is smooth and shining while the part which adheres to the banana bark is duller in appearance. After a few minutes each of the little pieces of button-lac is removed from the mould. They come off quite easily and resemble small pieces of hollow tile.

They should not, however, be removed from the mould until they have completely cooled, otherwise they will lose their shape and become quite flat. Then again, even though it is not quite so essential as it was for shellac, buttonlac should be spread out to dry for a few days to prevent the plaques from inter-fusion.

Button-lac of good quality should be clear chestnut in colour, with a very fine grain, the upper part should be smooth and free from any inflation, the borders should be rather transparent and the whole should be easily soluble in alcohol as it is intended to be used for varnish.

According to the old sale-price obtained by Mr. Hautefeuille, button-lac of Tonkin should be more expensive than shellac in comparison with the same two products of India. On the contrary, however, Mr. Hautefeuille assures us that in India it is button-lac which, more than shellac, contains a proportion of rosin.

The button lac furnace, in order to work properly, requires a head-workman at the furnace, a woman to turn the tube and an assistant for three or four furnaces. This group of workers can treat 30 kilos of material during one working day.

Washing the Tubes. The tubes that have already been used for either shellac or button-lac look like tightly knotted rope covered with wax. To renew them they should be boiled in water containing a little potash. During this cleansing process the wax that had collected on the cloth is removed and floats on the liquid in the kettle, forming broad, thin cakes.*) This commodity could be sold just as it is, because it appears to be used in the manufacture of sealing wax, as dabugala is used. At La-Pho, however, it is pulverised and added to the various lac-products which are collected for conversion into dabugala. The water in which the lac has been washed leaves a somewhat important deposit in the form of a solid violet material, like wine-lees, which can be used for dying. The trade in this purple dye, formerly so important in India, has become very dull since the discovery of artificial dyes, however, the present importation into foreign countries is practically nil.

Dabugala. Dabugala is a product of inferior quality not intended for varnish. It is made from the waste-products referred to earlier and from the sweepings of the factory and the lac store-room freed from actual dust. Its nature and its market value therefore vary according to the amount of good material in its composition.

Dust winnowed from the workshop and the store-room, crushed or even ground kiri, bad leakages from the tube, wax from the washing of the tubes, and the valuable material obtained by sifting the residues from the preliminary washing are all mixed in varying proportions and melted down to yield this product. In order to facilitate fusion, it is necessary to add about 40 per cent of rosin, or colophony.

A larger boiler-pan is placed on a round furnace heated by a wood-fire. Some of the colophony is first liquified, when the rest of the mixture of powder and rosin is added. While it is being heated two

*) Passewa, as this is called in India, floats to the surface. Mc. Glouston.

workmen provided with sticks, stir the mixture slowly at first; then more rapidly as it just begins to liquify. As soon as the paste becomes semi-liquid, which proves that the melting has continued long enough, it is poured from the pan into small saucepans which have been heated to the same temperature on a charcoal fire. The workmen take out the fluid material with iron spoons and put it on a sheet of zinc or tin. It spreads into flat biscuits which should be very lustrous without bubbles or lumps, and the grains on breaking should be as fine as possible without being as fine as those of button-lac.

Adulteration. As the natural condition of lac collected in India necessitates its grinding, which leaves the material in a very fine and powdery state, some manufacturers mix with shellac and specially with button-lac a certain quantity or rosin to facilitate fusion. It is a necessary adulteration when using lac of poor quality, but one that nevertheless lowers the commercial value of the product. At La-Pho it is always possible to purchase the two products without added colophony, and Mr. Hautefeuille tells us it is probably for this reason that the Indo-Chinese product has more and more taken possession of the European markets. orpiment is sometimes added in Calcutta, doubtless to help in moderating the colour of the lac, but as this sulphide of arsenic is dangerous to use, it has never been tried at La-Pho.

The Advantages of Refining. Now that we know the process of refining we should inquire into the advantages of changing the raw material which is also to be found on the European markets. What are the industrial uses of the refined products and what is their possible market? They are innumerable and all are not yet known.

Shellac is used principally in the manufacture of varnish and also, we are told, in the manufacture of hats. Button-lac, besides serving the same purpose as shellac, is also used in the manufacture of cutlery, electrical machinery and in the composition for gramophone records.

Dabugala is used as cement in making cutlery, in the manufacture of sealing-wax and in many other minor and less familiar industries.

Lac which has not been refined could be used for these same purposes, but common-sense recognises that the refined product, whose superior value can be appreciated even at first sight and which in addition has better-defined uses, must necessarily find a more favourable market than the other.

Moreover, refining diminishes the weight of the useful product to 71 to 75 per cent and thus there is economy of both freight and transport.

Finally, the third consideration is that crude material or stick-lac cannot be kept long in that form without deterioration. Placed in heaps or in sacks, it melts into a mass as soon as the temperature rises and loses its value. And even without the influence of heat it is spoiled by the attacks of insects and doubtless by fungi for it becomes powdery and the dyestuff tends in time to permeate the mass of lacresin.*)

The refined product on the contrary, having been treated under favourable conditions, preserves its qualities indefinitely**) and so can be sold at any time without losing its value.

Now what is the advantage from the financial point of view?

We are able to give details***) in the following calculations made by Mr. Hautefeuille.

The items are manual labour, cloth for the tubes and charcoal.

For a shellac-furnace daily producing 35 kilos of refined product from 40 kilos of sorted and washed seed-lac, the following manual labour is necessary for every working day:

Head workman in charge of the furnace paid	$ 0.30
One cooly paid	„ 0.25
One Assistant (Congai)	„ 0.12
Then one cooly for two furnaces paid	„ 0.50 (= $^1/_2$ is · 50).

This furnace consumes 25 kilos of charcoal at $ 1.80 for 100 kilos and 5 kilos of firewood; also two new tube-bags costing $ 0.70 per pair.

For a button-lac furnace giving 20 kilos of refined product daily, only 20 kilos of charcoal are used. The manual labour necessary is less, as only a head-workman at the furnace, 1 assistant (Congai) and 1 boy are needed.

Cleaning, crushing and sifting vary greatly according to the material to be treated and the equipment of appliances. According to Mr. Hautefeuille, the net cost for 100 kilos of stick-lac varies from $ 2 to $ 3.

Washing and drying hardly cost more than $ 1 per 100 kilos.

*) The darkening of lac on storing is probably due to the action of ammonia, liberated by the decomposition of insect-skins under the influence of fungi and bacteria. S. M.

**) Shellac also detoriates in value on storing and tends to become insoluble in alcohol though not to the same extant as seed lac. S. M.

***) The net cost of 1 kilogram of the refined product varies a little for each lot treated but nevertheless the cost of some of the operations and of some of the materials used is definitely fixed.

