

GET INTO PROFITABLE MANUFACTURE

READ

**INDIAN PERFUMES
ESSENCES & HAIR OILS**

**Giving out in elaborate details secrets of Manu-
facture of Natural & Artificial Perfumes,
Indian Essences, Hair Oils & Toilet
Preparations, Etc.**

DIVIDEND INTO FIVE BROAD SECTIONS.

DEALING elaborately with the possibilities of Perfumery Industries, classifications of Perfumes and Perfumery materials, modes of manipulation, principles of manufacture of Floral Oils, Extracts of flowers, Essential Oils, Preparation of Essences, of Ottos, Aromatic waters, Toilet waters, Hair oils, etc., etc.

THE whole subject of toilet and perfumery, Hair Oil, and Scented preparations are treated in every working detail and tried and secret formulas free from all technicalities given by an expert on the subject.

NICELY BOUND IN CLOTH COVER GILT LETTERED.

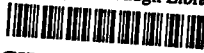
Price Rs. 2 only, Charges Extra.

**INDUSTRY BOOK DEPT.,
KESHUB BHABAN, SHAMBAZAR, CALCUTTA.**

REVIEW.

8227

Dhananjayrao Gadgil Library



GIPE-PUNE-008227

MONEY IN HANDICRAFTS.

Printed and Published by
K. M. Banerjee,
At the "Industry Press,"
Shambazar, Calcutta.

MONEY IN HANDICRAFTS

A detailed description of the process of work
in the diverse Money-Making Arts and
Handicrafts of India with practical
suggestions for improvements.

By

AN INDUSTRIAL EXPERT.

(All Rights Reserved.)

INDUSTRY BOOK DEPT.,
KESHUB BHABAN,
22, Shambazar Bridge Road, Calcutta.

X91.2

F9 8227
CONTENTS.

INTRODUCTION	1
The Industrial Outlook—Vitality of Handicrafts—Indian Handicrafts—Prospects of Handicrafts—Improvements.	
LAC WARES	3
Preliminary Operations—The Process—Abri Style—Atishi Style—Nakshi Style—Painted Ornamentation—Tinfoil Ornamentation—Lac Coloured Metal Wares.	
GLASS BANGLES	18
The Centres of Production—The Furnace—Implements—Manufacture—Method in the Punjab—Method in Sultanpur.	
BUTTON MAKING	27
Shells for Button—Process of Work—Cleaning and Polishing—Factory Method—Possibilities—Market.	
GOLD ENAMELLING	35
Implements Used—The Process—How the Enamels are Made.	
GOLD AND SILVER LEAVES	43
Preliminary Operations—Gold Beater's Skin—Modern Method of Making Skins—Process of Beating—Cautions—European Method.	
GOLD AND SILVER WIRE	51
General Principle—How Gold Wire is Made.	

BRASS MOULDING 54

Making of Brass Ingots—Different Qualities of Brass—Colour of Brass—Brightening and Lacquering Brass—Frosting Brass—Brass Castings.

BRASS FOUNDRY 65

Materials for Moulding—Composition of Sand Moulds—The Furnace—The Making of Moulds—Construction of Patterns and Cores—The Mode of Casting—Casting Small Articles—Method of Stamping.

HORNS AND HORN WORKS 78

The Horns of India—Classes of Horns—Physical Properties of Horns—Indian Centres of Horn Works—Principle of Manufacture—The Procedure—Making Horn Plates—Comb Making—Utilization of Horn Shavings—Miscellaneous Articles of Horn—Dyeing Horn—Modern Method—Conclusion.

MAKING MODELS AND MOULDS 94

Principle of Moulding and Casting—Moulds of Plaster—Plaster Mould of Fruits—Making Plaster Casts—Anatomical Models.

WAX MODELLINGS 103

General Principle—Casting in Wax—Wax Flowers—Cautions—Colouring Wax.

PEARL INLAYING 111

Splitting the Shell—The Etching Process—Finishing the Pearls—The Process of Inlaying—Inlaying on Cast and Sheet Iron—Inlaying on Papier Mache

MONEY IN HANDICRAFTS.

INTRODUCTION.

THE skill of our ancestors in the production of various handiworks of the most exquisite workmanship enjoys a world-wide celebrity. The arts of cotton spinning and cotton weaving were in a high state of proficiency thousands of years ago, and the delicate fabrics were known to the civilized world as long ago as the days of King Solomon. The distinguished travellers who had left their accounts regarding the handicrafts of India in one voice eulogized the artwares made by the Indian artisans. Bernier who visited India during the reign of Shahjehan marvelled over the incredible quantity of manufactured goods such as embroideries, streaked silk, tufts of gold turban, silver and gold cloth, brocades, net-work of gold, etc. which he

found in the important marts of India. Tavernier also gives a long description of the manufactured goods and dwells with wonder on the "marvellous peacock throne, with the natural colours of the peacock's tail worked out in jewels, of carpets of gold and silver, endless lists of exquisite works, of minute carvings, and other choice objects of art."

THE INDUSTRIAL OUTLOOK.

With the facilities of communications and the extension of markets the handicrafts are unhappily in a decaying condition. There is a growing tendency to produce on a larger and even larger scale. In view of competition from abroad Indian industrialists have been forced to carry on production on a large scale in specialised branches, to project integration of industries wherever possible for reducing the cost of production, and to arrange business combinations to put an effective stop to cut-throat competition among big companies.

The big industries loom large on the industrial horizon at the present day, and on account of the wide publicity which the manufactures receive, these dominate supreme in the markets. For good or evil, they have brought

about an industrial *cum* social and psychological revolution about the outlook of life all over the world. They seem to carry everything before their impetuous course, and have even taken up the manufacture of such articles which may be used by the artisans of the country as raw materials in the production of finished commodities.

VITALITY OF HANDICRAFTS.

Nevertheless the handicrafts have held their own against tremendous odds up to the present day. There is hardly a village in India where the humble handicrafts are not still carried on, though on a mediocre scale. The artcrafts of India have before them as wide a field as before. The display of the Indian artwares in the Wembley Exhibition, one of the biggest exhibitions ever held in the world, created a sort of sensation and received universal applause. The excellence of workmanship and the elaborate designs, which only the touch of an artist's hand can accomplish, cannot be surpassed by the machine made articles which have little scope for creation of artistic novelties.

INDIAN HANDICRAFTS.

Handicrafts are also best suited to the conditions and genius of India. The economic conditions of the country and the social and religious environments have helped the growth of handicrafts better than anything else. Hand-spinning and hand-weaving, the most ancient of Indian handicrafts, are still practised even in the remote villages and there is not a village in India where the rattling of the loom is not heard. The hand-loom occupies a very important position in the economic life of India and produce about 1,300 million yds. of cloth in a year. The vitality of the artistic section is still evident from the many centres that exist of figured *Jamdanees* manufacture—Dacca, Santipur, Chittagong, Tanda, Chanderi and Lucknow being among them. Embroidery and *chikan* work of bold design and distinctive patterns are executed in many parts of India of which the United Provinces is the most famous. Oriental rugs and carpets made in Kashmir enjoy a world-wide name. Ivory carving and inlay work is done skilfully in Delhi, Murshidabad, Mysore, Travancore and Moulmein. Mother-of-pearls are made

use of in the manufacture of buttons and various artistic lapidiary work. Conch shell bracelets, lacquered wares, papier mache curios, gold lace weaving, filigrain jewellery, enamelled metal wares, *koftgari* wares, wood carving are some of the handicrafts which are still sought after in the world's markets. Among other handicrafts mention may be made of preparation of gold and silver threads, glazing of earthenware, making of glass bangles, manufacture of wooden, and metallic toys, metal and horn buttons, clay models, cutlery, locks, safes, tools, implements, coir making, basket weaving, mirror making, etc.

PROSPECTS OF HANDICRAFTS.

A revival of handicrafts is to be looked for from more than one point of view. Besides giving employment to the starving millions this will put a stop to the rural exodus which is fast depopulating the villages and is one of the main reasons of the decay of the once prosperous villages.

Handicrafts may also prove a secondary occupation in many centres of India. In a country where owing to the character of the climate, the peasant cultivators are necessarily

prevented from working at their main occupation for four, five or six months in the year, it can easily be seen that unless there are alternative occupations, the village can hardly remain on a sound economic basis. The realisation of this position is one of the base of the desire of resuscitation of handicrafts in India, for this would then give alternative work for part of the year when the peasants have to lead a life of inactivity.

IMPROVEMENTS.

The methods in which the handiworks are made are often very primitive and antiquated. New tools and implements have been invented, labour-saving devices have been planned. In the interests of efficiency it is incumbent on our artisan class to adapt them to their use. This is destined to increase their output and thus reduce the cost of production. "In countries like Germany, Switzerland, Holland, Belgium, village industries are well established," says *Mr. R. K. Mukherjee*. He continues, "There are watch makers, weavers, wood carvers, basket-makers and the like in Switzerland; lace makers, furniture workers, silk weavers, cigar makers, shoe makers and

tailors in France; toy-makers, straw-plaiters and weavers in Germany, whose products even find an overseas market. Hand labour persists; the small employer keeps his workshop alone, or with his family or one or two assistants. Even spinning wheels are coming to life again in various German linen districts. No less than 240 small hand-operated linen factories have been opened lately in the rural districts of Oldenburg, Bremen, Luxemburg and further west. The estimated number of hand-operated spindles in Bavaria is 500,000. Similar conditions obtain in the Saxon and Silesian linen districts, where factory-made linen can hardly compete with hand-made qualities." The success of the handicrafts in the western countries is greatly due to the use of improved tools and modern methods wherever available. In these days of industrial reconstruction when there is a growing tendency towards small decentralised plants as a counter tendency to concentrated capitalism, handicrafts conducted on a more systematic line will form the basis—and there is every reason to believe it—of an economically prosperous India.

LAC WARES.

SIMPLE and ornamented lacwares constitute one of the most artistic handicrafts of India. Delicate decorative designs in lac colours on the metal and ivory articles as well as on wooden toys are distinctive features of the industry. The chief centres of the industry are Saharanpur, Agra, Lucknow, Benares, Mirzapur, Hoshiarpur, Jodhpur, Marwar, Salem, Podanur, etc. Painted lacwares with tin ornamentation are produced in Hyderabad (Sind) and Baroda. In Burma the chief centres of lacquered wares are Prome and Mandalay.

PRELIMINARY OPERATIONS.

In the simplest forms of lacwares where the structure is made of wood, the selection of the wood should depend upon the purpose for which it is intended. For ornamental objects light coloured and uniformly grained woods, that are not liable to warp or split are indispensable. The toys, boxes, etc. to be lacquered are first turned with the lathe. For lacquering

work shellac is first melted by being held over the fire until rendered plastic. It is then placed on a stone and a small quantity of pigment previously dissolved in oil or water is deposited within a hollow formed on the surface for colouring. The usual pigments employed are orpiment, sulphur, white lead, red mercury, prussian blue, lamp black and indigo. Orpiment and sulphur added to lac will give a yellow colour, white lead will produce a white colour, red mercury which is otherwise known as *hingul* will yield a red colour, while prussian blue, lamp black and indigo are used for colours their very names suggest. Many other intermediate colours may be obtained by the admixture of these pigments. For example, equal parts of orpiment and *hingul* will give a green colour. Recently however aniline dyes have been almost universally adopted though the colours are liable to tarnish. Metallic effects are produced by mixing the lac with powdered mica, with powdered tinfoil and imitation gold leaf or with an amalgam of mercury, lead and tin. The pigment added to the plastic lac is then closed over and the lac vigorously hammered and pulled

out with the hands until the colour is uniformly mixed. The hammering keeps up the heat, so that as the operation proceeds the mixture gradually assumes the consistency of India rubber. The coloured lac is then formed into sticks about the length and thickness of black lead pencils, or many times thicker as may be desired, with the help of wooden mallets. These sticks of sealing wax are known as *battis* and are of the form in which both the lac and the pigment are applied to the wood work.

When the article is intended to be artistically ornamented with lac it has to go through some preliminary processes before the application of the lac colours on the body. In practice when the article has been turned to the desired shape it is then polished with fine powder made from broken pottery. This polishing has the effect of filling up the pores. Should cracks or joints exist, these are plugged in with wood, waste lac or other materials, and at the same time pieces of cloth are glued across such imperfections. Articles so treated are again coated repeatedly with a preparation of glue and pottery dust. They are polished after

each coating with a sort of chisel made from the leaf stalk of the palm. All the imperfections and joints are thus made to disappear completely and a smooth and uniform surface is produced.

THE PROCESS.

The object, says *Sir George Watt* in *INDIAN ART AT DELHI*, is then mounted on a lathe and a stick of *batti* is pressed against it, as it revolves on the lathe. The heat generated melts the lac and thus colours the wood irregularly. A small piece of hard wood is next pressed firmly on the revolving article when the colour is effectively dissolved. Lastly a cotton rag dipped in sesamum oil is held against the revolving object, when the lac takes a polish that it never subsequently loses.

The article may thus be uniformly coloured in one shade or may be ornamented by rings and bands of different colours. In the higher flights of lac turnery rich blending of colours, the depth of tone and polish are mostly due to the several layers of colour and polish having been imparted, the one at the top of the other. For ordinary work the tedious process of polishing may be dispensed with.

ABRI STYLE.

