

this occasion.—Lieut.-Col. Grey proposed a vote of thanks to Mr. Hick for distributing the prizes, and for his sound and practical address.—The Rev. J. S. Birley, who was introduced by the Vicar as one of the founders of the Institution, seconded the motion, and delivered an address on the value of such Institutions.—The Mayor, after a complimentary allusion to Mr. Hick, who was well able to dwell upon the importance of technical education amongst the artisans of this country, expressed his entire sympathy with the remarks of Mr. Birley. The resolution was then put and carried with acclamation. There was a splendid exhibition of works of art and of scientific and mechanical productions on the occasion.

THE GLASS WORKS OF VENICE AND MURANO.

From an early date the city of Venice has been celebrated for its glass. In the 13th century the processes of the Phœnicians, who had long enjoyed the exclusive production of glass (in consequence of the abundance of its principal ingredients, natron, sand, and fuel, on their coasts), seem to have been learnt by the Crusaders, and transferred to Venice and the neighbouring island of Murano, where they were long held secret, and formed a lucrative commercial monopoly.

The old Venetian blown glass was light, bright, vitreous in appearance, stained with the richest possible colours, and fashioned into shapes which varied with the individual taste and skill of the workman; this branch of industry, during the fifteenth and two following centuries, rose to a pitch of excellence which obtained for it a world-wide reputation.

Some of the particular secrets of this beautiful manufacture have been handed down from father to son, and so carefully treasured up, that at this very day, quite as much as in the age of Marco Polo, Venice possesses the absolute monopoly of the art. Lineal descendants of the old Venetian glass manufacturers still inhabit the island of Murano; but the demand for the produce of their ancient handicraft has been so unimportant, that these workmen were driven to seek subsistence by the production of a more common-place material for every day use.

The revival of the ancient art of glass-blowing is due to Dr. Salvati, whose imitations of the old Venetian *soffiati* and execution of new designs are most successful, and have excited universal admiration at the Paris Exhibition. The *soffiati*, or blown glass, produced by Dr. Salvati, equal, and even surpass, the old in lightness, brilliancy, colour, and design. The glass blowers of Murano are now able to produce nearly all the famous kinds of ware so peculiar to Venetian glass, and which were thought to be entirely lost, such as "*filigree*" *flamma*, *retorto*, opal or *girasole*, *avventurina*, *reticello*, frosted or "*crackle*" glass, *morise*, *millefiori*, *acqua marina*, rich ruby colours, *giallo d'oro*, and many other kinds of work, some of which are imitations of the old glass and some new inventions.

It is hardly possible in words alone to convey a correct idea of the manipulations necessary for the formation of a bottle of the simplest form. The tools used are an iron tube about five feet in length, a few instruments like shears, of different sizes, and stamps with a strawberry-shaped die. The workman first dips the end of the tube into the pot of molten glass, twisting it round so as to accumulate a sufficient quantity of glass to make the required bottle, a few turns of the rod, and a breath or two into it, and a hollow ball appears at the end, and the required shape is given to the hollow globe by means of the shear-like instruments, whilst being rotated on the glass maker's chair; a "*pontil*" is then attached opposite to the tube, which is then broken off. After being reheated in the furnace the mouth of the bottle is formed; a boy then brings up on the end of a rod a small portion of ruby, *acqua marina*, or any other colour that may be

required to ornament the bottle. This must be so hot as almost to drop off, and must be ready at the exact moment; he touches with it the neck of the bottle, which is rotated on the chair by the glass blower. In this manner rings and other ornaments are wound round the bottle; these rings are scooped at the same time with the shears by the glass blower. Between these rings little lumps of the same or other coloured glass are then stuck on, and stamped as strawberries with the die. During this operation the bottle has to be introduced several times into the furnace. A vase, not by any means of the most elaborate pattern, required the labour of three pairs of hands during half an hour, in which time it went thirty-five times into the furnace. All this time the glass is drooping and twisting out of shape every time that it is put into the furnace, so that great care is required to retain the form. The finished glass is then put into the annealing oven, where it remains cooling very slowly till the next morning.