Thus for 35 kilos of shellac obtained the expenses would be as follows:

Manual labour at the furnace $ 0.30 + 0.25 + 0.12 + 0.12	=	0.79
Cloth and making of the tube-bag $ 0.70 + 0.02	=	0.72
Charcoal $\frac{\$\ 1.80 \times 25}{100}$	=	0.45
Fuel $\frac{5 \times 4}{100}$	=	0.02
Crushing and sifting $ 0.30 × 40	=	1.20
Washing and drying $ 0.01 × 40	=	0.40
Sorting and drying of refined product	=	0.10
Total	=	$ 3.68 for 35 kilos.
Therefore 1 kilo = $\frac{3.68}{35}$	=	$ 0.11 = fr. 0.275

to which should be added the general expenses of supervision and amortisation of the cost of the material, fixtures and appliances.

By taking the same figures for a button-lac furnace giving 20 kilos of refined product for 30 kilos of the initial material we get the following:

Manual labour $ 0.30 + 0.12 + 0.10	=	$ 0.52
Charcoal $\frac{\$\ 1.80 \times 20}{100}$	=	„ 0.36
Cloth and charges for making tube	=	„ 0.36
Crushing and sifting $ 0.03 × 36	=	„ 0.90
Washing and drying $ 0.01 × 30	=	„ 0.30
Sorting and drying	=	„ 0.05
Total	=	$ 2.49 for 20 kilos.
Therefore 1 kilo = $\frac{2.49}{20}$	=	$ 0.12 = fr. 0.30

to which also the general expenses and amortisation should be added. But Mr. Hautefeuille remarks it is important to notice that with a really adequate equipment of appliances one can lower the cost of crushing and sifting from $ 3 to $ 1, thus bringing the cost of refining 1 kilo from $ 0.21 to $ 0.24.

Under the present circumstances, however, the cost of treating the crude material at La-Pho is fr. 0.30 per kilo of refined product.

The minimum yield per 100 kilos of sorted and saleable lac is about 70 kilos.*) Taking the statistics given by the Journal of Tropical Agriculture for the year 1913 we get the following figures:

Month.	Price of 100 kilos of sorted lac. francs	Price of 100 kilos of shellac francs	Price of 100 kilos of shellac corresponding to 100 kilos of stick lac. francs	Difference on 70 kilos francs	Difference per kilo francs	Gain or loss per kilo after deducting f. 0,30 per kg for refining francs
January	95	180	126	31	0.44	0.14
February	100	200	140	40	0.57	0.27
March	112	195	136	24	0.35	0.05
April	110	170	119	09	0.13	0.17
May	115	190	133	18	0.26	0.04
June	125	225	157	32	0.46	0.16
July	120	230	161	41	0.58	0.28
August	150	255	178	28	0.40	0.10
September	135	245	171	36	0.52	0.22
October	130	225	157	27	0.39	0.09
November	125	221	154	29	0.42	0.12
December	125	222	148	23	0.33	0.03
Average per Year	119.78	209.51	146	27	0.38	0.08

*) I have not been able during my very short stay at La-Pho to verify the percentage of the refined products obtained in relation to the crude material used, I have therefore followed the figures given by Mr. Hautefeuille.

During the last period of manufacture (1907—1908), there was produced from a lot of 17 tons of stick-lac of good quality 72—73 percent of shellac and button-lac and 6.31 percent of dabugala, as far as we can ascertain from our report.

The lot treated at this same little factory last April gave 73.88 percent of refined products of the first quality (shellac and button lac) and 4 percent of dabugala.

The proportion of good material to dabugala varies appreciably according to the quantity and the condition of the raw material treated, its age and the temperature that may have caused it to block, and thus to retain the foreign matter that was in the crude stick-lac.

In spite of the poor current price of stick-lac and its derivatives in 1913, one can see from the above figures that the wholesale purchaser, who would have paid fr. 0.30 per kilo for having his raw material converted into the refined product, would have made his profit of fr. 0.08 during the course of the year without losing the numerous advantages noted above, e. g., the greater facility of placing the product on the market, lower freight and transport, and long preservation of the material. Evidently this profit of fr. 0.38 per kilo is not sufficient to justify the installation of a factory. There is no doubt at the same time that according to these figures which are accurate, the exporter should have great financial profit even under the exceptionally unfavourable yield of 70 percent resulting from treatment of the raw material. On the other hand it would support a small factory and employ a certain number of workmen for eight months of the year. Also the output of 70 percent is extremely exceptional and could only be possible under very bad circumstances. Moreover a residue of dabugala must be added which goes to lessen the cost-price.

Mr. Hautefeuille intends to introduce the process of refining among the producers of lac themselves, or rather among the first intermediate agents. Whether this is possible remains to be seen; at present it is too soon to give an affirmative reply. In any case it is not materially difficult or impracticable although the work and the manipulation of the raw material demand dexterity of hand and great experience, of handicraft; but the Asiatic, whatever be his nationality, learns easily in a few days quite as well as the inhabitants of La-Pho and as the workmen of the Agricultural and Commercial Museum sent by M. Crevost. For example, in the manufacture of button-lac, the only product to be recommended as a beginning, the uniformity of the granules after the lac has been crushed is of no importance; installation of the furnace will not be difficult and the cost of instruments and accessories, knife, charcoal, cloth, banana-plant, can be found in any of the villages. The inhabitants, treating the material as soon as the collection is over, will surely obtain a product of the finest quality which, they can be sure, will remain in good condition, and which they can sell at will, without being at the mercy of the purchasers, who know they could not leave the lac for any length of time without its deterioration.

For one who knows the apathy and carelessness of the lac-producers of Laos and Tai it is difficult to foresee that, at any rate for a very long time to come, a proper factory can be installed at either Muong-Hat or Ruan-Gias; but it is possible that the Chinese intermediate agents of Cho-Bo, Suyut and other places along the Black River, will take an interest in Mr. Hautefeuille's short demonstration, especially if they foresee any profit from the construction of small factories.

Plate 1.