For *abri* work which gives the pleasing cloud effects, the turnery after being polished and glued in the ordinary way has a coating of yellow lac applied all over. The operator then takes in his hand a specially prepared *batti* of red or orange colour. This is exceptionally hard, sharply pointed and not thicker than a lead pencil. In some cases the pigments used in colouring these hard *battis* have been dissolved in water, others in oil. By allowing the red hard oil *batti* to tremble in the hand and to thus touch the revolving object interruptedly, numerous irregularly shaped spots are imparted. By next using a water-prepared black *batti* of large size and soft texture, black borders are communicated to red spots. Lastly the interspaces are filled up by a white water *batti*.

ATISHI STYLE.

The peculiarity of the *atishi* (fire-works) style of ornamentation is that, after the article has been carefully prepared and polished with pottery dust, it receives a coating of finely divided tinfoil made into a paste with glue, the coating being either uniform or made up of a

multitude of minute dots after the fashion of the *abri* work. Over the top of the tin, a layer of red or yellow lac is next given, with the result that the object obtains a rich fiery glow. It is then polished on the lathe by means of a stone known as the *mohru* (agate); this communicates so much heat that the lac becomes more transparent than is the case in the other methods of lac ornamentation.

NAKSHI STYLE.

Of the *nakshi* (pattern) style there are two well-marked sections, viz., etched *nakshi* and scraped *nakshi*. For *etched nakshi work* the object is coated with first one colour, then on the top a second, a third or a fourth, uniformly all over. The *battis* employed are for the most part soft and water prepared. The first colour is usually yellow, the next red, followed by green and last of all by black; but, of course any assortment or number of colours may be imparted layer upon layer, the one on the top of the other. With a fine chisel or style the lac-coated surface is now scratched, the hand being made to move lightly or to press heavily as may be necessary to bring out the colour required from the numerous layers

beneath the surface. In this way, upon a black back-ground, yellow stems and leaf stalks, green leaves and red flowers with yellow or party-coloured views and shadings may be elaborated.

For *scraped nakshi work*, a specimen of *atishi* ware polished with oil, having patterns, floral designs or hunting scenes, etc., is subsequently worked on the surface. This is accomplished by scraping off the lines, loops or patches of the oil varnish and then applying a water-prepared *batti* as the article revolves on the lathe. The portions scraped off receive the new colour, but none of the intervening oil-varnished places do so. The article is again oil-varnished all over and further portions scraped off when these in turn are given the further colour desired. This is repeated time after time until the floral and other designs or pictures have every outline and detail of colouring imparted to them. The same result is often more laboriously obtained by scratching off the portions to which it is desired to impart colour, then coating the whole surface with the new colour and subsequently removing, by pumice stone, the

surface coating until the new colour is alone revealed within the places that had been etched for its special reception.

But occasionally longitudinal and parallel lines are scraped on a lac-coated surface, one after the other, and the superfluous colour removed until the article is seen to have a ground colour with a multitude of lines running along its length. If now it be desired to cause them to become variegated, an eccentric movement is communicated to the lathe while a piece of hard wood is pressed firmly against the lac coating. The result of this is that the straight lines are dragged into the zig-zag form.

PAINTED ORNAMENTATION.

In this class of work, the articles to be ornamented are repeatedly and carefully coated with fine pottery powder. Thereafter they are elaborately smoothed and polished. When a sufficiently good surface has been obtained, certain portions (panels or medallions) upon which bunches of flowers, groups of animals or hunting scenes are to be shown receive a coating of white paint or chalk. The desired illuminations are then made in water colours by a brush, and when quite dry, are varnished over

with lac dissolved in spirits of wine. The articles are then placed on the lathe and the designs completed by one or all of the methods of ordinary lac ornamentation. One of the most striking peculiarities of this style is that no ground colour is given, so that the rich texture of the wood shows through the transparent lac varnish. The borders and certain restricted parts are colour-lac coated and scratched (*naksni*) but only with a view to give panellings or borders and rich contrasts.

TINFOIL ORNAMENTATION.

For tinfoil ornamentation, a fragment of coloured lac is placed on a sheet of tinfoil and held over the fire until the lac completely covers the sheet. Flat surfaces that cannot be treated on the turning lathe are ornamented by clipping up coloured or plain tin foil into various shapes and forms, and gumming these over the surface, as desired. When the pattern has been completed the surface is ~~painted over~~ with a spirit or lac varnish, or if capable of treatment on the turning lathe, it is covered in the ordinary way. By colouring the varnish yellow, the tinfoil shows up as if in gold. Instead of lac, the varnish may be

made by boiling myrrh, copal and sesamun oil, for some hours, and when cool applying it with a brush.

LAC COLOURED METAL WARES.

Metals are given elaborate lac-colourings sometimes. The system of ornamentation appears to have been designed to imitate the class of encrusted ware known as *bidri*. The lac is accordingly coloured black, the copper vessels are tinned and an extensive background chased or punched away, thus leaving the floral ornamentation in relief. The depressions are then loaded with black lac fused by a hot bolt, and the excess, rubbed off with sand-paper or powdered brick. In consequence a liberal background in black is produced with, on the surface, a floral design in white metal. In the present days the pattern is in black or other coloured lac and the background in brass.

GLASS BANGLES.

GLASS bangles, universally used by the womenfolk in India are largely imported from foreign countries. An idea of the huge sum annually drained away will be obtained when it is stated that anything from 50 lakhs to one crore of rupees is paid for this fragile commodity. And this is the case when glass bangles are not at all incapable of being turned out in this country. In fact, they are actually manufactured on a large scale in many parts of the Punjab and the United Provinces and even in Calcutta. The manufacture of glass bangles may be taken up with profit on a commercial scale especially when India can supply all the raw materials necessary and Indian woman will consume the whole output. The indigenous industry such as there is extant may be revived and extended by the infusion of progressive element into it.

THE CENTRES OF PRODUCTION.

In an official monograph it has been pointed out that in the United Provinces crude glass is mostly manufactured in the Doab between

Meerut and Etawah, where *reh* is plentiful and to a smaller extent in Fyzabad and Rai Bareilly, where cheap fuel is obtainable in the *babul* and *dhak* jungles. Firozabad in the Agra district is the principal centre of glass industry as well as of the manufacture of bangles. The factories are usually situated in the heart of the *usar* tracts. *Reh*, the material chiefly employed, is a substance of uncertain composition, consisting of varying proportions of the carbonates, sulphates and chloride of sodium with a large admixture of clay and sand. The fuel used consists of dried leaves, *arhar*, *bajra* and indigo stalk.

THE FURNACE.

The furnace for the manufacture of glass bangles is always roofed over and is a roughly pentagonal dome of clay varying in size with the number of workers and covering a pit about three feet in depth in which the fire burns. The fire is fed through a large stoke-hole called *jotak*. All round the sides of the dome about three inches above the level of the ground are small openings (shaped like horse shoes and called *hari*) through which the workers hold the glass in the heat of the fur-

nace . During the actual working each of these openings is flanked by two clay walls or wings so that every worker has a separate stall or compartment for himself. The wings are called *patta* and the whole compartment *dukan* or workshop. Inside the furnace on a level with the sill of each opening runs a clay ledge all round three inches broad. On this is rested an earthen crucible *ghurah* in which the crude glass or the colouring matter is melted up. Before the spot where the workman sits and resting on the ground in the centre of the space between the extremity of each wing of the stall is a big flat stone called *pathri*. One edge of this stone hangs over a square pit called *pait* for receiving completed bangles; and beyond the pit is a broad step or ledge, *kandi*, in front of the operating hole. Usually two extra compartments are set apart commonly accessible to the workmen. At the end of one of them is the crucible holding crude black or green glass being melted up with colouring materials while at the end of the other is the crucible in which thoroughly molten glass is kept ready for immediate use.

IMPLEMENTS.

The following is an enumeration of the implements required:—

(1) ANKRI.—An iron rod about two feet long, hooked at one end and fixed into a wooden handle at the other. It is used for stirring the molten glass and fishing it out of the crucibles.

(2) SAILAKH.—A long pointed spit of iron of uniform thickness.

(3) MALA.—A moulding and pressing tool of iron. It is shaped like a ladle with the hollow filled up.

(4) TAKLA.—An iron rod with a thick butt tapering off to a point.

(5) BARHONA.—A short piece of stout iron wire fixed into a light bamboo handle, and sometimes hooked, sometimes straight at the other end. It is inserted between the inchoate bangle and the various other instruments prevent its sticking to them.

(6) CHITARNA.—An iron rod used for twisting the molten glass for certain kinds of bangles.

(7) KALCHUL.—An iron ladle used for transferring the molten glass from one crucible to another.

(8) KALBUT.—A cone of clay fixed on to an iron handle.

MANUFACTURE.

To make plain glass bangles the furnace is lighted and some big blocks of crude glass are set on the floor of the furnace almost in contact with the fuel. After they have been heated for about ten minutes they are thrown into a basin of water, which causes them to split up into small pieces. These are then thrown into the crucible for half-molten glass with such colouring matter as may be required, and when properly fused, ladled out into the second crucible for completely molten glass. The workman next dips the end of the iron hook (*ankri*) into the crucible and takes out a small ball of molten glass enough for one bangle. This he winds off like treacle upon the end of the iron spit (*sailakh*) into a thick irregular ring. He now throws down the iron hook, takes up the ladle-shaped pressing tool (*mala*), and resting the end of the iron spit round which the glass ring is wound on the

stone slab (*pathri*) taps and squeezes the ring until it has half cooled. The iron wire (*barhona*) is next inserted between the spit and the ring of glass, which is thus detached from the spit and left on the iron wire. From the end of the iron wire it is transferred to the tip of the tapering clay cone (*kalbut*). The workman then holds the clay cone towards the opening in the furnace, pressing its thin iron handle between his open palm and the surface of the stone slab in such a way that the clay cone is slanted upwards towards the furnace. In his other hand he holds the iron wire which he inserts between the clay cone and the glass ring. Next by rubbing his open palm with the handle beneath it backwards and forwards over the stone slab he causes the clay cone to spin rapidly round, and the glass ring upon its tip becomes gradually enlarged and slips down to the broad base of the cone until it has grown to the size of a bangle. It is then slipped off and thrown to cool into the pit and between the stone slab and the furnace. To produce more evenly shaped bangle, the glass ring is sometimes transferred from the iron spit of uniform thickness (*sailakh*) to the

tapering iron spike (*takla*), and from that to the clay cone.

METHOD IN THE PUNJAB.

In the Punjab, the workmen have three furnaces; one is called *hans* in which they prepare the *kach* or glass; one, in which the melted material is kept for use by the maker of glass articles; and thirdly, a small furnace in which they make the *mina* or enamel glass colouring for ornamenting the bracelets.

The furnace is fed with *karir* (*capparis*) wood, as it gives a fiercer fire.

Glass is made by melting *lal-pathar*, a red sand-stone with *sajji*. They make the material into balls (*pinni*), and burn it all night with a slow fire. Next day they heat it more fiercely, and then it fuses into *kach*. The glass is then removed with the aid of an iron hooked rod (*kundi*) provided with a wooden handle.

To make bracelets, some *kach* is placed in an earthen pot and melted, the progress being tested with an iron rod. The workman then takes a long pointed iron rod and lifting a portion of the glass, makes a thick ring on the rod; he loosens this when cool, and hanging it

on the pointed end of the rod, puts it into the furnace, spinning it round and round on the rod till the ring opens out and forms a bracelet, he then withdraws it and slips it over the conical mould so as to adjust it to the size required; when cold, it is finished.

The colouring is done afterwards, with lac applied to the glass while warm, so that the colour sticks, or else ornaments are made by melting small points of coloured glass rods and applying them.

METHOD IN SULTANPUR.

There are also *churigars* in Sultanpur in the Punjab. Formerly they made their own crude glass, collecting stones of the kind required in the river bed, and mixing them, pounded, with nine times their weight of *sajji*, to be burnt for 24 hours in furnaces. Now they find it cheaper to import the raw material from elsewhere together with colouring matters. One maund is sufficient for 1,000 bracelets of the largest size.

One man can make in a day about 125 of the large thick bracelets about 3 inches across, 250 of the same size but thinner and 500 of the small ones $1\frac{1}{2}$ inches in diameter.

The furnace there consists of two parts, the lower being a large trough in which the glass is mixed and coloured, and then taken out and cooled for use when required; above are six small troughs for the actual work, at each of which one man can work. He takes up on an iron rod in his right hand sufficient molten glass for his purpose and moulds it with a circular motion, on a cone-shaped implement held in the left. The bracelets are generally ornamented with a line of dots of some other colour, which is separately dropped in a melted state on the finished ring.

BUTTON MAKING.

ARTISTIC buttons of gold and silver with delicate enamelling on them were made in India in very old times and were much in favour with the fashionable people. Ivory and ornamented horn buttons embellished with the highest workmanship were also in fashion. The practice continues to this day and artisans and jewellers are still engaged in making costly buttons, sometimes set with jewels. Of late the demand for buttons among the common class of people has developed to a great extent, thus creating a good market for coat and shirt buttons of all kinds for bazaar use. These being produced on a big scale by foreign countries who send their surplus stocks for sale to India are offered at rates lower than that quoted by the indigenous workers. This has naturally crippled the indigenous industry. But the shell button industry which is of recent development in Bengal and Bihar shows marked possibilities of development. The industry has been gradually growing since the *Swadeshi Movement* and

Dacca has come to be one of the great industrial centres on account of the large quantity of buttons turned out there mostly with cheap manual labour.

