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A DICTIONARY

OF

Mechanical Engineering and the Mechanical Arts,

ILLUSTRATED WITH

NEARLY FIVE THOUSAND ENGRAVINGS.

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tubes are drawn out 150 feet in length, and to the diameter of a goose-quill, those for the smallest beads by the workmen receding from each other at a pretty rapid trot. The tubes are cut into lengths of about 27 inches and assorted for size and color. Women or boys then take several together in the left hand, and run them on the face of an anvil up to a certain measure, and with a blunt steel edge break off the ends all of the same length, which is commonly about twice the diameter of the tubes; the bits fall into a box. These are next worked about in a meistened mixture of wood-ashes and sand, with which the cylindrical pieces become filled; and they are then introduced with more sand into a hollow cylindrical vessel, which is placed in a furnace and made to revolve. The glass softens, but the paste within the bits prevents their sides from being compressed; they become spherical, and their edges are smoothed and polished by the friction. When taken from the fire and cleaned from the sand, they are ready to be put up for the market.

The Venetian *filigree glass*, which consists of spirally-twisted white and colored enamel glasses cased in transparent glass, is much used for the stems of wine-glasses, goblets, etc.; and when arranged side by side in alternate colors, it is manufactured into tazzas, vases, and other ornamental

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articles. In making this kind of glass, pieces of plain, colored, or opaque white cane, of uniform length, are arranged on end, the different colors alternating, around the interior of a cylindrical mould (Fig. 2182). The selection and arrangement of colors depend upon the taste of the manufacturer. The mould and the pieces having been subjected to a moderate heat, a solid ball of transparent flint-glass, attached to the end of a blow-pipe or punty, is placed within the mould, the various canes forming an external coating to the glass, to which they become welded. The ball is now

taken from the mould, reheated, and marvered till the adhering canes are rolled into one uniform mass. This being covered with a gathering of clear glass, the lumps thus formed, with the ornamental work in the interior, may be drawn into canes of any size, and presenting either the natural or the spiral arrangement, the latter being effected by the workmen rotating the glass in opposite directions while drawing it out into a cane. By variously arranging the colors in this process, and by skillful manipulations, many wonderful and ingenious effects are produced. Beautiful vases are also made by the above process, the glass when prepared being blown into that form instead of being drawn into canes. The *mille-fori* consists of a variety of ends of variously-colored tubes, cut in the form of lozenges,



which, having been arranged to represent flowers or other ornamental design, are enveloped and massed together with transparent glass. The lump is then worked into the required form, a very common one being hemispherical for use as paper weights. Portraits and even watches and barometers have been represented in the interior of glass; but in this case these articles and the glass have not formed a homogeneous mass, the former being arranged in a cavity of the latter.

Mosaic glass is produced by arranging vertically side by side threads or small canes of variouslycolored opaque or transparent glass, of uniform lengths, so that the ends shall form a ground representing flowers, arabesques, or any mosaic design. This mass is now submitted to a heat sufficient to fuse the whole, all the sides at the same time being pressed together so as to exclude the air from the interstices of the threads. The result is a homogeneous solid cane or cylinder, which, being cut at right angles or laterally, yields a number of layers or copies of the same uniform design. This process was practised with great skill by the ancients, who are supposed to have produced pictures in this way; but in existing specimens, the pieces have been so accurately united, by intense heat or otherwise, that the junctures cannot even be discovered by a powerful magnifying glass.

Vitro di trino represents fine lace-work with intersecting lines of white enamel or transparent glass, forming a scries of diamond-shaped sections, each containing an air-bubble of uniform size. In making this, a lump of glass is blown in a mould, around the inner sides of which are arranged pieces of canes of the required colors, as described in the case of filigree glass, which, adhering to the glass, form ribs or flutes on its external surface. The lump, having been twisted to give the spiral arrangement to the adhering canes, is formed into a conical shape and opened at the base. This forms the inner case of the vitro di trino. A corresponding outer case is formed in the same manner, which being turned inside out, the projecting canes appear on the inside of the cup with a reversed spiral arrangement. One case is now placed within the other, and both being reheated are collapsed together, forming uniform air-bubbles between each white enamel-crossed section. The two cases, thus welded into one, may be formed into the bowl of a wine glass or other vessel.

Frosted glass, like the preceding, is one of the few specimens of Venetian work not made by the ancients; and although the process of making it is exceedingly simple, it was considered a lost art until recently practised at the Falcon Glass Works in England. The appearance of irregularlyveined, marble-like projecting dislocations, with intervening fissures, is produced by immersing the hot glass in cold water, quickly withdrawing it, reheating the ball of glass, and simultaneously expanding it by blowing.

Canco incrustation is also of modern origin, having been first introduced by the Bohemians The figure intended for incrustation must be made of materials requiring a higher degree of heat for their fusion than the glass to be used. The figure, having been heated, is introduced into a cylindrical-shaped piece of glass, attached at one end to a blow-pipe and open at the other. The open end is then closed, leaving the figure in the interior of the hollow pocket. The air is now exhausted through the hollow tube, which produces a collapse and causes the glass and figure to form into a homogeneous mass. In making "paper weights," thin sections of little ornamented rods are placed in a circular iron mould or bed, in the form of the required design. A workman presses a piece of hot glass on the end of a punty into the mould and takes up the design. Then another workman drops a piece of hot glass on the opposite side of the design. The whole is now taken to the furnance, where the parts are welded into a hemispherical form, which magnifies the interior design and presents a fine picture inclosed within the transparent setting.

In making *spun glass*, the workman heats one end of a tube of glass, white or colored, by the flame of a lamp, and, seizing the softened end with a pair of pincers, draws out a long thread. Owing to the extreme ductility of glass, these threads can be drawn to an extraordinary fineness and length. In some cases spun glass has been made to imitate the hair of animals.

Crackle-glass (verre craquelé) is clear glass covered with an opaque layer of powdered or broken glass, producing a rough surface. This kind of glass is largely made in Bohemia. The broken glass is spread upon an iron plate, and the object to which it is to adhere is, while yet pasty, rolled upon the fragments. The ordinary blowing process follows.