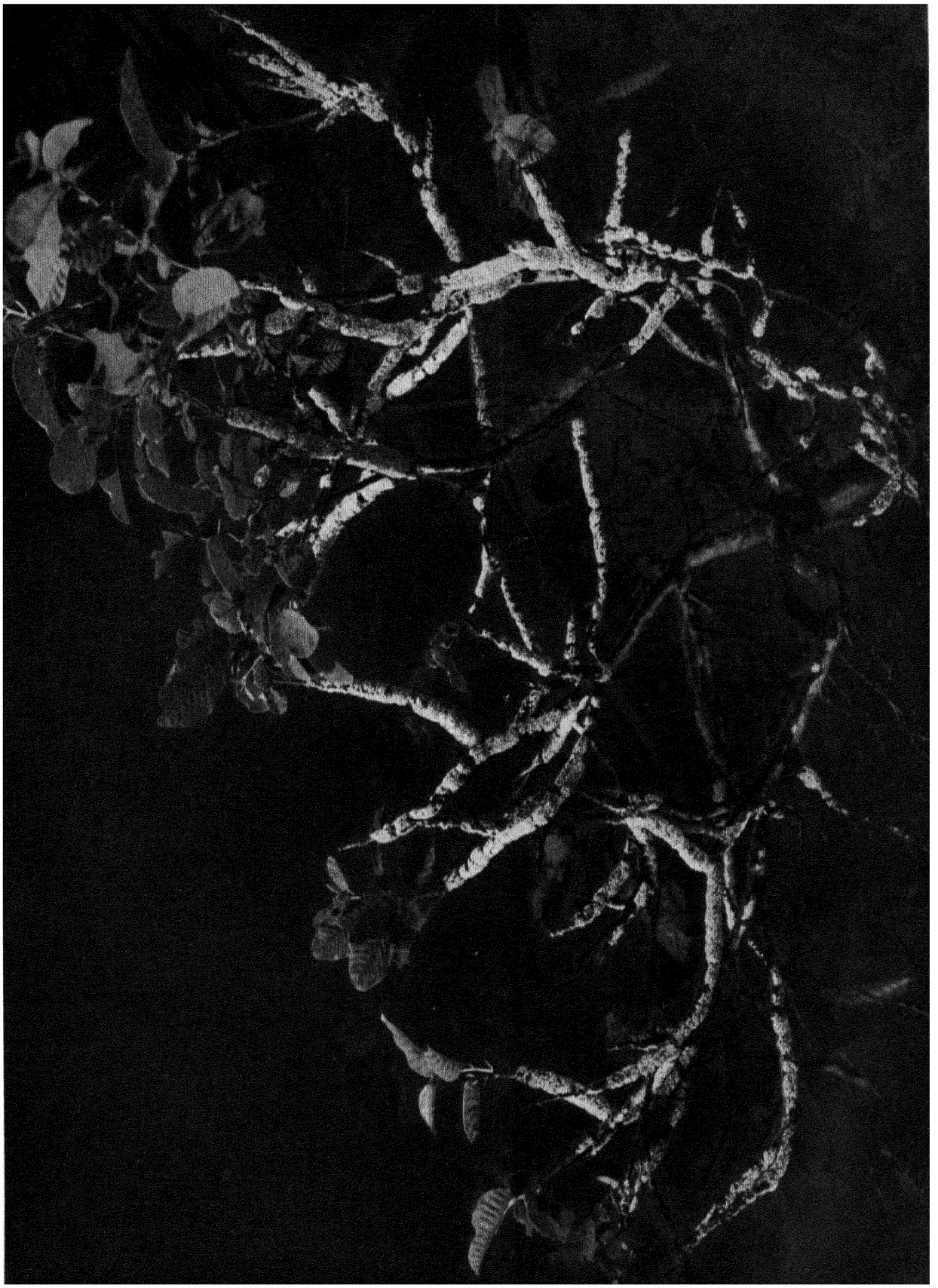
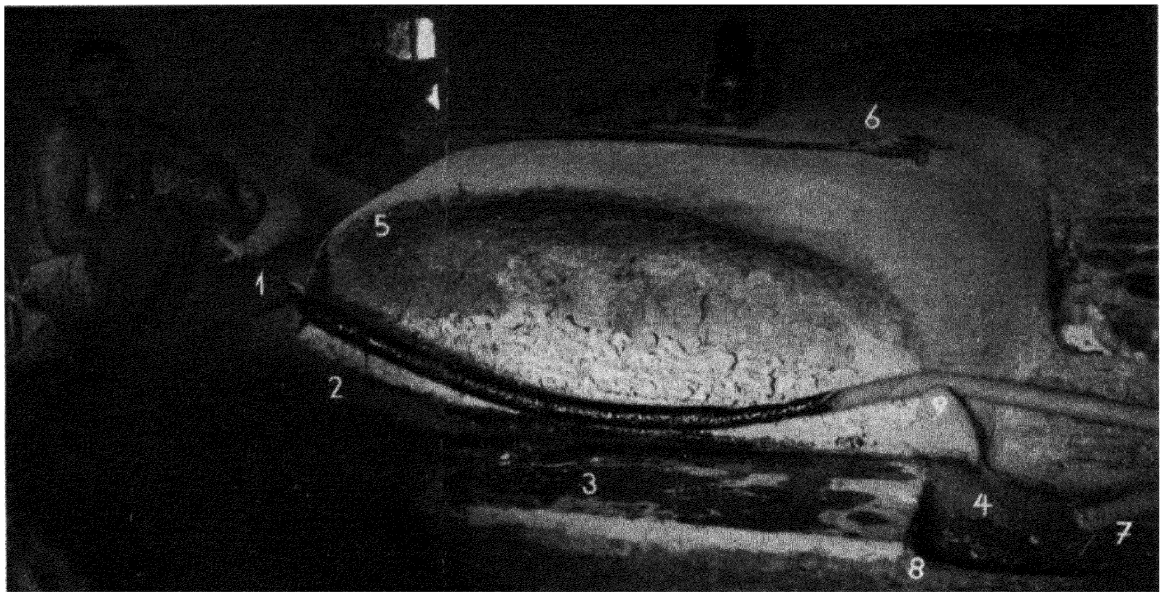


Fig. 1.

Plate 2.

Fig. 2.