SHELLS FOR BUTTON.

The shells principally used in the manufacture of buttons and ornaments in Bengal and Bihar belong to two genera, viz., *Parreysia* and *Lamellidens* (family *Unionidoe.*) The various species of the genus *Lamellidens* have shells which are usually not very massive. Members of the genus *Parreysia*, have shells more rounded in appearance and more massive than is the case in the genus *Lamellidens*.

According to the REPORT ON THE FRESH-WATER PEARL-MUSSEL FISHERIES, the following are the species most commonly used for button making:—

Parreysia Corrugata (Muller).

Parreysia Favidens (Benson)

Parreysia Daccoensis Preston.

Lamellidens Marginalis (Lamarck).

Lamellidens Marginalis var. *Corrianus*
Lea.

Lamellidens Narainporensis Preston.

There are a large number of varieties both of *P. corrugata* and *L. marginalis* in Bengal, and, in all probability many of these varieties are also used.

PROCESS OF WORK.

The only instruments in use amongst the workmen are the following:—

1. A pair of cutting pliers.
2. An ordinary file.
3. A small grind stone in a wooden trough, mounted so as to be rotated by a handle.
4. A wooden-box, about 14 inches high, which serves as a low table for the operator, who works sitting on the ground. This is covered with a piece of gunny sacking, which serves to secure the buttons during the grinding and other processes.
5. A hand drill with a punching face.
6. A small hand drill for making the holes.

In preparing the buttons, the shells are soaked in water for a number of days to soften them. The operator then cuts small pieces from the shells. These are next placed on the piece of the gunny cloth which is spread over the

wooden box, which serves as a low table. By drilling, the pieces of shell are marked. Next the edges are trimmed by means of the grind stone; the button is held with one hand and the stone is rotated with the other. In some places, the workmen use a file to trim the edges.

CLEANING AND POLISHING.

The method of cleaning and polishing the buttons, practised by the villagers, is as follows:—

About 400 gross of buttons are placed in an earthenware or metal receptacle, and are covered with kerosine oil. The mouth of the receptacle is closed and the oil is boiled. The buttons are allowed to stay in the hot or boiling oil for about 20 minutes. By means of a wooden spoon, samples are removed and examined from time to time. Unpolished buttons frequently have a reddish hue, and the hot oil is said to remove this. Great care should be taken during the process of cleaning, otherwise accidents are likely to occur.

The buttons are next rinsed in water a few times, after which they are rapidly washed—about 15 gross at a time—in a boiling

dilute solution of nitric acid. They are then spread out on a mat, covered by a thin cloth in order to exclude dust, and dried in the sun. When dry, they are mounted on cardboard in the usual way, and are then ready for the market.

It need not be mentioned that buttons are made on a small scale with family members in Dacca. The men merely cut out suitable pieces from the shell, and the rest of the work viz., drilling holes with a small hand drill, sewing the buttons on cardboard, cleaning the buttons with kerosene and nitric acid, cutting the cardboard to size, finishing and brushing are done by women.

FACTORY METHOD.

For a small button-making factory the shells should be obtained fresh. Generally the operators working there may be broadly divided into two classes: trained hands and untrained hands. Those specially trained should be permanently retained while the others may be engaged in collecting shells, preparing copper attachments for links and buttons, repairing machinery, and fixing the studs and buttons to cardboard, ready for the market.

In practice, the buttons are first blocked out from the shells by means of a punching machine. The edges and surfaces are then smoothed and polished by means of a file. The buttons are then taken to the designing machine. The holes are then bored by a machine. Finally the buttons are polished.

POSSIBILITIES.

The difficulty with the button industry is that the shells obtained locally are so thin that massive buttons cannot be made from them. This suggests that there is room for improvement in the supply of shells in the button making districts and also that, if thicker shells in quantity were available at a cheap rate, a considerable extension of the industry would be possible. The buttons manufactured from the carapace of turtles and tortoises appear to be quite suitable for general purposes.

In addition to buttons, various kinds of ornaments, such as ear-rings, hair ornaments, nose pendants, and watch chains can be manufactured from the shells. They are now made on a small scale but there seems to be a good market for these classes of articles provided their sales are pushed ably in the market.

The instruments used for the manufacture of buttons are also used in making the various ornaments, the only additions being a special drill and a fine file.

MARKET.

Mussels are found all over Bengal. In Eastern Bengal, the principal fisheries are situated in the small rivers, the *beels*, and the canals, throughout the districts of Tippera, Mymensingh and Dacca. This, however, is not because the mussels are necessarily more abundant in these districts than elsewhere, but because these fisheries are not very distant from the central pearl and shell-market at Damera (Dacca district), and the button-making villages in the vicinity. Mussels fished in the river, canals, and *beels* in the Sylhet district are also brought to the Dacca markets.

In West Bengal the principal fishery is the Bhandardah *beel* in the district of Murshidabad. Here the fishermen belong to the *Bagdi* caste and they fish from *Chaitra* to *Ashar*, i.e. from March to June. During the rest of the year they make nets and engage in

agriculture. It is stated that three kinds of mussels are usually available in the *beel*.

In Bihar the shells are obtained from the rivers Gandak, Burh Gandak, and Bagmati which flow through the adjoining districts of Darbhanga and Muzaffarpur. The catches of the mussels along the course of these rivers are brought or sent to nearest button factories.

The shells for button making are either bought direct from the fishermen, or from merchants in Damera (Dacca district.) The principal market for shells and pearls is at the latter place while the market for the manufactured buttons is at Nangalbandh. The shell buttons made in the Dacca districts are also sent to the Calcutta market. Buttons from the Bihar factories are disposed of principally in the Punjab, the United Provinces, as well as locally.

GOLD ENAMELLING.

GOLD enamelling is carried on by goldsmiths manufacturing artistic jewellery.

The enamel (*mina*) is usually of three kinds, viz., a dark blue, dark green, and white, but red and yellow are also sometimes used. Besides the tools generally required by goldsmiths, such as small hammers, files, pincers and anvils, the following peculiar appliances are necessary for enamelling purposes:—

IMPLEMENTS USED.

1. **HOLA**—A small instrument like a knitting-needle flattened at one end, used for putting the enamel into the interstices of the ornament to be operated on.

2. **GHOR**—A half cylinder of baked clay about 3 or 4 inches long, closed at one end and perforated with holes. The ornament is heated under this in the fire to fix the enamel.

3. **KHAN**—A file made from a kind of heavy sandstone, known in the vernacular as *jaron*. To make the file, the sandstone is first of all pounded to powder, and then a piece of lac is heated and pressed into the powder, some

of which adheres. The lac is heated again, and takes up more powder, and so on till the whole has become a close compound of the two ingredients. The product is pressed on the end of a piece of bamboo, and made roughly into a square column. This forms a very fine-grained file for smoothing the surface of the gold.

THE PROCESS.

Now fanciful patterns in gold threads are usually shown in the body of the enamel in the finished ornaments. They are evidently formed of wire laid on before the enamel. The process is described in an official publication. When the wires have all been put on and the pattern which is to appear through the enamel formed upon the ornament is in process of completion, some powdered enamel of the desired colour is mixed with water in a shell (*khamuk*) and the coarse paste so formed applied by means of the *hola* to the spaces between the gold wires. These having been filled up, the ornament is fixed by a hole, purposely left in it, to the top of a nail, standing up out of a flat piece of iron (*hal patta*). The *ghor* is then placed in the furnace

(*aphuri*) in a clear space which has been made for it in the charcoal and the bellows is carefully put inside. The whole is then covered up with red charcoal and the bellows (*bhati*) applied. The *ghor* and its contents soon become red hot, the enamel melts and forms a solid mass just in the places where it was laid over as a paste. When cool the ornament is boiled in a solution of lime juice and water. If on examination it is found that any part has not been enamelled, the above process is repeated after adding more enamel. The process of applying and melting the enamel is known as *Bharandia*. The ornament is finally filed with the *khan* until the surface of the enamel corresponds exactly with upper edges of the gold wires. The latter then look as if they had been inlaid. The article must be kept wet during filing. It is then boiled again in the solution mentioned above and when cool, brushed with a small bundle of hog's bristles (*pachrangi*). This is repeated two or three times, until the object presents a perfectly smooth, albeit unpolished, surface. Great care is needed to ensure a polish on the enamel. The ornament is put again

under the *ghor* in the middle of the fire, and red charcoal piled up around and fanned (not bellowed). When the article becomes red and the enamel is again in a state of fusion, the ornament is taken out of the fire, and cooled with the aid of a blow-pipe (*nalichunga*). It is then boiled once more in the acid solution, and the enamel is found to be smooth and polished. The last process employed puts a reddish colour on the gold. Now a little water is poured into a small earthenware vessel, the sides of which are rubbed with sulphur. Next, small quantities of salt, copper sulphate (*tuntia*) and the leaves of *Ixora* plant (*the-keratenga*) are put into the water, and the solution boiled. The article is then dipped into boiling liquid, and kept there for a couple of minutes. After taking out, the ornament is finally rubbed with a piece of linen, and the enamelling process is complete.

Two processes are generally employed by the goldsmith for colouring gold. The first is known as *Borrangan*. In this method the entire ornament is covered with a thick solution of sulphate of copper, salt and water, and then heated under the *ghor* till the salts cease

to effervesce. If, however, this is found insufficient for the purpose the second process, known as *Pani rangan*, is employed. This consists in simply boiling the ornament for a minute or two in a weak solution of sulphur and water.

HOW THE ENAMELS ARE MADE.

The basis of all enamels is a highly transparent and fusible glass, called Frit, Flux, or Paste, which readily receives a colour on the addition of the metallic oxides.

RED ENAMEL.—To get red enamel take Red lead, 16 parts; calcined borax, 3 parts; pounded flint glass, 12 parts; flints, 4 parts. Fuse in a triangular crucible of sand and clay for hours, then pour it out into water, and reduce it to powder in a biscuitware mortar.

Red enamel may also be made from the protoxide of copper. Boil a solution of equal parts of sugar and acetate of copper in four parts of water. The sugar takes possession of a portion of the cuprous oxide and reduces it to the protoxide; then it may be precipitated in the form of a granular powder of a brilliant red. After about two hours of

moderate boiling, the liquid is set aside to settle, decanted off the precipitate, which is washed and dried. By this pure oxide any tint may be obtained from red to orange by adding a greater or smaller quantity of peroxide of iron. The oxide or salts of gold and the purple of Cassius (the precipitate obtained by adding a mixture of stannous and stannic chloride to a solution of auric chloride) are likewise employed to colour red enamel. This composition resists a strong fire very well.

BLACK ENAMEL.—Black enamels are made with peroxide of manganese, or protoxide of iron, to which more depth of colour is given with a little cobalt.

VIOLET ENAMEL.—The violet enamel of a very fine hue is made from peroxide of manganese, in small quantity, with saline or alkaline fluxes.

GREEN ENAMEL.—This can be produced by a mixture of yellow and blue, but is generally obtained direct from the oxide of copper, or better still, with the oxide of chrome, which last will resist a strong heat.

YELLOW ENAMEL.—To make this take one part of white oxide of antimony, with

from one to three parts of white lead, one of alum, and one of sal-ammoniac. Each of these substances is to be pulverised, then all are to be exactly mixed, and exposed to a heat adequate to decompose the sal-ammoniac till the yellow colour is well brought out.

BLUE ENAMEL.—A brilliant blue enamel colour is obtained from the oxide of cobalt, or some of its combinations, and the tint produced is so intense that only a very little can be used, lest the shade should pass into black.

WHITE ENAMEL.—This is made with a calcine formed of 2 parts of tin, and 1 of lead, calcined together. Of this combined oxide, 1 part is melted with two parts of fine crystal and a very little manganese, all previously ground together. When the fusion is complete the vitreous matter is to be poured into clear water, and the frit is then dried and melted anew. Repeat the pouring into water three or four times, to insure a perfect combination. Screen the crucible from smoke and flame. Even traces of oxide of iron or copper admitted into this enamel will destroy its value.

HINTS.—The artist makes his enamel colours by pounding them in an agate mortar,

with an agate pestle, and grinding them on an agate slab, with oil of lavender rendered viscid by exposure to the sun, in a shallow vessel, loosely covered with gauze or glass. He should have alongside of him a stove in which a moderate fire is kept up, for drying his work whenever the figures are finished. It is then passed through the muffle.

BLACK ENAMEL ON GOLD AND SILVER.—

Take $\frac{1}{3}$ oz. of pure silver, $2\frac{1}{2}$ oz. of copper, $3\frac{1}{8}$ oz. of lead and $2\frac{1}{2}$ oz. of chloride of ammonia. Melt together, and pour into a crucible with twice as much pulverized sulphur; the crucible is to be immediately covered so that the sulphur may not take fire, and the mixture is to be calcined over a smelting fire until the superfluous sulphur is burnt away. The compound is then to be coarsely pounded, and, with a solution of chloride of ammonia, to be formed into a paste which is to be placed upon the article it is designed to enamel. The article must then be held over a spirit lamp till the compound upon it melts and flows. After this it may be smoothed and polished up in safety.

GOLD AND SILVER LEAVES.