The *reticello* is produced by a kind of net-work, consisting of small bubbles of air inclosed within the mass, and arranged in a regular series, crossing and interlacing each other. This ornamental appearance is produced in the following manner:—A tube is made by arranging a number of small glass rods, or *canna*, as they are called, round a centre, so as to form a cylinder, and they are fixed in this position by melted glass. The cylinder is then heated until the rods stick together, and are next drawn out into a long cone, and twisted spirally at the same time; this cone is next inserted into another that has been prepared in a similar manner, but twisted in the contrary direction; the two are then heated until they fuse together. Whenever the little rods cross each other a bubble of air will be enclosed in the diamond shaped space; this occurring in a very regular manner a reticulated appearance is produced.

The "*filigree*" glass is produced in a somewhat similar manner, but by using rods which contain threads of white or other coloured enamel in a body of clear glass; these filigree rods are prepared by placing in a mould alternately small rods of white and coloured enamel; the workman then prepares a solid ball of clear glass, which, being deposited in the mould in contact with the rods at a welding heat, causes them to adhere; this ball is then taken out and rolled on the iron plate, or "*marver*," as it is called, into a uniform mass; the ball is then dipped into the pot of clear glass, and then drawn out to the required length and size. Should a spiral rod be required, the mass is twisted during the drawing process.

The *millefiori* are slices of coloured glass rods embedded in a colourless or differently coloured ground of the same material, and are used chiefly for making paper weights.

The *ritorto*, or twisted patterns of many coloured rods are fused together with clear glass. These beautiful striped patterns are very simply made; for a goblet of ruby and aventurine, for instance, a number of rods of the two colours are laid side by side, alternately, on a sort of shovel, and introduced into the furnace. As they begin to melt and adhere together, the workman, with a piece of half-molten glass at the end of his rod, presses upon the end of the first, and turning round the hollow rod winds them all up, so that they come together into the form of a cylinder, the end of which is fixed to the handle that is to control them during the subsequent operations of blowing.

The celebrated frosted, or "*crackle*" glass, of the Venetians was long considered a lost art; it is made by suddenly plunging the hot glass into cold water, and in this manner fractures are produced of a crystalline character. The glass is then reheated at the furnace, and the heated ball is afterwards expanded by blowing. Although frosted glass appears covered with fractures it is perfectly sonorous.

Venice still possesses the absolute monopoly of the art of bead-making. The manufacture of beads is of the highest antiquity; they are found in the tombs of Thebes, and in the ruined temples of Assyria; in the tombs of Greece

and Rome and even in the burial-places of the ancient Britons we find beads, and these, too, of the particular zig-zag pattern which has always been, and still is, manufactured at Venice, and found over the entire continent of Africa. In the history of the conquest of America these beads played a most important part, and were used by the Spaniards to trade with the natives. At the present time great impetus has been given to the bead-trade on account of the prevailing fashion of black beads, for which there is a great demand.

The bead manufacture, or *conteria*, may be divided into two distinct branches, the first the ordinary bead, or *margaritine*, and the other, *Perle alla Lucerna*, which are a finer, and, consequently, more expensive bead.

The manufacture of *margaritine* is also divided into two sections, the first of common glass beads, *canna di vetro*, and the second *canna di smalti*, or enamel beads. The manufacture of these last differs but slightly from the other, but the "paste" is of a finer quality and more costly.

The furnaces are built of a fire clay, found at Cerone, in the Friuli; these furnaces last about two years, 44 weeks being a year's work. The materials are vitrified in pots (*padelluti*) made of pure refractory clay, and for the manufacture of beads are usually four to five in number, each capable of containing about 1,300lbs. of "paste." The furnaces for the finer quality of enamel beads are constructed in a different manner from those for *canna di vetro*. The pots are separated from each other by divisions in the furnace, so that the heat can be regulated according to the colour and quality of the paste.