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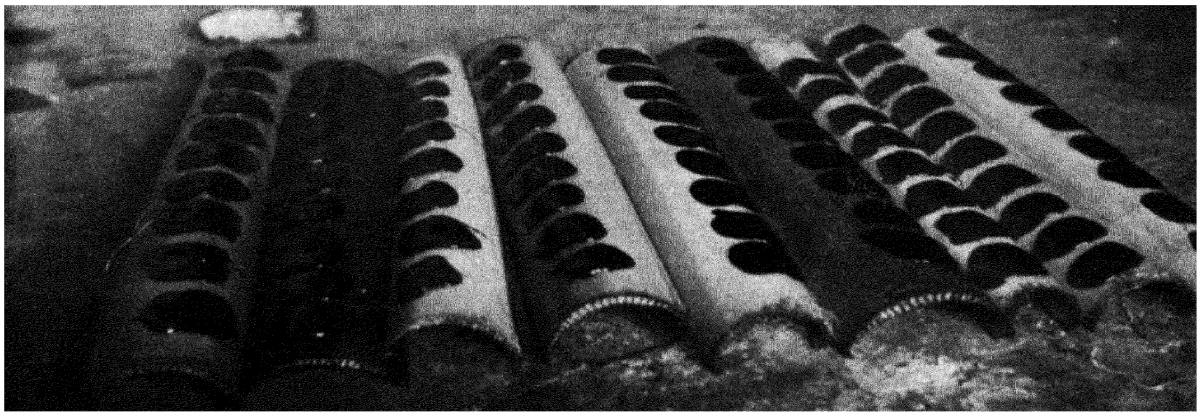
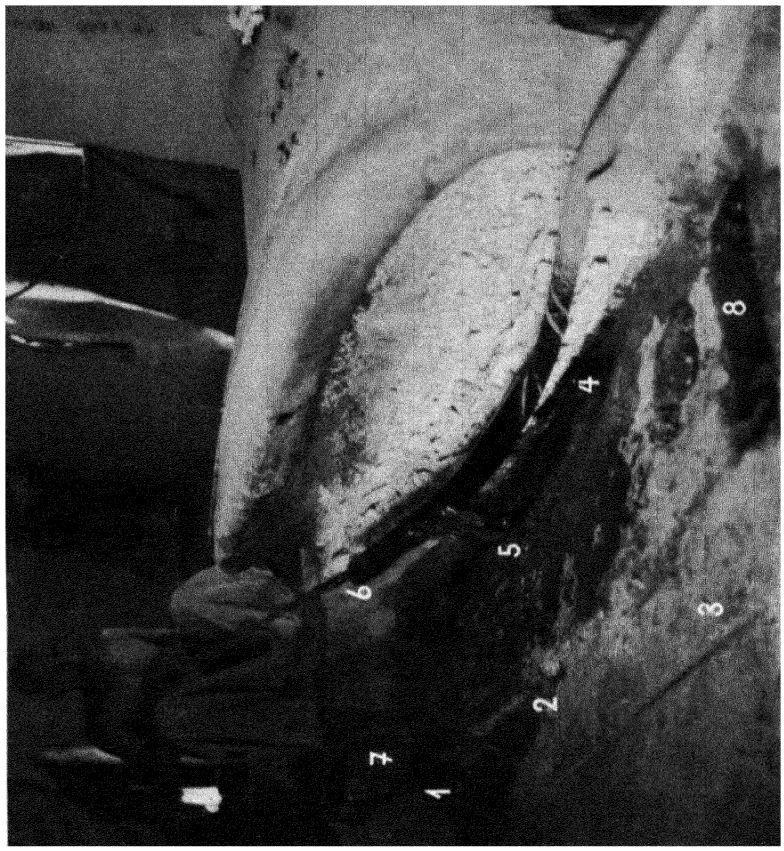


Fig. 4.

Plate 3.

Fig. 8.



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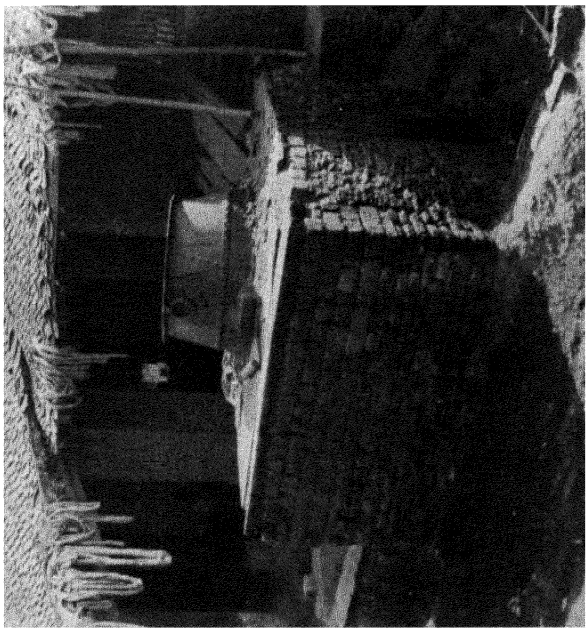

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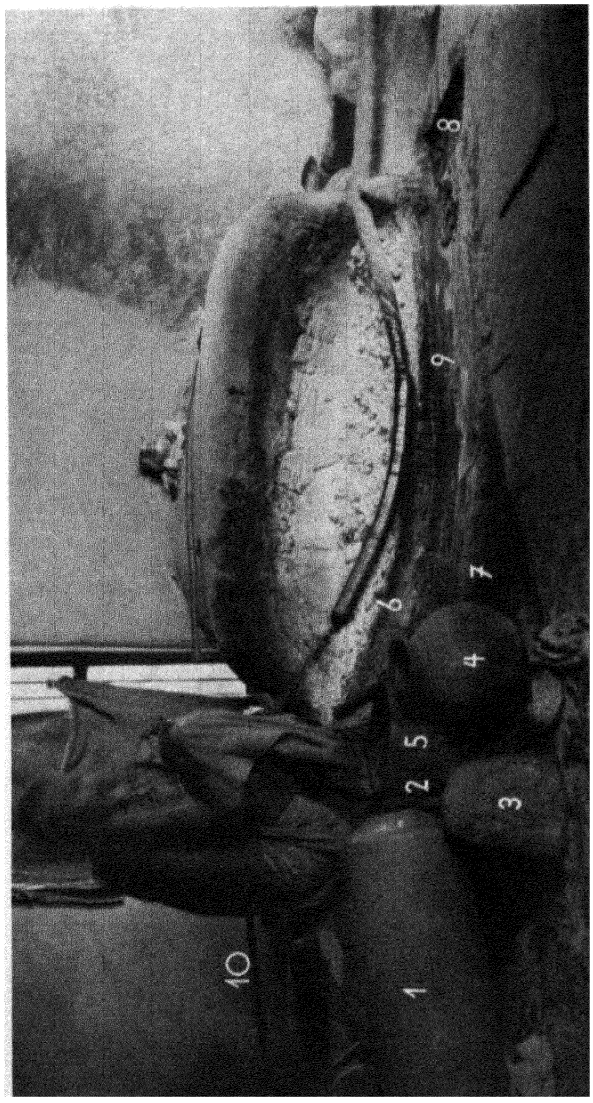

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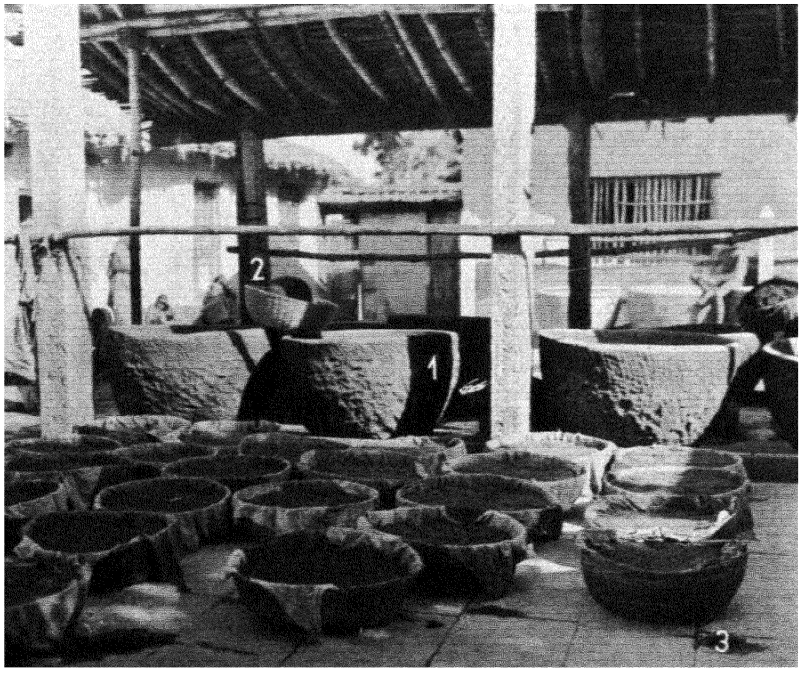