GOLD and silver leaves are manufactured largely in Northern India. These are extremely thin tissues of gold and silver, prepared by beating the metal until the requisite degree of fineness has been obtained. These are largely used in various arts and industries and specially for coating sweet-meats, pills, etc. The workers engaged in this handicraft are known as *Duftri Kul*. Their prime accessory is *jilli*, or gold-beater's skin which must be prepared with great care.

PRELIMINARY OPERATIONS.

It is found that a minute percentage of silver and copper is necessary to give the gold for gold leaf a proper malleable quality—a percentage of perhaps one in 70 or 80. The refiner manages this alloy and brings the product to a certain stage of completion; he melts the gold and the cheaper alloys in a black-lead crucible; he pours the molten metal into an ingot mould, six to eight inches long; he removes the solidified and cooled ingot from the mould and reduces it by hammering to the

form of very thin sheets. Steel rollers may be used for the purpose. The sheets are then sent to be beaten out further.

GOLD BEATER'S SKIN.

The gold beater's skin is prepared from the scarf skin of the sheep. It is a thin skin which lies immediately below the wool, and can be removed separately. 100 such skins are taken with the wool on, and soaked for eight days in a mixture consisting of 3 seers of wheat flour, $1\frac{1}{2}$ seer of rock salt and 1 seer of the milky juice of the *madar* plant (*Calotropis*), macerated in sufficient water. When the soaking is completed, the hair is scraped off with an iron scraping rod. The skins are then spread on stones and the scarf skins removed entire. The upper skins so removed are thoroughly washed with 1 seer of sour milk (*dahi*) and after that twice with fresh water. They are finally dried in the sun.

Herein come a group of spices and a group of drugs, which are used to strengthen the skin and preserve it for long.

The first group comprises such things as cloves, mace, nutmeg, cinnamon, saffron, cardamom (major and minor), sandalwood,

(white and red), dates, coconut kernel, etc., etc.

About 30 *mashas* of each is taken, thoroughly mixed and boiled over a slow fire in 4 seers of water till only 2 seers of the decoction is left.

The second group consists of a variety of indigenous herbaceous roots, leaves, seeds, etc., which are mostly astringent and aromatic. These are to be well mixed in 1 maund of water. The whole is to be boiled down to 20 srs. The clear liquor is strained off through a basket lined with *dhak* leaves, (*Buttea frondosa*) into an earthen naund, and the dregs on the strainer thrown away.

The two decoctions prepared as above are now mixed and the mixture boiled down to 15 seers. A quantity of *ghee* and camphor is now added to the liquor which is again warmed and then the 100 skins soaked in it.

The purpose of the above elaborate preparations seems to be to cure the fine skins by a sort of tanning with the astringents to preserve it from decay by the aromatics, and to soften it by the oily and other demulcent substances employed. The skins are now spread

on separate clean stones to dry, after which each skin is cut into a dozen leaves of convenient size. As all of them do not turn out of equal thickness, so the thicker ones are selected for silver beating and the finer ones for gold. The skins are separately rubbed with plaster of paris. 300 such skins after being separately dusted with a clean cloth are collected into a book and tied up in a leather case, which is subjected to hard beating on a stone with the gold beater's pestle; this goes on for 2 days, after which each skin is again rubbed with a clean cloth. The skins are then ready for use.

MODERN METHOD OF MAKING SKINS.

The thin and tough skin employed in the beating of gold and silver leaves may also be specially prepared from the external coat of the blind gut of neat cattle. The part which encircles the junction of the pouch with the rest of the intestines, is first separated and turned over. It is then drawn off in an inverted manner from the other coats to the length of about 2 ft. After this it is soaked for a short time in a weak potash liquor, and is then cleaned by scraping with a knife upon

a board. Next it is steeped in water; and afterwards stretched upon a special frame. The frame is made up of two uprights held together by two cross bars, having longitudinal grooves $2\frac{1}{2}$ ins. in width: the total covering is 1 ft. by 4 ft. The outer surface of the membrane is placed in contact with the upper part of the frame. It is stretched in every direction, and then glued to the rim. Another membrane is then stretched over the first, with its outer surface upward, and secured by glueing round its edges. When dry the membranes are separated by passing a knife along the grooves. Each strip is then glued upon a similar frame (excepting the groove) and is washed with alum solution. For this purpose 1 ounce of alum is dissolved in 2 quarts of water. After it has dried, the surface is wiped over with a sponge dipped in a strong solution of fish-glue in white wine, flavoured with clove, nutmeg, or camphor. When this is also dry, a coating of white of eggs is applied. After a final drying each strip is cut up into pieces of required size (4 or 5 ins. square) which are then smoothed under a press and bundled.

PROCESS OF BEATING.

Gold intended to be beaten is first of all made in thin strips of plate. The strips are enclosed between layers of skin, till a sort of pile is formed. They are tied up in the leather case, and beaten with an iron hammer on an anvil of stone; the blows are delivered first round one edge of the parcel, then it is turned half round and the other edge gets beaten and so on. Four times the packet has to be opened and the position of the gold bits shifted to prevent the skins being cut. After that the gold is too thin to be moved again. A *daftar* of gold leaves is ready in 3 or 4 days, and require a lakh and half of blows with the hammer. Silver, zinc and lead may be similarly treated.

CAUTIONS.

In beating gold, the dryness of the leather case is a matter of extreme delicacy. They require to be hot-pressed every time they are used, although they may be used daily, to remove the moisture which they acquire from the atmosphere, except when they acquire so little moisture that then a difficulty arises from their over-dryness; the brilliancy

of the gold is diminished, and it spreads very slowly under the hammer. On the contrary if the leather case be damp, the gold will become that which is technically termed *hollow* or sieve-like; that is, it is pierced with innumerable small microscopic holes and sometimes becomes reduced to a pulverulent state. This condition is more easily produced in alloyed golds than in fine gold: It is necessary that each skin should be rubbed over with calcined gypsum (the fibrinated variety) each time the leather case may be used, in order to prevent the adhesion of the gold to the surface of the skin in the process of heating.

EUROPEAN METHOD.

The following process of preparation obtaining in European countries will be read with interest:—

The thin leaf of gold, pure or alloyed, is obtained by hammering. The best gold leaf is made from 23 carat gold. The metal is cast into a thin ingot, and rolled out into a leaf until its thickness is 1-900th. of an inch. After being softened this is carefully divided into pieces an inch square. As many as 150 of these squares, with as many pieces of vellum

or tough paper 4 inches square, are piled so as to form a "cutch," and are beaten until the gold is as large as the paper or vellum. Further cuttings into pieces an inch square are made, and the leaves are placed between gold beaters' skin, and again hammered. This process is continued until the thickness is reduced to $1/282000$ th. of an inch. The finished leaves are trimmed and generally made into books of 25 leaves. The gold leaves should be all interleaved in the book, the paper of which has been rubbed over with red chalk to prevent adhesion.

Pure gold leaves are said to be very durable and last for many long years without cracking or fading.

GOLD AND SILVER WIRE.

THE making of the gold wire is one of the most singular mechanical operations imaginable. Gold wire should be more accurately called gilded wire, the core being of silver. The demand for these wires in the weaving of gold laces is much greater than that for silver wire, as the cost of gilding is not very much and gold has such a matchless lustre.

GENERAL PRINCIPLE.

In making the gold wire the refiner prepares a solid rod of silver, about an inch in thickness; he heats this rod, applies upon the surface a coating of gold leaf, burnishes this down, applies another coating, burnishes this down, and so on until the gold is about one fiftieth part the thickness of the silver. Then the rod is subjected to a train of processes which brings it down to the state of a fine wire; it is passed through holes in a steel plate, lessening step by step in diameter. The gold never deserts the silver but adheres closely to it, and shares all its nutations; if it is one-hundredth part the thickness of the silver at

the beginning and it maintains the same ratio to the end. It has been calculated that the gold on the very finest silver wire for gold lace is not more than one-tenth the thinness of ordinary leaf-gold.

The silver rods may be drawn into silver wires by passing them through holes in a steel plate as in the case of gold wire.

HOW GOLD WIRE IS MADE.

A quantity of silver is first taken which is generally very pure. The silver is melted down, poured into a mould which is about eight inches long, one inch wide and one inch deep. After being cast in this rectangular mould, the short rough ingot is taken out, heated and hammered, the edges being at first chiselled away. This process is repeated until the silver assumes the shape of a round bar about a foot or more in length and slightly more than half an inch in diameter.

The process of gilding the bar is comparatively simple. The weight of gold used to cover a silver bar varies, on an average, from 2 to 3 per cent. of the weight of the bar. The gold must be perfectly pure, 98 to 100 touch. It is sometimes purified by being boiled in

lime juice. It is heated and beaten evenly into a thin foil on a polished anvil with a flat hammer. The breadth of the foil is made exactly equal to the circumference of the silver bar while in length the foil is slightly shorter than the bar.

The surface of the silver bar is made somewhat rough by the use of a broad file. Then the gold foil is melted and neatly folded in a single layer round the silver bar. The workman then rolls the bar up and down his thigh till the adhesion of the two metals is complete. To assist this adhesion, the bar is heated slightly once or twice and cooled in a vessel of water. Gold being a more ductile metal than silver, the latter never again shows through the gilded surface however fine the wire may be drawn out.

The bar is heated and hammered out, the ends being made slightly pointed. One end is then inserted through the largest hole in a steel plate with 20 to 30 perforations. Each hole tapers somewhat being of wider diameter on the side through which the bar is inserted. The pointed end of the bar, when it shows itself through the hole, is grasped tightly by a

larger pair of pliers, the handles of which are inserted in one of the spokes of a windlass.

As the workman guides the bar through one of the holes of the steel plate, his assistant at the other end pushes down the spoke to which the chain is attached. At the start the effort is great. But the bar being smeared with beeswax, which acts as a lubricant and saves the surface from being scratched, slowly slips through the hole and is gradually elongated. The process is repeated and the bar steadily grows longer and longer. Each successive draw reduces the diameter of the bar and enables it to be drawn through a smaller hole in the plate. The bar has to be heated at intervals in an iron vessel containing live charcoal and hot ashes. When the wire becomes long enough the chain and pliers are dispensed with, and one end of the wire is tied to a spoke of the windlass. The process of drawing out the wire is repeated about 20 or 30 times until the wire is several scores of yards in length and not much thicker than a needle.

BRASS MOULDING.

BRASSWARES occupy a very important place in the Indian households and there is hardly a home where brasswares are not to be met with in some form or other. The demand for the brasswares still continues in spite of the advent of cheap aluminium and enamelled wares. The brass utensils may not be as largely required as before but the use of brass in making articles in other directions has recorded a big increase and brass moulding should prove one of the most profitable industries of India.

The physical properties of brass bear a strong general resemblance to those of copper; but it possesses certain advantages over the pure metal. The first of these is an economical one, the price of zinc being so very much lower than the other, that after allowing for expense of manufacture, the cost of the product is very much lower than that of copper. The alloy is harder than either of its constituents, and is of greater density, than their mean; but it melts at a lower temperature than

copper, and produces very good and sharp castings, all which circumstances combine to render it a most suitable material for small engineering work. Moreover, it is less affected by atmospheric influences than copper, and by a very simple process which will be referred to presently, a most brilliant surface can be given to it which will effectually prevent it from tarnishing. Hence brass is applied to an almost infinity of uses, domestic, engineering and scientific. It is constantly to be met with in locks, hinges, handles, and bolts; in ornaments for the table or mantelpiece; in chandeliers and gas burners; in weights and other machines; in clocks; in mathematical and optical instruments, etc.

MAKING OF BRASS INGOTS.

Brass is an alloy of copper and zinc, in various relative proportions, but the ordinary composition is about 70 per cent. of the former to 30 of the latter. If more zinc be added, the alloy will lose its tenacity; and all the compounds in which there is an absolute excess of zinc are so brittle that they are practically valueless. The ordinary commercial article will often be found to contain some

small quantity of lead and tin, but these are generally accidental impurities, often arising from the melting down of old metal to which some solder may be adhering.

The simplest plan of making brass consists in the direct combination of the two metals when brought to a molten state; but even in this some precautions are necessary in order to produce a satisfactory result. The process may either be conducted on the hearth of a reverberatory furnace or in crucibles placed in a kiln. The principal objection to the former is the risk of great loss in the weight of the product from the readiness with which the zinc oxidises and becomes volatilised.

The crucibles used are made of refractory clay; in these a certain quantity of pure copper is placed, and heated up to just the melting point, when small pieces of metallic zinc are gradually dropped in and allowed to mingle with the other until the suitable proportion has been arrived at. This point will, of course, be determined according to the kind of brass wanted; but in any case the quantity of zinc used will have to be somewhat in excess

of that desired to remain in the alloy, as, under the most careful management, 24 lb. of copper and 12 lb. of zinc will only produce 34.8 lb. of brass, having the percentage composition of 68.8 of copper and 31.2 of zinc, showing that the loss is exclusively in the latter metal. Under the repeated remeltings to which it may be subjected to after use, the brass will continue to suffer some further loss in weight, and the relative proportion of copper will be found to be still on the increase.

As soon as the contents of the crucible have properly combined, the metal may at once be poured into sand moulds to make castings; but if it is intended merely to produce ingots of brass, for subsequent rolling or remelting, closed iron moulds are used, which are gently heated prior to the alloy being poured in. The interior surface of the moulds is previously oiled, and dusted over with a little charcoal powder, to prevent the metals from adhering together.