The principal ingredients used in the manufacture of glass beads are Pola sand, Catania soda, natron (a native sesqui-carbonate of soda, found deposited on the sides of several lakes to the west of the Delta of Egypt), antimony, arsenic, manganese, minium, nitre, etc.

The materials used for the production of enamel beads are far too numerous to be enumerated here; almost every product of the mineral kingdom might be mentioned; amongst others, gold and silver, of which considerable quantities are used. The Venetians are still in possession of the best enamel processes, and they supply the French and other nations with the best kinds of enamels of every possible coloured shade.

The raw materials are first calcined in a reverberatory furnace for about ten or twelve hours, where they are kept at a red heat. Whenever the pots are worked out in the glass furnace, the "frit" is immediately transferred into them from the reverberatories in an ignited state; the glass requires from twelve to seventeen hours, according to its quality, to be melted down.

The drawing out of the glass into tubes, or *canna*, is performed by "shifts" (*muda*) of six hours each. Each shift is composed of the gatherer, or *maestro scagnor*, who dips the end of an iron rod into the pot of melted "metal," and gathering up the requisite quantity of glass by turning the rod round and round. He then hands it over to the two assistants, or *pastonieri*, who roll the plastic lumps of glass on the iron plate, or "marver" until it assumes a cylindrical form about $4\frac{1}{2}$ inches in diameter, according to the quality of bead that is intended to be made; a circular hole is next made with an iron tool (*borsella*) in the direction of the axis of the cylinder, and the other assistant applies the end of a solid iron rod, tipped with melted glass, called a "punto," and thus attaches it to the opposite end of the cylinder; the two rods are then handed over to the *tiratori*, or drawers, who draw the cylinder out into a small tube, in a gallery adjoining the glass house; these galleries are usually about 300 feet in length. At the end of the "shift" these tubes are cut into lengths of about three feet, and packed into boxes, so as to be passed off to the manufactory, where they are reduced into beads. This is quite a separate business, although sometimes carried on in the same establishment as the first. During the last few months, on account of the extraordinary demand and high prices for black beads, most of the glass houses of

Murano and Venice have turned their attention to the production of these glass tubes, or *canna*, for bead manufacturers.

For the production of coloured or enamel beads greater care is necessary, as the materials of which they are composed are costly, especially the imitations of coral, cornelian, ruby, opal, agate, mother-of-pearl, &c.; some of these, as the cornelian, are composed of two qualities of paste, the first opaque, forming the core, and the second transparent, of another colour. The tubes, or *canna*, of which the ingredients contain oxide of gold or silver, do not present their true colour until they have undergone a second action of the fire in the process of reduction into beads. Prismatic tubes are also drawn, and are used for different shaped beads.

Besides the production of an infinity of shades of enamels, or *smalti*, as they are called, Murano still preserves the secrets of producing imitations of precious stones of the most dazzling brilliancy, sapphires, rubies, emeralds, topazes, opals, lapis-lazuli, malachite, and *avventurina*, which is exclusively the speciality of Venice and Murano. The inventor of this most beautiful material was the celebrated Miotti in the 13th century, who discovered it by accident, whilst engaged in the preparation of a certain enamel for mosaic, the name *avventurina* was given to it from *avventura*, which signifies chance. According to the most eminent chemists, *avventurina* owes its rich golden iridescence to a crystalline separation of metallic copper from the mass coloured brown by the peroxide of iron.

The following is an analysis of the *avventurina* of the present celebrated manufacturer, the Cav. Pietro Bigaglia, of Venice:—

Silicic acid	67.3
Lime	9.0
Protoxide of iron	3.4
Binoxide of tin	2.3
Protoxide of lead	1.0
Metallic copper	4.0
Potash	5.3
Soda	7.0

Almost infinite are the uses to which it can be applied in jewellery and ornamentation. The glass-blowers of Murano are enabled to remelt and introduce it as a decoration to their celebrated glass wares.