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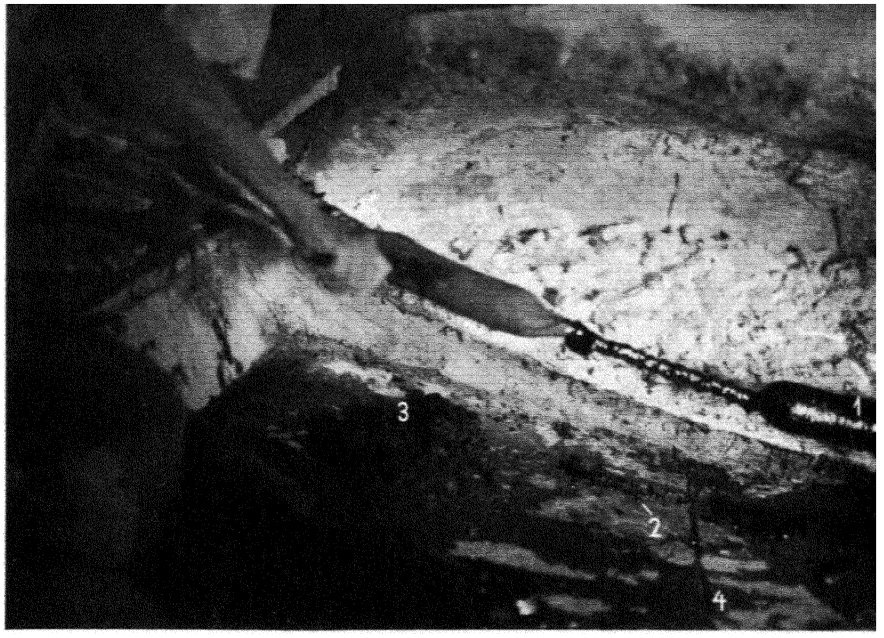

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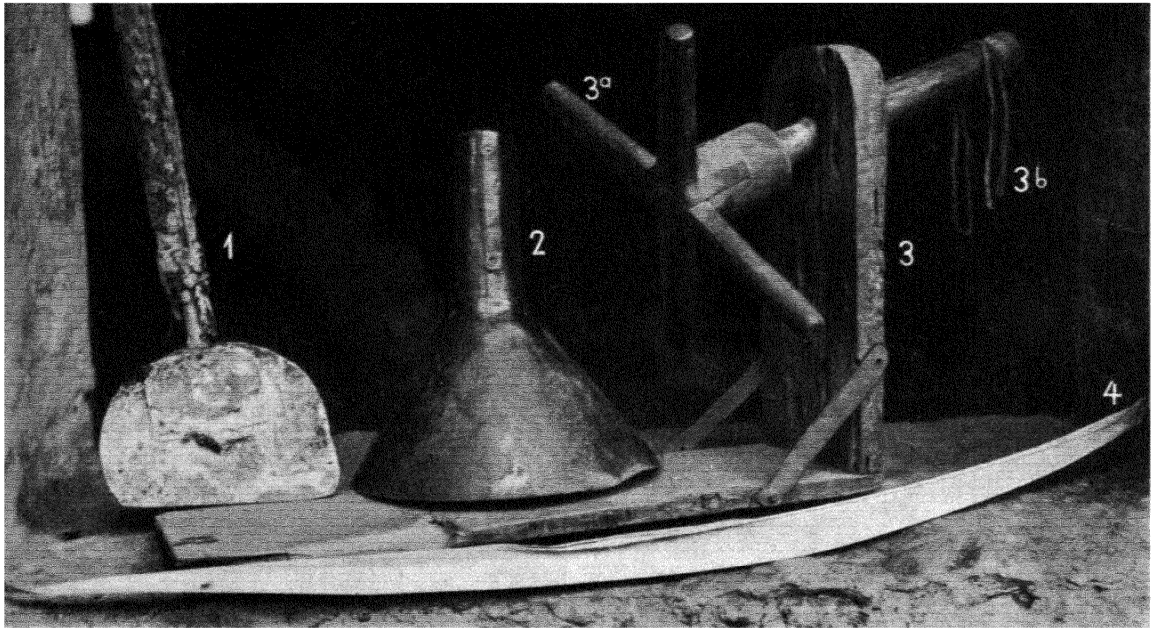

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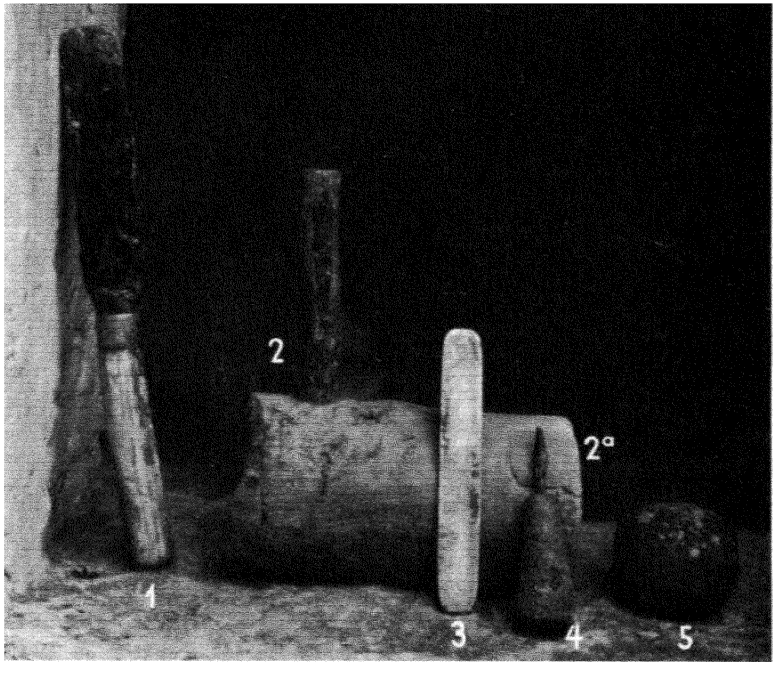