Brass ingots can be, if necessary, rolled or beaten out into very thin sheets, and drawn into very fine wire. It can, indeed, be beaten out into leaf, quite as thin if not thinner

than that of gold, for which it is often used as a substitute.

DIFFERENT QUALITIES OF BRASS.

The properties and colour of brass depend upon the composition of its two chief ingredients, copper and zinc. 15 per cent of zinc would yield a hard fibrous metal with good working qualities. Brass for wire drawing purposes contains about 20 per cent. of zinc. 25 per cent of zinc gives brass a highly tenacious character and this is used in machinery. 30 per cent zinc produces common brass and works well under the hammer. 35 to 40 per cent zinc is used in making brass for rolling while for ornamental castings 50 per cent of zinc is required but the latter is too brittle for other purposes.

It will be noticed that copper and zinc combine in any proportion. As more zinc is added the alloy becomes still more brittle, it loses its fine colour, which then passes into a grey, and has no special quality to recommend it. A slight admixture of lead, not exceeding about 2 per cent. is rather an advantage if the brass is intended to be worked upon the lathe, and a similar quantity of tin will not injuri-

ously affect it when employed in making castings, while it is even advantageous if the brass is to be used by the engraver; but a much less proportion of either of these metals or of antimony, will destroy its value for wire-drawing. For this last purpose the alloy cannot be too pure. A little antimony will in like manner affect the rolling of it into thin sheets by rendering the metal brittle.

COLOUR OF BRASS.

It is found that with an increase in the copper content the colour inclines more towards a golden. With an increase in the zinc the colour becomes lighter and lighter and finally shades into grayish white. As the price of brass increases with the greater copper content, investigations have been made into the effects of the additions of zinc on the colour of copper. Thus, the addition of 5 per cent. of zinc affects the red colour of copper very little; when 10 per cent. is added the colour becomes a true bronze; with 15 per cent. a light orange shade; with 20 per cent. a green yellow; from 20 to 25 per cent. the colour changes very little, and these alloys are included under the term "green gold." Brass

with 30 per cent. zinc has the true yellow brass colour, and this is continued to 35 per cent. zinc; at 38 per cent. the colour begins to change again from yellow to a reddish yellow shade; at 45 per cent. the colour is a rich golden; at 55 per cent. the colour resembles 14 carats gold and at 60 the brass begins to whiten.

BRIGHTENING AND LACQUERING BRASS.

Brass resembles copper in its behaviour under the hammer, and needs annealing from time to time in order to restore its malleability. During these repeated heatings the surface becomes tarnished by the formation of oxide, from which it is subsequently purified by dipping it into weak acid, and then washing it with water.

On prolonged exposure to the action of the atmosphere it gradually acquires a dirty, black colour, but this can be effectually prevented by coating the surface when quite pure and bright with a thin film of lacquer. This is made by dissolving shellac in alcohol and applying the solution to the surface by means of a fine brush. Both the articles to be lacquered, and the lacquer itself, should be thoroughly warm; and then, on drying, the

thin film of lac will be found to be quite transparent, and to have so smooth and bright a surface as to resemble the most highly polished metal. The lacquer adheres with such pertinacity to the surface that it can only be scraped off with difficulty, and the brass may afterwards be bent to and fro as much as one pleases with its being separated. By discolouring the surface of the metal, through the agency of acids or otherwise, prior to lacquering, various tints, such as those of bronze can be produced; or a deeper tint may be given to the lacquer itself by the addition of some of the more, highly coloured resins.

FROSTING BRASS.

If a dull or frosted surface is desired, which often forms an agreeable contrast to the other in ornamental work, it is produced by a process which is termed *dead dipping*. In this case the brass is exposed for some time to a comparatively strong solution of nitric acid until the surface has become thoroughly granulated. It is then washed in pure water to remove all the acid, and next dipped in a cold weak solution of tartrate of potash, after

which it is dried by rubbing it with hot saw dust. It is then ready for the application of the lacquer.

BRASS CASTINGS.

To make castings molten brass is poured into sand moulds of proper design. For full particulars refer to BRASS FOUNDED.

When an opening, or hollow, has to be left in the interior of a brass casting, a core is inserted in the mould. This consists, as usual, of a properly shaped piece of baked sand, exactly the counterpart of the hole that is desired. This is placed in the mould to prevent the metal or alloy from running into the space. To keep the core in its position it is made a little longer or wider than necessary so as to have a bearing to rest on at each end. The pattern must have projections on it, so as to leave an impression in the sand to receive the end of the cores. Some cores have only one bearing. Innumerable modifications in the size and shape of cores exist in every day practice, and much skill is required in their preparation.

Cores are usually made in boxes; where it would be too costly to construct a core box.

it may be dispensed with by moulding the pattern in sand, and casting it solid. A good composition for this purpose is one of plaster of paris to two of brick dust, mixed with water. When cast and dry, scrape down to the form of the core.

The cores must be dried in a stove, at a temperature not exceeding about 400 degrees. When dry they should be *black washed*, i.e., coated with a mixture of charcoal and water, with a little size; this wash must be dried on in the stove, when they are ready for use.

If the sand moulds are in long use, it is advisable not to insert the cores till just before pouring the molten brass so as to prevent their absorbing moisture.

When a thin brass casting is required the upper half of the mould is moulded from the opposite impression, and a thin packing piece of clay or other material is placed between the two boxes to keep them the required distance apart.

BRASS FOUNDRY.

BRASS foundry has been practised in India from very ancient times. The brass of modern commerce is of course of comparatively late introduction; that which was known by the name in ancient times being probably bronze, a mixture of copper, and tin. The alliance of copper with zinc, now one of the most common processes in metallurgy, seems not to have been thought of as an art until after the Christian era.

Owing to the advent of cheap enamelled and aluminium wares brass wares as utensils for daily use are not as largely used as before. But different useful articles and building fittings made of this beautiful and useful metal, such as brass knobs, sash-fasteners, blind pulleys, bell-pulls, hat pegs, curtain rings, letter-clips, cup board fastenings and bolts, table and chair castors, stair rods, and an infinite number of miscellaneous and incongruous articles, from idols and toys to brass headed nails are coming up to popular demand

and the indigenous workers who find their occupations in a moribund condition may do well to make the articles mentioned.

MATERIALS FOR MOULDING.

The various articles of brass foundry are produced in the first place either by casting or stamping. If by the first, they are spoken of as wrought or solid work.

The principal materials used in the various branches of moulding are sand of various kinds, clay, etc.

Sand is superior to all other substances as a material for forming moulds generally. In selecting sand it is necessary to avoid that which contains crystals of gypsum; if it contains salt it must be thoroughly washed before use. Felspar, chalk, iron pyrites and coal must also be carefully avoided.

Parting sand is used to prevent the various parts of a mould to be afterwards separated from adhering to each other. Red brick dust, fresh free sand, or blast furnace cinder, finely ground, may be used.

Moulding sands for green sand moulds, as distinguished from the natural rock sand

referred to, is composed chiefly of the latter with a proportion of ground coal or charcoal dust added to it. These two materials must be thoroughly mixed throughout, and afterwards maintained in a suitably damp state, so that the sand mixtures now produced may have the necessary binding properties that will enable it to retain any moulded form imparted to it, and further, resist the washing action of the molten metal during the casting process.

Facing sand, for green moulds as already indicated, is made up from new rock sand, with coal dust added to it, and so specially prepared each day by one man set apart for that purpose. For proper mixing the sand and coal dust in the first place are laid on top of each other in alternate layers so as to form a mould, the size of which will, of course, depend on the amount of facing sand required. The man referred to then makes a vertical cut through the mould of sand and coal dust; that portion of the mixtures separated being turned over once or twice with the shovel, is then thrown into a sieve driven either by belt power or by hand. When the sand has thus passed through it, this is considered ready for use.

COMPOSITION OF SAND MOULDS.**FACING SAND.**

Black floor sand	10 parts.
New rock sand	5 parts.
Coal dust (good quality)	1 part.

FOR BRASS CASTING.

Rock sand (new)	1 part.
Rock sand (previously used for dry sand moulds)	3 parts.

FILLING UP SAND.

Floor sand (previously used for dry sand moulds)	1 part.
Dried loam powdered down	1 part.
Rock sand (good quality)	2 parts.

CORE SAND.

Rock sand (good quality)	1 part.
Floor sand, already used and emptied from dry sand moulding boxes	1 part.

THE FURNACE.

The furnace for moulding brass articles need not be large, two pots being sufficient for a caster and his assistant to keep going at one time, their size being about that of a common flower pot, only longer. These are lifted per-

pendicularly out of the furnace with a pair of tongs which clip them round, and afford a good leverage for pouring. Round the sides of the shops are wide troughs filled with sand, which from being turned black by frequent use, looks more like garden mould than any thing else.

THE MAKING OF MOULDS.

Good casting sand has its value. The brass caster makes use of moulds of an oblong square form, composed of two stout rims of iron, with front and back boards, and wooden screw clamps to hold the whole firmly together. Filling one half of this box with sand, which he kneads down tightly with his hands and strikes off level with a straight edge, he presses the patterns down upon it, placing them flatwise or sidewise according to their shape, and half buries them in the compact bed. He then shakes dry dust over the surface from a bag and fitting the other half of the box on the top he fills with sand also, pressing it well down, and stamping on it with his feet. The top board is then laid on the mould turned deftly over, and the first half lifted off, when the sand will part clearly in the middle, leaving the patterns behind in their

second bag. They are now carefully picked out one by one, so that the mould when put together contains a perfect print of each of them. But before the two halves of the mould are joined, the caster has to make channels for the metal from the pouring holes in the iron rim to the prints, by scooping out little gutters in the sand, connecting two or more prints where necessary in the same manner. For hollow castings, he has also to place the cores, a very delicate process, sometimes requiring great care and dexterity of hand.

CONSTRUCTION OF PATTERNS & CORES.

Some explanation is necessary as to the construction of the patterns and cores. The patterns for small articles are perhaps first of all roughly shaped in wood, and a casting then taken in lead, which is trimmed down nearer to the final size and fashion. A second casting in brass enables the pattern maker to produce a perfect model by filing, turning, or otherwise shaping it as required. Should an ornamental raised design be intended to appear upon the article, it must be now moulded upon the pattern in wax and a third casting taken, which must be cleanly finished and chased up.

The pattern maker should be a man of considerable mechanical knowledge and skill. He must know exactly how to adopt his article to the purposes for which it is wanted and he must also know how far he may presume upon the resources of the caster's art. He must not make a pattern that it is impossible to cast, and especially he must take care that, however intricate it may be, its sides and angles must be so inclined as to leave the sand.

If the pattern is to be a hollow casting, the pattern must not be made hollow, but, on the contrary, must have projections upon it, in addition to being solid throughout. Thus, if the article to be cast be of hollow cylindrical shape, the pattern maker will construct a core mould or box, the matrix in which will be a correct copy of the interior shape of the cylinder with elongations at the two ends. This box dividing into two halves, enables the caster to obtain a reverse model of the interior in moistened and compressed sand. He will lay this in his mould after the pattern has been taken out, and the metal will run round it,

filling up the space between that and the other print. The pattern maker has, therefore, to leave on his first model projections corresponding to the elongated ends of the core, so that they may leave a print in the caster's mould, and enable him to lay the core exactly in its proper place.

Careful allowances should be made at each step of the process for the shrinkage of the metal while cooling, so that the final pattern may be just sufficiently larger than the article to be cast from it. Should there be deep indentations or under-cuttings in the pattern, which would tear away part of the mould on being lifted out, the caster has to resort to a process called false coring, which is the most difficult of all his operations. He first fills these interstices with moistened sand, which he well dries and smooths off, and thus produces an artificial surface capable of leaving the mould easily. When he has procured a good print from the pattern so metamorphosed, he picks out the cores carefully from the pattern without breaking them, and builds them up in the mould in their proper

places, the greatest nicety being requisite until the matrix is complete.

THE MODE OF CASTING.

The whole of the moulding frames having been prepared for the entrance of the metal, and screwed up tightly are ranged along the shop in an upright position, mouths uppermost, and the caster, tying a handkerchief over his mouth to guard against the fumes, lifts the pot from its fiery bed, and quickly goes down the row, pouring a little of the molten metal into each hole until it comes gurgling up to the top, emitting a whitish blue flame with sulphurous vapour. A few minutes suffice for the operation, and the metal, which is of a dull coppery red when melted, sets immediately, so that no time need be lost in breaking up the moulds. Each in turn is lifted into the trough, unscrewed, and the contents, sand and casting together tumbled out in a heap.

Some will be found to be imperfect, the metal not having reached extremities of the print, while some will be damaged from the sand having broken down but the major-

rity, in the hands of a good workman, will be clean sound castings, beautiful in their newness, and perfect copies of the patterns. When cooled sufficiently, they are picked out from the still smoking heap of mould, beaten to free them from adhering particles, and broken off from the *gets* which are the thin strips of metal filling the connecting gutters.

CASTING SMALL ARTICLES.

These *gets* often absorb as much weight of metal as the castings themselves, especially if there has been a run on small articles for that pouring, these being treated in a peculiar way by the pattern maker. To mould each one separately would give the caster endless trouble, so that pattern maker connects a number of them in a *spray*, *i.e.*, a central stem with branches springing out on either side, and at the end of each branch a pattern of the article. A quantity can thus be moulded at one operation, effecting a great saving of time, though there is the drawback of a great part of the metal being necessarily run to waste, the *gets* and *sprays* having all to be remelted when their purpose has been served.