The reduction of the glass tubes or *canna* into beads, consist of the following operations:—1st. The sorting of the tubes, according to size, as it is impossible in drawing that they should be all equal. This is done by women (*cernitricie*), who acquire by practice a marvellous dexterity at this work. The sorted tubes are next passed over to the *tagliatori*, who chop them into small pieces of uniform lengths, on the upright edge of a fixed chisel. The next operation is the dividing of the bits of tube from the broken pieces by sifting. The next process is to round off the angular ends of these cylinders, and for this purpose they have to undergo a second action of the fire. The workmen employed for this purpose are called *tubanti*, from the tubes used by them for reducing the little bits of glass into beads. This tube is made either of copper, brass, or iron, and is fixed at the end of an iron rod. Before being put into the tube, these little pieces of glass are put into a mixture of lime and powdered ashes, moistened with a little water, and are stirred about until their cavities are filled up. This is necessary to prevent the bore of the bead being partially or wholly closed whilst undergoing the action of the fire. A certain quantity of the little bits of glass are put into the tube with a proportion of sand and powdered ashes, according to the quality of the beads, to prevent their sticking together. The tube is then introduced into the furnace, the heat of which can be regulated as required, and the workman continues turning it round until the cylindrical bits of glass assume a smooth rounded form. The beads are then allowed to cool slowly and afterwards taken out of the

tube and separated by sifting from the sand and ashes. The beads are then sorted according to their various sizes by sifting, and the perfect are separated from the imperfect by being turned out on to a slightly inclined table. Those of a perfectly globular form roll off into a box placed below, whilst the imperfect, badly-shaped ones remain on the table. The workmen employed for this purpose are called *governadori*. The beads are next polished in a very simple manner by the *lustradore*, or polisher, who shakes a certain quantity of them in a bag with a little bran. The finished beads are finally threaded on strings, and tied up in bundles of dozens, grosses, &c. This is chiefly done by women and girls (*infilatrici*).

The art of bead-making at the lamp, "*Perle alla Lucerna*," is, as we have said before, quite a separate business. In working at the lamp, tubes and rods of glass and enamel are used. It is impossible to describe all the manipulations of this ingenious art, over which the taste and dexterity of the artist so entirely preside. But we may give an example: a black bead, decorated with roses, forget-me-nots, and leaves of aventurine. The artist first takes a rod of black glass, and melting it in the blow-pipe flame of the lamp, twists it about an iron wire until he has made a small ball of the required size, rolling it on a kind of iron mould with a circular groove, and smoothing it with an iron tool until it has acquired a perfectly spherical shape. He then takes a small rod of aventurine, and softening it in the flame, traces on the black glass ball leaves of any other pattern that may be required, and smooths it again with the iron tool. He next traces with a small rod of rose-coloured enamel the roses on the ball, smoothing it as before with the smoothing tool. The forget-me-nots are next traced on the bead with a small rod of blue and white enamel, that has been previously twisted together spirally in the flame, and drawn out to about the diameter of a shawl pin. The bead thus completed is taken off the wire, and left to cool in a box filled with sand.

An endless variety of beads are made in this manner of every possible colour. Gold and silver beads are made by rolling a bead made of common glass, whilst still hot, on a leaf of gold or silver; some of these are ornamented with little points of crystal, ruby, turquoise, &c. Artificial eyes for stuffed birds, animals, and even for human beings, are also made at the lamp. Spun glass of every tint is also made, and is used for making feathers and flowers of most surprising lightness, baskets, mats, trays, and even ladies' hats.