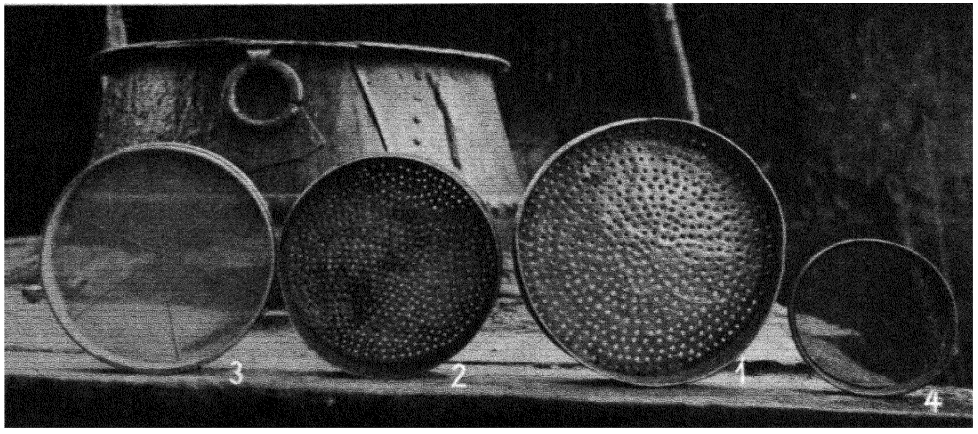


Fig. 13.

Fig. 14.

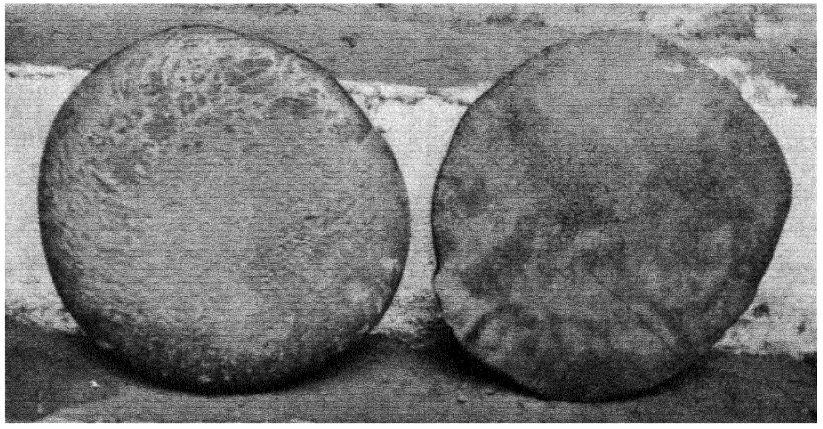
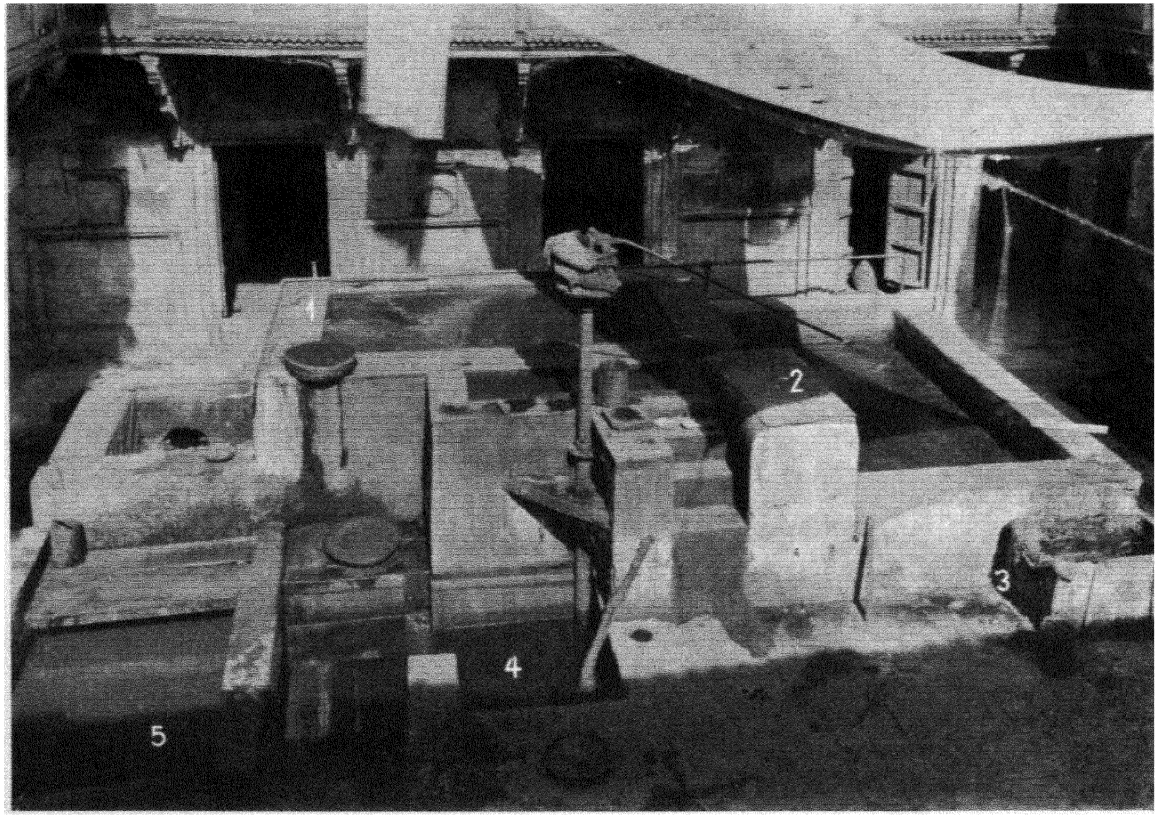


Fig. 16.

Fig. 15.