The making of the *sprays* does not involve so much labour as might appear. The pattern maker will in the first instance make but one pattern of the article, and the caster sticking this occasionally in an odd corner of his mould, will get from it a number of duplicates in due time. Being trimmed up, these will do duty as patterns, and the caster, moulding them in two rows, will connect them in spray fashion by scooping out channels in the sand. From the rough casting thus obtained a final and perfect spray pattern can be made.

Little now remains to be described in the casting process. The cores which are by this time baked hard, have to be picked out of the hollows, the sand brushed out of the bends and corners, and the castings are ready for the warehouse. An allowance of 5 or 6 lbs. per hundred weight is made for waste, as at each remelting some part will be lost. The extreme delicacy of detail thus obtained sometimes is really surprising.

METHOD OF STAMPING.

The second method of giving initial form and shape to brass articles is by stamping. Rolled sheet, and not ingot brass, is the mate-

rial used in this case, and the metal being laid upon a die, is forced to take its shape by repeated blows. It resembles, therefore, beaten or repousse work, when finished, the contour of the relieve being followed, in the depressions of the underside. Much saving of weight is thus effected and brass becomes applicable to a variety of ornamental purposes in which lightness is a desideratum. The introduction of stamped brass foundry has created a new era in the trade.

The die is a block of steel welded in a larger block of iron, the impression of the intended work cut in its face. This block the stamper lays upon the stamp bed, immediately under the descending hammer, and fixes it there by tightening up four strong screws, which surround it horizontally. He has now to consider how many rests the metal will require before it can be forced into all the depressions of the die. If the pattern be sharp and deep, it will require a good many, being reannealed each time. The stamper perhaps first begins by half filling his die with clay plastering up all the sharp indentations; he will then take a cast of the hole with metal lead,

having first surrounded it with rolls of clay to prevent the metal from running over. When cold, he lets the stamp-hammer down sharply, which being furnished with roughened studs upon its underside, lays hold of the lead *force* and picks it up when relifted. This shapeless lump is now made to descend upon the thin metal, and gives it the first rudiment of the form it is ultimately to assume. Successive operations of the same kind bring it up gradually nearer and nearer to a finish, and the final strokes are given by a *force* cast in brass or some harder alloy in the clean dice. Repeated annealings prevent the metal cracking or *flying* in the process, and the acme of art consists in producing a stamping unbroken in any part, and yet reaching the utmost limit of tenuity that the metal can be made to bear.

HORNS AND HORN WORKS.

FOR a very long time horns have been largely utilised in the manufacture of many useful goods. As the Fauna of India is numerous and varied, it is no wonder, therefore, that the animals, which yield horns of commercial and industrial importance would be numerous and varied also. These are extensively available in the country sides, and any enterprising industrialist can employ men to procure these horns and industrially use them.

THE HORNS OF INDIA.

The chief horned animals of India may be enumerated here: —

The Spotted Deer; the Hog Deer; the Wild Buffalo; the Domestic Goat; the Markhor; the Himalayan Ibex; the Barking Deer; the Sikkim Stag; the Kashmir Stag, or Bara Singh; the Gayal; the Gaur or Bison of Anglo-Indian sportsmen; the Burmese Wild Bull; the Nilgiri Wild Goat, or Ibex; the Ravine Deer, Goat Antelope, or Indian Gazelle Antelope; the

Ther, or Himalayan Wild Goat; the Serow or Forest goat; the Gural, or Himalayan Chamois; the Yak; the Great Indian Rhinoceros; the Lesser Indian Rhinoceros; the Indian two-horned Rhinoceros; the Swamp Deer; the Manipur or Burma Stag; the Samber Deer, or Elk of Indian sportsmen.

Besides the above wild animals which yield special and fancy horns, the different varieties of domesticated Ox, Buffalo, and Sheep yield horns which are collected with their hides or skins, and, indeed, these form the major part of the commercial horn in India.

CLASSES OF HORNS.

Anatomically, the horns are of very various structure and according to the late PROF. OWEN, "these belong to two organic systems as distinct from each other as both are from teeth. The horns of deer consist of bone, and are processes of the frontal bone; those of the giraffe are independent bones, or *epiphyses*, covered by hairy skin; those of oxen, sheep, and antelopes are *apophyses* (or direct processes) of the frontal bone covered by the *corium* (or skin) and by a sheath of true horny

material; those of the prong-horned antelope consist at their bases of horny processes covered by hairy skin, and are covered by horny sheaths in the rest of their extent. They thus combine the character of those of the giraffe and ordinary antelope, together with the expanded and branched form of the antlers of the deer. Only the horn of the rhinoceros is composed wholly of horny matter, and this is disposed in longitudinal fibres, so that the horns seem rather to consist of coarse bristles, coarsely matted together in the form of a more or less elongated sub-compressed cone." The so-called horns have thus been roughly divided by SIR GEORGE WATT into two large classes, comprising five sub-divisions:—

GROUP I.

Horns consisting of bone, and having no true horny matter in their structure:—

(1) True processes of bone, *e.g.*, antlers of the deer.

(2) *Epiphyses* or separate pieces of bone, covered by skin, *e.g.*, horns of the giraffe.

GROUP II.

Horns more or less consisting of true horny matter:—

(1) Processes of bone covered at the base by hair, and tipped by horn, *e.g.*, horns of the prong-horned antelope.

(2) Processes of bone covered by horn, *e.g.*, horns of the ox.

(3) True horn, *e.g.*, nasal horn of the rhinoceros.

True horny matter, found in Group II, is formed by a modification of epidermal tissue (the superficial layers of the skin) and consists of an albuminoid material called *keratin*, a substance identical with the chief constituent of wool.

PHYSICAL PROPERTIES OF HORNS.

Horns of the first group are extensively found in India under the name of deer horn. The horns of the Sambar Deer seldom exceed 40 inches in length, and are generally under 3 feet, but 4 feet along the curvature has been recorded. These consist of a basal antler springing directly from the burr or base of the horn and pointing forwards, upwards and outwards, the beam bifurcating at the extremity, and a snag separating posteriorly and pointing obliquely to the rear. The horns of the

Spotted Deer are about 30 inches in length, have a long antler sweeping upwards and backwards, with one sub-terminal snag, the former projecting forwards and upwards from the beam. The whole horn is pale and somewhat smooth. These are extensively used as bone handles for cutlery, umbrella sticks, etc.

Horns of the second group are principally used in the manufacture of *horn* for the purposes of comb making. The *keratin*, of which the commercially valuable part is composed, is eminently suited to a number of purposes, owing to its elasticity, flexibility, and toughness, together with its physical property of softening under the application of heat, and its capability while in this condition of being moulded and welded into various forms under pressure.

The horns of sheep and goats are whiter and more transparent than those of other animals, and are, therefore, most valued for comb making purposes, while those of the arna buffalo are the most handsome and best for more ornamental work. The solid tips and the hoofs of cattle which like horn consist largely of *keratin* are made into buttons.

INDIAN CENTRES OF HORN WORKS.

The chief forms of horn used in the Indian arts and industries are buffalo and bison, as cow horns are not much in use due to religious objections. According to SIR GEORGE WATT buffalo horn is by far the most largely employed but the least beautiful. It is made by the Indian workers in horn (*kangisaz*) into cups, tumblers, card trays, ink stands, combs, chains, handles for sticks, umbrellas, swords, daggers and knives, musical instruments, workboxes, powder-flasks, bows and arrows, *hukka* mouth pieces, scent bottles, snuff boxes, penholders, and many other such articles. The centres of the trade are Cuttack, Monghyr, Satkhira, Jessore, Hooghly, Serampore and Calcutta where combs, buttons, brooches, necklaces, snake bangles and the like are made. In Bhutan large horns, often richly ornamented, are used for carrying milk, and in Nepal the rhinoceros horn cups used in oblations to the gods are produced. In Assam, Sibsagar turns out salad spoons of buffalo horn with quaint elephant handles. Of Rajputana, mention may be made of the Jaipur bows, ornamented in diaper pattern, and of the

Kota veneered work. The Rajkote combs, Baroda spoons, Kathiawar knife handles and the Surat and Ahmedabad boxes veneered with horn are well known. Baroda sometimes, however, attempts articles of a higher character. The veneer workers of Vizagapatam make very beautiful fancy boxes of buffalo horn. Madura produces large varieties of most admirably made and life-like animals in horn, such as, crab, scorpion, bloodsucker, bull, cobra, deer and different kinds of birds. In Mysore umbrella handles, powder boxes, buttons and other such articles are made of buffalo horn and often richly inlaid with ivory and copper. Curiously interesting money-boxes are constructed in this way. In Coorg, knife and *kukri* handles are made of buffalo horn.

Bison horn is a more artistic material than buffalo horn and lends itself better to treatment. In Ratnagiri and Savantvadi a fairly large trade exists in working up bison horn into ornamental wares. The chief centres are Vijaydrug, Moban and Rajapur, the horn being imported in small quantities from Malabar and Cochin.

PRINCIPLE OF MANUFACTURE.

The articles of horn require a little skill. The principle of manufacture according to MR. E. H. AITKEN essentially consists in keeping a portion of horn moist with coconut oil and heating before a fire until it becomes almost as soft as wax. It is then worked or pressed, into the required form, either with the hands or by means of moulds made of hard wood, and finished off with scraping tools and a small lathe. It remains to polish the whole and ornament parts of it with simple but graceful designs. The ornamentation is done in line with a fine, double-pointed steel engraving tool. The tools used in this work are indeed all extremely simple, and there are not many of them. A small, rude lathe, a fine saw, a few triangular blades, without handles, for scraping and polishing, a pair of compasses or callipers, three or four engraving tools of sizes, with perhaps a file or rasp, and moulds made for the occasion, complete the necessary equipment. Antlers such as those of the black buck may be made into knife, pen-holders and dagger handles and for securing fancy shapes they are sometimes mounted in silver.

THE PROCEDURE.

The detailed method of treating horns and making articles of them follows:—

The first process is the separation of the true horn from the bony core on which it is formed; for this purpose the entire horns are macerated in water for a month or six weeks, according to the temperature; during this time, the membrane which lies between the core and the horn is destroyed by putrefaction, so that the core becomes loose and can easily be extracted. The cores are not thrown away, but are burnt to ashes, and in this state form the best material for those small tests or cupels employed by the assayers of gold and silver. The next process is to cut off with a saw the tip of the horn, that is, the whole of its solid part. This is used by the cutlers for knife handles, is turned into buttons, and applied to sundry other purposes. The remainder of the horn is left entire or is sawn across into lengths, according to the use to which it is destined.

MAKING HORN PLATES.

The portion of the horn left after cutting off with the saw the solid tips is

made into plates. The essential principle consists in first splitting the softened horn lengthwise in the direction of the grain. The split horn is then warmed in hot water, opened out flat, laid between cold iron plates, and pressed level. If the goods are to be subsequently stained, the slices are further placed between hot steel plates, and very strongly pressed, to reduce the thickness and destroy the superficial grain. The prepared slices may subsequently be stamped out by cutters as required.

In actual practice the portion left after cutting off the tips of the horn is immersed in boiling water for half an hour by which it is softened; and, while hot, it is held in the flame of a coal or wood fire, taking care to bring the inside as well as the outside of the horn, if from an old animal, in contact with the blaze. It is kept here till it acquires the temperature of melting lead or thereabouts, and in consequence becomes very soft. In this state it is split lengthwise by a strong pointed knife, like a pruning knife, and by means of two pairs of pincers, applied one to each edge of the slit, the cylinder is opened out nearly flat. These *flats* are now placed on their

edges between alternate plates of iron, half an inch thick and eight inches square, previously heated and greased, in a strong horizontal iron trough, and powerfully compressed by means of wedges driven in at the ends.

The plates thus obtained are laid one by one on a board covered with hide, are fastened down by a wedge, and are then scraped with a draw knife having a wire edge turned by means of a steel rubber; when reduced to a proper thickness and smoothed, they are polished by a wollen rag dipped in charcoal dust, adding a little water from time to time, then rubbed with rotten stone, and finished with horn shavings. The longest and thinnest of the films cut off by the draw knife, when dyed and cut into various figures, are sold under the name of sensitive Chinese leaves, (being originally brought from China) which, after exposure to a damp air, will curl up as if they were alive when laid on a warm hand or before the fire.

COMB MAKING.

The manufacture of combs is by far the most important application of horn. The liminatory character of the horn, its very

diversely running grain, and the raising up of the fibres by the use of the various tools, render it very difficult to apply machinery in its conversion, and the large amount of hand-labour required causes the proportionately high price of the manufactured article.

For making combs, the plates of horn should be pressed as little as possible, otherwise the teeth of the comb will split at the points. It is so arranged that as many combs as possible, of various sizes and shapes may be obtained from the plate, so as to fully economize the material. They are shaped chiefly by means of rasps and scrapers of various forms, after having been roughed out by a hatchet or saw. The teeth are cut by a double saw fixed in a back, the two blades being set to different depths, so that the first cuts the tooth only half way down, and is followed by the other which cuts to the full depth; the teeth are then finished and pointed by triangular rasps. If a comb or other article is too large to be made out of one plate of horn, two or more may be joined together by the dexterous application of a degree of heat sufficient to melt but not to decompose the

horn, assisted by a due degree of pressure; and when well managed, the places of juncture cannot be perceived.