Mosaics also constitute a most important branch of manufacture at Venice, and may be divided into two distinct classes. The first, inlaid, or *marqueterie* mosaic, which is produced by all the enamel pieces having their edges perfectly close and adherent one to another; such kind of mosaic is generally used for the production of personal ornaments, such as brooches, earrings, bracelets, &c., or objects of household decoration, such as table tops, and other furniture. The Venetian differ from the Florentine and Roman mosaics, being chiefly of complicated geometrical patterns, of extremely showy colours, in enamels, aventurine, artificial agate, chalcedony, lapis lazuli, &c., instead of being made up of stones, as in the Florentine; or like the Roman mosaics, which are manufactured of very thin pieces of enamels of numberless colours, rubbed and polished, and represent landscapes, fruit, flowers, views, animals, &c.

The other kind of mosaic is made by using stone or enamel pieces, cut into shapes which are not quite regular or geometrical. These pieces are then put together more or less near to each other, so that between them the joints are seen, and the work does not in this case appear smooth, but rough. This style of mosaic is known as the Monumental, or Byzantine. This is most fitted and generally adopted for the purpose of architectural decoration, both for the interior and exterior of buildings.

Venice, in nearly all ages, seems to have been the

home of mosaic, and here the walls of the fine basilica of St. Mark's have been during many ages covered with masterpieces of mosaic decoration.

In England fine specimens of modern Venetian mosaics may be seen at the South Kensington Museum, and St. Paul's Cathedral, London. The whole vaulted roof of Cardinal Wolsey's Chapel, at Windsor, representing the kings and queens of England, is now being decorated in mosaic, a great part of which is already fixed, and Dr. Salviati is now executing mosaics for the National Memorial to the late Prince Consort, now in course of erection in Hyde-park.

Enamels are much more permanent than any other substance that has been used in the composition of mosaic, whether stone, marble, or clay, on account of their less porous and less dilatable body.

With regard to the gold and silver enamels, which are used with such effect in monumental mosaics, great improvement has been made of late years in their production. On a ground of thick glass, or enamel, according as it is desired to render the gold enamel transparent or opaque, or to impart to it a warm or variegated colour, there is laid a leaf of gold or silver, to which it is attached principally by the action of the fire; then a film of the purest glass is spread over it; this film may be perfectly colourless, or of any tint that may be required. When well manufactured, these three layers, after being fired, become perfectly united to each other, and form a homogeneous body. If this operation be perfectly successful, the metal will be for ever protected against all possibility of injury, either by atmospheric action, dust, gas, smoke, or insects, and in such a manner as not to lose any of its brilliancy or colour, even after many centuries of exposure. When this delicate film of glass possesses the requisite thinness, fineness, and purity, and the whole surface of the sheet exhibits no inequality of thickness, the metal appears in all its native beauty, and the glass with which it is covered is scarcely discernible.

The manufacture of mirrors and chandeliers also forms an important branch of industry. These mirrors are usually decorated with figures, leaves, &c., of most original design, engraved at the back, and are afterwards silvered. The frames of these mirrors are decorated with leaves and flowers in white or coloured glass. These mirrors have obtained a great success at the Paris Exhibition, and are being sent in large quantities to Paris and London.

THE AIR IN RAILWAY TUNNELS.

The following report of an examination of the air in the tunnels of the Metropolitan Railway was read at the inquest upon the body of Elizabeth Stainsby, whose death was alleged to have been caused or accelerated through the foulness of the air in the tunnels of the underground railway. The evidence had shown that the deceased was suffering from disease of heart at the time of her death:—

London, October 23rd, 1867.

Having received instructions from the directors of the Metropolitan Railway Company, through Messrs. Burchell, their solicitors, by letter addressed to Dr. Bachhoffner, to examine and report on the state of the atmosphere in the different tunnels on their line, and on the sanitary condition generally of the stations and tunnels, we beg to present the following as the result of our investigations:—

We proceeded in the first instance to obtain samples of the air in the tunnels, and we collected them on three separate occasions, namely, first, immediately after the trains had ceased running at night; secondly, just before they commenced running in the morning; and, thirdly, in the afternoon between four and five o'clock, the period of the day when there is generally the greatest amount of traffic.