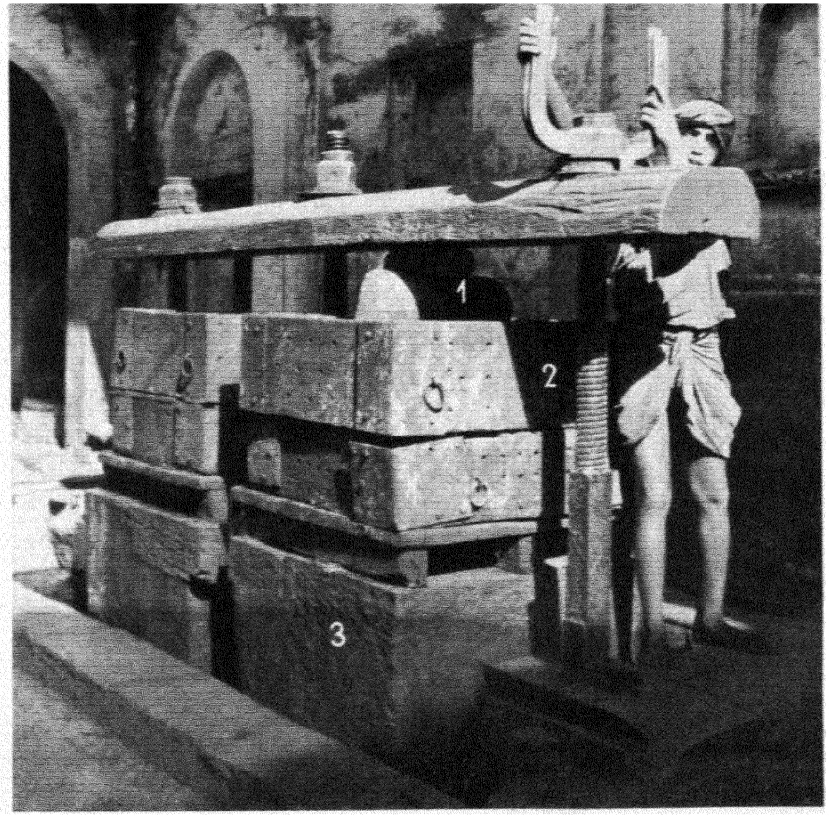
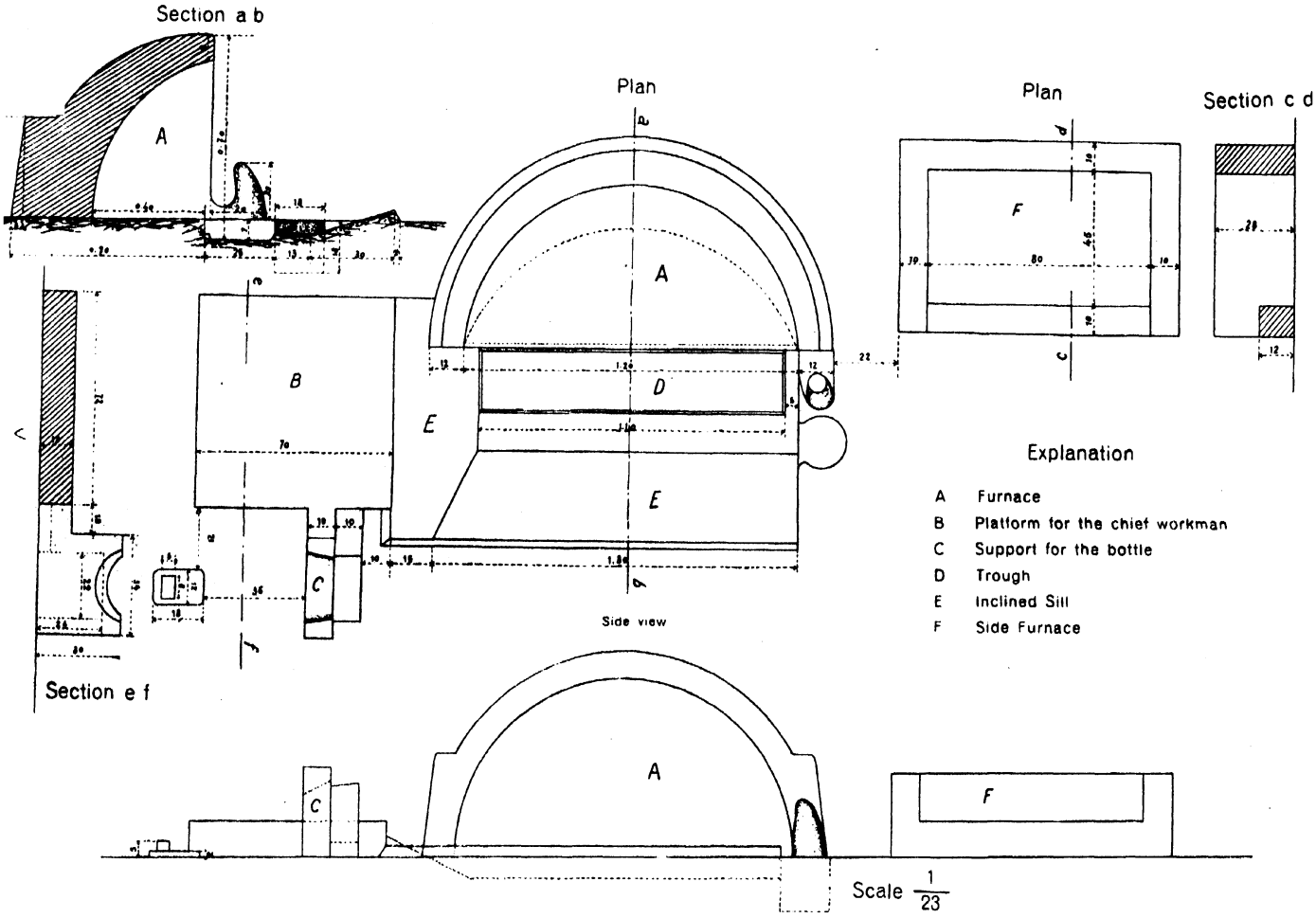
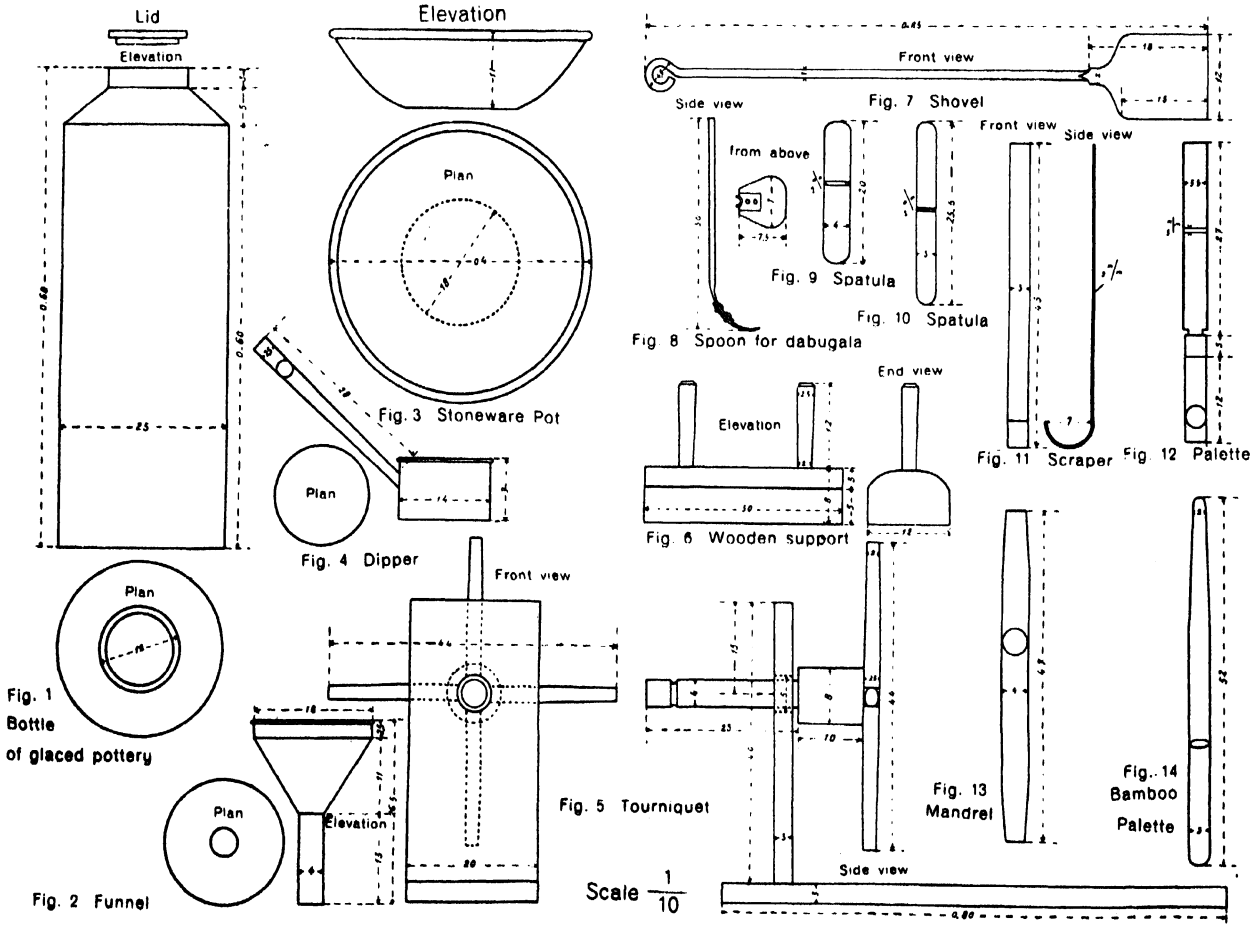