If a work in horn, such as one of the large combs worn by women, is required to be of a curved or wavy figure, it is finished flat, and is then put into boiling water till it becomes soft and is immediately transferred to a die of hard wood, in which it is cautiously pressed, and remains there till cold.

As an alternative method, each slice for comb may be pressed and straightened and ground ready for cutting the teeth, which operation is performed by a parting engine, or die-stamping machine, in the case of coarse combs, and by circular saws in that of fine toothed combs.

UTILIZATION OF HORN SHAVINGS.

Horn steeped for a week in liquor, the active ingredient of which is caustic alkali, becomes so soft that it may, easily be moulded into any required shape; and shavings subjected to the same process become semi-gelatinous, and may be pressed in a mould into the form of snuff boxes and other articles. But the

horn, so treated, becomes hard and very brittle, probably in consequence of its laminated texture being obliterated by the joint action of the alkali and strong pressure.

MISCELLANEOUS ARTICLES OF HORN.

To make drinking cups of horn, the horn is sawn to the required length, is scalded and roasted over the fire as already described; but instead of being split and opened, is placed while hot in a conical mould of wood; corresponding plug of wood is then driven hard in, to bring the horn to shape. Here it remains till cold, and is then taken out and fixed by the large end on the mandrel of a lathe, where it is turned and polished both inside and outside, and a groove, or chine, as the coopers call it, is cut by a guage tool within the small end for receiving the bottom. The horn is then taken off the lathe and laid before the fire, where it expands and becomes somewhat flexible; a round, flat piece of horn, of the proper size, (cut out of a plate by means of a kind of crown saw) is dropped in and forced down till it reaches the chine, and becomes perfectly fixed in this situation, and water-tight by the subsequent contraction of the horn as it cools.

The Chinese make bows partly of wood and partly of buffalo's horn; but the best Indian bows, those, namely of Lahore, are made of horn combined with wood, and strapped round with sinew.

DYEING HORN.

Horn is easily dyed by boiling it in infusions of various colouring ingredients. It is generally coloured rich red brown, to imitate tortoise-shell, for combs and inlaid work. The usual mode of effecting this is to mix together pearlsh, quicklime, and litharge, with a sufficient quantity of water and a little pounded dragon's blood and boil them together for half an hour. The compound is then to be applied hot on the parts that are required to be coloured, and is to remain on the surface till the colour has struck; on those parts where deeper tinge is required the composition is to be applied a second time. The horn articles may be dyed black or brown by dipping them into a bath containing a weak solution of mercury or lead salts, and rubbing on sulphate of ammonia, or it may be mordanted in an iron bath, and dyed by logwood. Fancy markings are produced by immersing the horn in a bath

of lead salt, and then in hydrochloric acid, thus forming white lines in the interstices of the horn.

MODERN METHOD.

In modern workshops the horn is first sawn approximately to size with a circular saw and put into a tank to boil until soft. It is then cut to shape, scraped and finished for the die. The die meanwhile is being heated, and is then withdrawn, cleaned, a spot of oil dropped in each division, the prepared horn laid in position, the die closed, fastened in a vice, and left to cool. The die is now opened, the horn taken out and dressed by paring the edges with a razor blade set in a stout handle and put under a weight to keep flat.

CONCLUSION.

Horn is not dissolved for the purpose of working, as there is no known method of doing this without altering the properties of the horn. It is either turned as for pipe stems or punched out as for buttons; but it is more or less moulded by treating with boiling water or steam and then submitting it to high pressure.

MAKING MODELS AND MOULDS.

MODELS of natural and artificial objects with natural colour of the objects are articles of beauty which every one will be glad to keep in his room. Like all other beautiful things these are always things of joy. Models and moulds of clay, metal, wax or plaster are required in many arts and industries as well. The trade in such models is extensive and the manufacture being not a very difficult process can be easily taken up by our people. We have already clay modelling of beautiful things of Krishnagar and other places but we may also take up plaster modelling if we are to develop the art of modelling in this country. We have gypsum in the country—plenty of it, and we can get plaster of Paris by heating it. We need not go to other countries for any ingredients required in developing the industry. Yet while the imported articles are still scarce we can build an industry—a very profitable industry—for the benefit of a large slice of our people.

PRINCIPLE OF MOULDING AND CASTING

In most modelling works plaster of Paris casts would be the first necessity. Plaster of Paris is a dry white powder composed of anhydrous sulphate of lime which when mixed with a little water sets or becomes hard. It is this property of the thing that has been taken advantage of in taking models and casts, and uniting slabs of marble and alabaster. In taking casts the plaster of Paris of commerce may be employed with good effect. This is sold in barrel in the form of white impalpable powder. When a quantity of this dry powder is rendered half fluid by thorough mixing with water until the whole mass is about the consistency of thick butter, the plastic material becomes solid in a few minutes; and in the course of a few hours, every part will be nearly as hard as white chalk. This peculiar property of plaster of Paris—of solidifying quickly after it has been mixed with water—enables artists to take impressions of forms, with admirable precision, which could not be taken in any other way.

When a cast is to be taken a mould must be first made, having the exact form and shape of the original delicately impressed on the interior surface. Then the mould is filled with plaster in a semifluid state. After it has become hard the mould is taken apart, and the cast removed.

Care must be taken not to use faulty plaster, for if it is so the result of the modelling will of course be more or less faulty also. The use of natural fruits which are a bit elastic in early experiments often leads to a want of accuracy in the first step of the operation, which causes annoying difficulties afterwards; and therefore a solid inelastic body, an egg boiled hard for instance, may be recommended as the first object to be imitated.

MOULDS OF PLASTER.

In making the mould first fill up a small basin or bowl about three quarters full of damp sand (the finer, the better). Lay the article to be moulded, say, an egg lengthwise in the sand, so that half of it is above, and half below, the level of the sand, which should be perfectly smooth round it. Then in another basin, which should be half full of water, mix

the plaster in quickly till it comes to the consistency of thick cream, then pour the whole upon the egg in the first basin.

While the half mould thus made is hardening thoroughly, carefully remove every particle of plaster from the basin in which it was mixed, and also from the spoon which has been used. This is highly important, since a small quantity of plaster which has set will destroy the quality of a second mixing if it is incorporated therewith. In about five minutes the half mould will be fit to remove, which may be done by turning the basin up with the right hand (taking care not to loose the sand), so that the mould falls into the left hand. The egg should then be gently allowed to fall out of the mould; if, however, it adheres, lightly scrape the plaster from the edge of the mould, and then shake it out into the hollow of the hand. The mould or casting must be *trimmed*, that is, the sand must be brushed from the flat surface of the mould with a small brush very lightly, without touching the extreme and sharp edges where the hollow of the mould commences. Then upon the broad edges from which the sand has been brushed, make four

equidistant hollows (with the round end of a table knife) like the deep impression of a thimble's end. These are to guide hereafter in the fixing of the second half of the mould. The egg should now be replaced in the casting, the edges of which with the holes should be thoroughly lubricated with linseed or sesame oil, laid on with a feather, or, what is better, a large camel hair brush.

Into the small basin or bowl from which the sand has been emptied, place with the egg uppermost the half mould, which, if the operation has been managed properly, should fit close at the edges to the side of the vessel; then prepare some more liquid plaster as before, and pour it upon the egg and mould.

In due time remove the whole from the basin; the halves will be found readily separable, and the egg being removed, the mould will be ready to cast in, after it has been set aside for an hour or two, so as to completely harden. This is the simplest form of mould and all are made upon the same principle.

These moulds may also be utilised in making wax models, etc.

PLASTER MOULD OF FRUITS.

If it is desired to take a plaster cast of a fruit, say, a mango, the first step is to put about a pint of the dry plaster into a bowl, after having oiled the bowl with grease on the inside, to prevent the material from adhering to it. Water is then mixed with the plaster until it is so soft that it might be poured out. Now oil the surface of the mango thoroughly, and press the calyx end down into the plaster, until the largest part of the fruit is on a plane with the surface of the plaster. Hold the fruit quite still, until the plaster has become hard. Let it dry for a few minutes, and then gently lift the fruit from its place. In case the plaster has been allowed to rise above the bulge of the fruit, the surface must be shaved away down to the largest diameter of the fruit before the latter can be extracted. Replace the mango, and dress the surface of the mould with a sharp knife to a perfect level; make four counter-sinks, half an inch deep, and as large as the end of a man's thumb, in the surface of the mould, while it remains in the bowl. Then oil the stem end of the fruit and the upper surface of the mould, and with a case knife lay

on a coat of plaster of Paris all around the fruit, until it is covered to the thickness of an inch. The stem of the fruit must be first removed, as it can not be drawn out of the mould. The plastic material must be applied gradually, as fast as it will solidify. Continue to lay on the semi-fluid material until the outside has been brought up to the desired form, nearly square, and flat on the top. After the part of the mould has become hard, lift it carefully from the lower portion, and take out the fruit. If the inside of the mould is not sufficiently smooth, let the rough places be dressed off, and the depressions filled with plaster. Then oil the interior surface with linseed oil, and allow it to dry. The mould is now ready for use.

MAKING PLASTER CASTS.

To take a plaster cast from the moulds bind the two parts of the moulds together, cut out a small hole on one side, say an inch in diameter, and fill the mould through this hole with plaster, rendered plastic by being mixed with water. After it has had sufficient time to become hard, take the mould apart, and remove the cast, which will appear, in every

respect, like the original, except in colour. For greater effect, as in the case of a mango, a small hole may be bored for the stem, and a genuine stem may be inserted, and fastened with a little plaster; or an artificial stem may be made, and introduced to a sufficient depth to enable it to sustain the weight of the cast. The final products may be painted if necessary in bright natural colours.

ANATOMICAL MODELS.

When a cast of a person's face, either alive or after death, is desired, let the hair and whiskers be modelled with potter's clay, brushed back smoothly, and oiled. Then prepare a quantity of plaster in a shallow dish, and lay the head back in it to the desired depth, until it has become hard. After the plaster has set, dress off the edge of the mould and oil it. Now proceed to make another section of the mould over the face, by oiling the surface, and applying the plaster, as described above with reference to the cast of a mango. During the operation upon a living person, he must breathe through his nostrils. As soon as the material has hardened, lift it carefully, and remove the remaining section of the mould.

Depressions must be counter sunk always in the edges of every section, to receive the dowel points of the corresponding part of the mould. If the eyes are to be represented as open, depressions must be carved in the mould corresponding to the eyelids and brows. Now smooth and oil the inner surface of the mould with linseed oil; let it become dry; turn in plaster through the orifice left by the neck, roll the mould over and over, until every depression has been filled. After the material has become dry, remove the sections of the mould. If there be wrinkles or depressions with overhanging edges, which will hold the mould, they must be first filled, so that every section of the mould may be lifted off, without fracturing the corners. The depressions around and in the ears, for instance, must be first filled out, and smoothed off, before the mould is made. Otherwise the sections could not be lifted off. A beginner may exercise his skill in taking casts of a hand, or of any other simple object which will require a mould of only two parts.

WAX MODELLINGS.

IMITATIONS in wax of various fruits, flowers, anatomical models, etc., are most beautiful representations of art. The products can be made without much technical skill or capital.

The first thing necessary is to make two plaster of Paris half moulds of the article to be imitated in wax according to the method detailed in **MAKING MODELS AND MOULDS**. The general principle of preparation is as follows:

GENERAL PRINCIPLE.

(1) The two pieces of the plaster of Paris mould must be soaked in hot water for ten minutes.

(2) The wax should in the meantime be very slowly melted in a small covered tin saucepan, with a spout to it, care being taken not to allow it to boil, or it will be discoloured. As to the quantity of wax to be melted, the following is a general rule:—A lump, the size of the object to be imitated, placed in the

saucepan, should be sufficient for casting twice, at least.

(3) As soon as the wax is melted thoroughly, place the saucepan on the hob of the grate, and taking the parts of the mould from the hot water, remove the moisture from the surface by pressing them gently with a handkerchief or soft cloth. The mould must not be wiped, but only pressed. If the water has not been hot enough, or if the drying is not performed quickly, the mould will be too cold, and the wax will congeal too rapidly, and settle in ridges and streak; on the other hand, if the wax has been made too hot, it will adhere to the mould, and refuse to come out entire.

(4) Having laid the two halves of the mould so that there can be no mistake in fitting the one in its exact place quickly on the other, pour from the saucepan into one of the half moulds as nearly as much wax as will fill the hollow made by the plaster model, quickly fit the other half on the top of it, squeeze the two pieces tightly together in the hand, and, still holding them thus, turn them over in every possible position, so that the wax which is

slowly congealing in the internal hollow of the mould may be of equal thickness in all parts. Having continued this process at least two minutes, the hands (still holding and turning the mould) may be immersed in cold water to accelerate the cooling process. The perfect congealment of the wax may be known after a little experience by the absence of the sound of fluid on shaking the mould.

(5) As soon as the mould is completely cooled the halves may be separated carefully, the upper being lifted straight up from the under and if the operation has been properly managed a waxen model will be turned out of mould.

(6) The model only requires trimming, that is, removing the ridge which marks the line at which the halves of the mould joined, and polishing out the scratches or inequalities left by the knife with a piece of soft rag, wet with spirits of turpentine or spirits of wine.