Plate 6.

Furnace for refining lac



Refining of Lac — Appliances and accessory utensils



EXPLANATIONS OF PHOTOGRAPHS.

Pl. 1, Fig. 1. *Lakshadia mysorensis* encrustations on *Shorea talura*, monsoon season crop of 1924, Bangalore.

Pl. 2, Fig. 2. Lac furnace, photographed in Mr. Ali Mian's Factory, which was freshly set for operation. Portion of the exhausted tube marked 1 is called Danri.

Pl. 2, Fig. 3. Buttonlac on Banana stems photographed in Rukhar Ghat Lac Factory.

Pl. 2, Fig. 4. *Lakshadia mysorensis* on *Shorea talura*, monsoon crop of 1920, Bangalore; photographed by Master Ragnaikulu Naidu.

Pl. 3, Fig. 5. Pathila or large Kettle for boiling Passeva; in Mr. Ali Mian's Factory.

Pl. 3, Fig. 6. Pipa or bottle of glazed pottery resting towards the neck on a raised mound called Unta; the other end rests on a lower support called Thairee. It is seen with a thick sheet of fused lac allowed to harden a little after the workman had lifted the sides, called later as Ganthi, with the thumb and forefinger giving this sheet on each side a frill like appearance.

Pl. 3, Fig. 7. Lac furnace in Mr. Ali Mian's Factory with a long exhausted tube or Danri, marked 10. The tube was in rotatation while it was photographed.

Pl. 3, Fig. 8. Lac furnace in Messers. Kasi Prashad and Sons' Factory. Fused lac, placed on the bag for further fusion and dehydration, is seen at 5 gradually melting down.

Pl. 4, Fig. 9. Courtyard in Rukhar Ghat Lac Factory with washed seed lac in baskets for drying in sunshine. In the background are stone vats in which seed lac is washed.

Pl. 4, Fig. 10. The Chief workman holding the Kirkhudni seen pierced into the tube for exhausting the Kiri (marked 3); in Mr. Ali Mian's Factory.

Pl. 4, Fig. 11. 1. Kalchula or Shovel for regulating the intensity of the fire.
2. Bharna or Funnel for filling the tube with seed lac.
3. Charkhi or Tourniquet for rotating the cloth tube tied at 3b.
4. Nera or Palm leaf used as thong for spreading molten lac over the hot water bottle.

Pl. 4, Fig. 12. 1. Charna or a large Palette.
2. Dharna or wooden support over which the tube rests and slides.
3. Pirbanda or an iron Spatula.
4. Kirkhudni, literally digger of Kiri, used to rip open the tube and to remove the accumulated refuse or Kiri.

Pl. 5, Fig. 13. Different sieves for grading seedlac, seen against the Passeva Kettle; in Mr. Ali Mian's Factory.

Pl. 5, Fig. 14. Passeva, thin large discs or circular plates containing lac wax with lac and other impurities, after boiling the exhausted bags with alkaline hot water — Courtesy of Mr. Ali Mian.

Pl. 5, Fig. 15. Courtyard in Messers. Kasi Prashad and Sons' Factory with cisterns for precipitating and preparing the lac dye.

Pl. 5, Fig. 16. Messers. Kasi Prashad and Sons' press for making cubical cakes of lac dye.

EXPLANATIONS TO PLATE 6.

M. Hautefeuille's explanatory notes to his Figures added as Appendix to M. Pidance's Report.

Fig. 1. Bottle (Pipa) on which the fused lac is spread.

Fig. 2. Funnel (Bharna) for filling seedlac into the long tube of cloth.

Fig. 3. Stoneware pot (Athari) placed on the right of the head workman, containing water which is continuously needed.

Fig. 4. Dipper or basin of white cast-iron used for washing with water.

Fig. 5. Tourniquet (Phirki) made of wood on which is fixed the tube containing seedlac when twisting it before the fire.

Fig. 6. One of the six or twelve wooden supports (Dhanna) placed at a distance of about one metre from one another and on which the cloth tube could turn without slipping.

Fig. 7. Shovel made of iron (Kalchula) within reach of the chief workman or his assistants for cleaning around the furnace and arranging the fire.

Fig. 8. Spoon made of iron for exhausting the molten material constituting the dabugala or refuse.

Figs. 9 and 10. Iron spatula (Pirbanda) which the chief workman uses for lifting by rapid scraping the molten paste from the tube and also to pass it, by a jerk, on the bottle.

Fig. 11. Scraper for the purpose when it is intended to make the bajoo lac.

Fig. 12. An iron palette with a wooden handle (Charna) corresponding to the "Cut-Cut" Knife of the Annamite but without the sharp edge, for replacing the molten material which oozes from the portion of the bag facing the fire.

Fig. 13. Wooden mandrel used for opening or forcing the bag tube inside out at the time of replacement. After repairs the bag can be used with advantage.

Fig. 14. Bamboo palette preferred to the iron spatula Fig. 12 used in the manufacture of button lac.