(7) For colouring the wax while the wax is yet on the hob, and in a fluid state, stir into it a little flake white, in powder, and conti-

nue to stir the mixture while it is being poured into the half mould. It will be found that unless the fixing and shaking of the moulds are managed quickly, the colouring matter will settle on the side of the half into which the mixture is poured; a little care in manipulation is therefore requisite.

CASTING IN WAX.

To make an imitation of any fruit in wax, say, a lemon, plaster half moulds should first be made, for the purpose of which take a basin and stand the lemon upright in it; then surround the lemon evenly with sand so that exactly the half of it has been covered by sand, and exactly the other half projects from an even layer of sand. The visible half of the lemon is encircled by a band of paste-board which is exactly 1 inch larger in circumference than the fruit. Then in the dish mix enough plaster of Paris to the thickness of a stiff cream to cover the half of the lemon with a coat about $\frac{1}{2}$ in. thick. When the plaster is of right consistency, it is poured over the half of the lemon, the card board cylinder preventing any plaster to spread out. When the plaster has again set in, take the fruit out

from the plaster shell very carefully so that the fine indentures of the peel may not be affected. Remove any sand that may be clinging to the base of the half mould and make in its rim four holes. Grease the rim and the holes with a little oil and fat mixed. Replace the mould in its place, and in the same manner as before complete the other half with fresh Paster of Paris. When this has again set in, apply the point of a knife at the joint and force the two half moulds to separate. The fruit is taken out and the half moulds are allowed to rest for some half an hour. For general hints on making plaster models go through our article on MAKING MODELS AND MOULDS.

Next comes the process of casting the wax. In a covered basin enough wax is melted as to nearly fill one of the halves of the mould and if necessary mix one or two colours as suited to produce the required effect. In cases of lemon, simply chrome yellow will do. Next take the mould and immerse it in hot water for a minute, then add a little balsam of fir to wax and pour it in one of the half moulds. Fix the other half on and taking the moulds in the hands press the halves together

and shake the whole in the air for about ten minutes so that the wax is being run evenly over the interior of the mould. Then the moulds are immersed in cold water for two minutes and the two halves are again loosened when a finished product comes out. Any finishing touch may be given by hand as regards external colours.

The above method applies in cases of anything that is mouldable including fruits, nuts, vegetables, etc. In cases where actual things in enlarged or shortened forms are not available at all, an engraven piece in wood may do.

WAX FLOWERS.

The making of artificial flowers from wax is more difficult than the making of wax fruits, as there are no moulds as in the first case. The principle upon which the whole process rests is that first, a number of leaves is made separately with very thin wax, and joined by wire. In the construction of twigs of plants, it is most important to be guided by twigs of the natural plant, as various kinds of plants have many different characteristics in the grouping of their flowers, leaves and branches.

To make wax flowers and leaves a sheet of glass 18 in. square will be required. First of all, warm the wax over a slow fire as in the case of fruits and add to it any colour as desired to make leaves appear of natural tint. In another vessel some warm water with bits of soft soap in it sufficient to give lather is heated. When these are ready the glass plate is plunged in water and after removal from the bath it is steeped into melted wax and taken out again at once to put it in water again so that an even layer of wax is deposited on the surface. This is laid upon a board and dried and finally a leaf whose imitation is wanted is pressed upon it so that all the veins leave an impression on the leaves. With a sharp pen knife then cut out the wax in the shape of a leaf and curl by bending over the finger or back of the hand. When the leaves are made, they are joined by the aid of fine wire and mounted under glass case to resemble flowers.

CAUTIONS.

• Scrupulous cleanliness is throughout indispensable; even a particle of dirt may spoil the whole thing. In mixing the plaster, always remove all traces of one lot before mixing the

next. The mixing and applying of plaster of Paris should be done very quickly as it is too apt to dry. Without the balsam fir the whole wax work may melt during the strong heat of summer and hence its use must not be lost sight of. While melting, the wax should not come in contact with iron.

COLOURING WAX.

In conclusion too much stress cannot be laid upon the production of the things in their natural colour. For this some dyes should be added to the melted wax and some others are to be painted on the dry articles as finishing touches. For apples use chrome yellow with wax and have it touched greenish; for pomegranate mix burnt umber with wax and touch up with purple to nature; for peach, use white dye and touch up with chrome-yellow and lake; for oranges, use different parts of yellow and red lead well mixed in the wax before casting; for pine-apple use yellow colour with wax and finally paint with gamboge.

PEARL INLAYING. 7

THE art of ornamentation with the mother-of-pearls is an extensive industry in many places such as Ahmedabad, Kota, Bhera, Agra. The variegated colour representations by the grotesque arrangement of the tiny pearls are very fascinating to the eye and images of gods and goddesses, necklaces, safety-pins and similar trinkets made with the mother-of-pearl look very artistic. The mother-of-pearl is largely used in lapidary work and this has been so from time immemorial. Marble pieces can also be gracefully ornamented with bands of black lac-cements with mother-of-pearl sunk within them as if inlaid.

SPLITTING THE SHELLS.

Mother-of-pearl is the inner coat or layer of several kinds of oyster shells. It owes its beautiful tints to its peculiar structure. The surface is covered with minute grooves about three thousand being contained in an inch. These decompose the light into the rainbow colours and reflect the light. The mother-of-

pearl, or the pearl, as it is called by the artist, should possess a clear white surface. Owing to the lamellar structure of the pearl shell the shells can be split into laminas. But splitting is not taken recourse to, for this is most likely to spoil the shell. The pieces are generally cut according to requirement by the use of the saw, file, or grindstone. In preparing the rough shell, if square or angular pieces are required, the circular saw or the ordinary back saw is used; while if a circular form is wanted, it is cut by an annular or crown saw fixed on a mandrel.

THE ETCHING PROCESS.

Another process of working the pearl is similar to that of engraving in metals in relief, by the aid of corrosive acids and the etching point. The shell is first split up as may be necessary, and artistic designs or patterns are drawn upon it with an opaque varnish. Strong nitric acid is then applied over the plates repeatedly with a brush until the parts unprotected by the varnish are sufficiently eaten away by the acid. The varnish is then washed off, and the portions which the acid has not touched are found to present a nicely

executed design. If the design is to be after the manner of common etching on copper, the process upon the shell is precisely the same as that process upon metal.

For commercial purposes a considerable number of duplicates of this shell are required to be of the same size and pattern. In that case the requisite number of plates are cemented together with glue, and the device or figure drawn upon the topmost one. These may then be held fast in a vise or clamp, and cut out as one plate with a fine saw, or wrought into the desired form with files; drilling tools may be employed to assist in the operation. When the pieces are to be separated, the cemented shells are thrown into warm water. Thereby the glue gets softened and the pieces separate out easily.

FINISHING THE PEARLS.

After being cut out the pearls are ground to the necessary thinness on a grindstone. Plenty of water should be added to avoid the great friction which always ensues.

The shell being ground or turned to the proper form in this way, it is rubbed with

pumice stone and water. This is then rubbed with finely ground pumice stone, which has been carefully sifted to extract all except the minutely powdered portion, with the help of a piece of cork or damp cloth. The shell is then polished with rotten stone moistened with dilute sulphuric acid, the latter tending to develop the striated structure of the shell. In some cases emery paper may be used, followed with rotten stone moistened with acid or some limpid oil instead.

THE PROCESS OF INLAYING.

To make pearl handles used for razors or knives, the shells are first roughed out, then drilled where the rivets are to be inserted and then lightly riveted together in pairs. They are then ground to the proper size and thinness and finished as directed above.

According to *Mr. Lely*, the simple designs of Ahmedabad are followed by filing pieces of mother-of-pearl to the required size and letting them into the pattern cut in the block of wood. The more elaborate designs are with fragments of different coloured mother-of-pearl worked into cements, and laid on the

surface to be ornamented. Instead of cutting out spaces the exact size of the mother-of-pearl, and filling these up without showing any trace of the cement, it is customary for the cement itself to be treated as an ornamental feature and doubtless it is much easier to cut out hole lines to be loaded with lac and mother-of-pearl than to cut a multitude of small recesses for each piece of the shell.

INLAYING ON CAST AND SHEET IRON.

Cast and sheet iron and papier mache are the materials upon which pearl is generally inlaid. The following process is followed. If the article be of cast iron, the sand which usually adheres to the casting is cast off. The article is then painted with a coat of varnish and lamp black. When this is thoroughly dried, a further coat of Japan or black varnish is spread evenly upon it. Before the varnish becomes too dry, pieces of pearl cut in the form of leaves, roses, or such flowers as the fancy of the artist may dictate, or the character of the article may require, are laid upon it and pressed down with the finger, and they immediately adhere to the varnished surface. The work is then placed in a heated oven and

kept there for several hours, or until the varnish is perfectly dried. It is then taken from the oven and another coat of varnish applied indiscriminately on the surface of the pearl and then the previous coating, and again placed in the oven till dry. The process is repeated several times. The varnish is then scraped off the pearl with a knife, and the surface of pearl and the varnish around it is found to be quite even. The pearl is then polished with a piece of pumice stone and water, and the surface of the varnish is rubbed smooth with powdered pumice-stone, moistened with water. Its final beauty and finish depend altogether on the skill of the artist who now receives it.

INLAYING ON PAPIER MACHE.

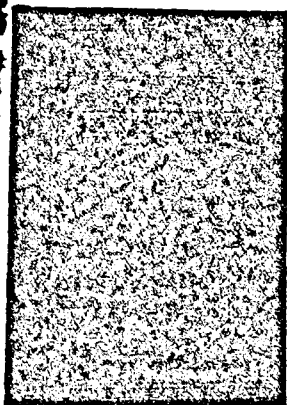
If the article be of papier mache, the artist traces the stem and leaves of the flowers with a camel's hair pencil, dipped in a size made of varnish and turpentine; upon this he lays gold leaf, which adheres where there is size, and the superfluous gold is carefully brushed off with a piece of silk. The flowers and leaves are then painted in colours, and when dry, the picture and surface of the article is covered with a coat of refined white varnish. For in-

laying, the thin pieces of pearl are cut by the artist into the required shapes by ordinary scissors, or by means of punches or dies worked by the foot of the operator.

In stead of tracing stems and leaves of flowers or other designs direct on the pearls, the surface of the mother-of-pearls can, for simplicity of process, be ornamented by transferring drawing or engravings to it. The process is as follows:—A thin coat of copal varnish is spread upon the surface of the article and when nearly dry, the engraving is applied with its face downward and carefully pressed to exclude all air bubbles. When the varnish is sufficiently dry, the paper is thoroughly moistened with a sponge dipped in warm water, and can be rubbed off, leaving all the lines of the print upon the varnished surface.

Send for it—

RECEIVED
1903-08



That Complete Book of General Letter Writing. Now that Letter-Writing is growing to be the essential requirement of success in all spheres of activity in Society and Business.

You Cannot Neglect to Master the Art.

The 7th. Edition of
Mr. K. M. BANERJEE'S

WIDE WORLD

English

Correspondence

CONTAINS hundreds of actual and Typical Letters, besides a very elaborate and comprehensive general introduction covering the whole art of letter writing and the particular branch of grammar and idiom that relates to it, and special introduction for special branches of letters giving in details the kinds of subject a particular letter should contain and also the kinds it should avoid.

THE CONTENTS COVER:

Commercial and Business Correspondence:—Import, Export, Correspondence with the Customs House, Correspondence relating to small Trades, Merchant Office, Post and Telegraph Office, Courts, Income Tax, Municipality and District Board, Certificates, Newspaper and Public Press; **Family Correspondence:**—Letters of Introduction, Congratulation, Condolence, Friendship, Relationship, Society, Favour, Advice, Excuse, Invitation, House, Money, Notes accompanying Gifts; **School Correspondence;** **General Forms:**—Bill of Exchange, Credit Notes, Bill of Lading, Invoice, Promissory Notes, Bill Form, Contract Form, Agreement, Note of Hand, Form of Will, Forms of Address, Common Abbreviations, Service Rules, Submission of Petition to Government, Post Office Rules, etc., together with a new chapter on every day useful definitions.

Price Re. 1-12, Charges Extra.

INDUSTRY BOOK DEPT.,

KESHUB BHABAN, SHAMBAZAR, CALCUTTA.

GET INTO PROFITABLE MANUFACTURE
READ
INDIAN PERFUMES
ESSENCES & HAIR OILS

**Giving out in elaborate details secrets of Manu-
facture of Natural & Artificial Perfumes,
Indian Essences, Hair Oils & Toilet
Preparations, Etc.**

DIVIDEND INTO FIVE BROAD SECTIONS.

DEALING elaborately with the possibilities of Perfumery Industries, classifications of Perfumes and Perfumery materials, modes of manipulation, principles of manufacture of Floral Oils, Extracts of flowers, Essential Oils, Preparation of Essences, of Ottos, Aromatic waters, Toilet waters, Hair oils, etc., etc.

THE whole subject of toilet and perfumery, Hair Oil, and Scented preparations are treated in every working detail and tried and secret formulas free from all technicalities given by an expert on the subject.

NICELY BOUND IN CLOTH COVER GILT LETTERED.

Price Rs. 2 only, Charges Extra.

**INDUSTRY BOOK DEPT.,
KESHUB BHABAN, SHAMBAZAR, CALCUTTA.**