nary still, and is composed of three concentric rings, which augment the condensation of the vapors, and which also prevents a large portion of the odorous principles passing over with the alcohol.

M. Deroy (fils ainè) has constructed several forms of apparatus for distilling rum more perfectly than the simple still just described. This apparatus (Fig. 20) is composed of three pieces—the still, which has a large base; the head, with the "elephant's trunk;" and the worm, which is placed in a tub or in a stone tank. The heater is filled to about three-quarters of its capacity with the material to be distilled; the joints of the head are luted on. The worm is cooled by cold water and the heating is commenced. The distillation is conducted slowly, so as to carry away the aqueous vapors with the alcoholic. The heating terminated, the still is emptied by the cock, leaving only a little liquid at the bottom. M. Deroy has also devised two
40 THE MANUFACTURE OF other varieties of stills, one with a wine heater and the other with a wine heater and an apparatus for rectifying.

SECTION IV.—BRANDY FROM GRAIN.

(Les Eau-de-vie de Grains.)

In Belgium, Holland and England a brandy is prepared from grain which is known as gin or whisky. The first is made of a mixture of malt and ungerminated wheat; the second, the favorite liquor of the Scotch and the Irish, is obtained from a mixture of malt, rye and oats, or from corn. The distillation of the must is conducted in the manner already described, either with crude appliances or the most perfect apparatus that can be devised. The juniper or juniper brandy is prepared by throwing into the must a certain quantity of juniper berries. It appears that it is not possible to stop the use of these berries in preparing the liquor so dear to the inhabitants of the North.

SECTION V.—THE NATURAL BRANDIES.

A list or table is given below of all the natural liquors that are produced in various parts of the world, with their origin and the principal place of consumption. [Our author's term eau-de-vie or brandy is very comprehensive, whisky and gin, for instance, being classed with the brandies.—Ed.]

Brandy, properly so called:
Wine. — France.
Brandy from lees or potatoes:
Glucose. — Northern Europe.
Brandy from beets:
Juice, pulp or molasses from beets. — Northern Europe.
Brandy from rice:
Saccharified rice. — Different countries.
Brandy from grains:
Beers, saccharine grains. — All parts of the world.
Juniper:
Schiedam:
Saccharine grains, fermented, perfumed by juniper berries. — Holland.

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Goldwasser:
Brandy from grains, more or less perfumed. — Dantzig.
Whisky:
Rye, oats, corn. — Scotland, Ireland, United States.
Kirschenwasser or kirsch:
Fermented cherries. — France, Germany, Switzerland.
Maraschino:
Cherries, fermented. — Zara.
Zwetschenwasser:
Plums (coulis de prune), fermented. — France, Germany, Hungary.
Raki:
Plums. — Hungary.
Rakia:
Mare of grapes, perfumed. — Dalmatia.
Azaka, Arza, Arka, or Arika:
Mare's milk, fermented. — Tartary.
Taña:
From molasses. — Antilles.
Rack or Arrack:
Must of cane sugar. — Hindostan.
Rum:
Must of cane sugar, molasses. — Antilles.
Aqua-ardiente or Pulque Fuerte:
Juice of the Agave. — Mexico and South America.
M. De Brevans names twenty-five additional ones, but they are of little importance, being mostly Asiatic drinks of the Chinese.

SECTION VI.—ARTIFICIAL BRANDIES.

The production of true brandy having decreased and the demand increased is clear proof that a large part of the modern brandies are simply a mixture of alcohol with various substances calculated to give the taste of true brandy. Various receipts are given, but the base of the adulterated article is a mixture of cachou (cashoo, a kind of resin), vanilla, green walnut shells, balsam of tolu, orris, essence of bitter almonds, rum and old kirsch, sirup of grapes, sassafras, broom plant, maidenhair, licorice, etc. In order to obtain artificially the effect of age, it is necessary to make an infusion of oak shavings. This is used in connection with molasses or caramel for coloring matters.
THE MANUFACTURE OF LIQUORS AND PRESERVES.

FIG. 24.—COPPER BASIN.

FIG. 25.—OSCILLATING BASIN FOR STEAM.

FIG. 26.—COPPER BASIN WITH DOUBLE BOTTOM, VALVES, PIPES, ETC.

FIG. 27.—FIXED BASIN FOR STEAM.
heated by an open fire (Figs. 24, 25, 26, 27), skimmers, spatulas, an assortment of alcoholometers and hydrometers, mortars, balances, etc.

The filtration of raw materials and the finished products requires the use of bone black filters. Fig. 28 represents one of the large tinned funnels terminated in a cock. The distiller must have at his disposal a series of siphons of different sizes in glass or metal. Fig. 29 represents a siphon of large size, and it is very convenient for transferring alcohol. The reservoirs or holders of raw materials and finished products are made of tinned copper (Fig. 30). A scale placed on the outside and a gauge glass determine the amount of

Fig. 28—Filter Holder.

Fig. 29—Bellows and Compressed Air System for Moving Liquids.

the liquid inside. A perfect holder and distributor is illustrated in the Scientific American Supplement, No. 516.
In the useful arts the name spirits is given to alcohols which mark 70° on the alcoholometer of Gay-Lussac, the only legal standard recognized in France since the law of July 8, 1881, rendered effective by the decree of December 27, 1884. In commercial language, the different spirits are known under the names 2, 3, 4, which are derived from an old method of estimating the strength of alcohol relating to brandy, called "preuve de Hollande," marking 19° Cartier, which included about 50 per cent. of the volume of absolute alcohol. As we have already seen, spirits are produced from the distillation of wine, beets, molasses, grain, and potatoes. The distiller, or rather liquuriste, requires to make at least, if not absolutely, neutral spirits of good taste, because it is evident that if the spirits (alcohol) used have a pronounced taste, it will materially affect the product.

The principal kinds of alcohol used in France are named as follows: 4° commercial = 85° G.-L.

The 4° Languedoc.—Alcohol distilled from wine, strength 85°, very scarce at the present day. Used principally in making cognacs.

The 3° Neutral, or Extra Fine.—Alcohol obtained by the rectification of alcohol, particularly from rice. It is of a strength equal to 90° to 95°.

The 4° Fine of the North.—Alcohol from beets, rectified. It nearly always has a taste of the beet root. The spirits obtained by treating molasses are preferable. This alcohol is generally sold at 90°.

SECTION II.—ESSENCES.

Essences, or essential oils, have an oily look, generally very volatile, and are produced from a large number of substances in the vegetable kingdom, producing the odor of the plant. Their chemical composition is very complex. All odorous materials are generally very volatile, but at different temperatures. Their vapor tension is considerable, which explains the diffusion of the odor of flowers, as well as aromatic plants, to great distances. The essences are very volatile, as already stated, and are in the liquid form at ordinary temperatures, except in rare cases. The greater part are uncolored, but some are colored yellow, brown, green, and even blue, all are soluble in alcohol, ether, chloroform, and light hydrocarbons; but, to speak properly, they are not dissolved in water, they are diffused only—that is to say, distilled waters owe their perfume only to minute drops of the essence, which are held in suspension, but it is not a perfectly homogeneous mixture, as the mixture of sugar and water.

Light has a certain action on essence. The air, by its oxygen, produces a great change, more or less rapid.
producing a difference in the odor and a gradual resinification. The essences have variable specific gravities, some being lighter and some heavier than water. These points are very valuable when testing for adulterating materials.

**Extraction of Essences.**—The manufacture of essences is an industry of warm countries, and is extensively carried on at Grasse, Nice, and Cannes. Certain plants, such as the mint, are largely cultivated in the regions of the north. The industry of perfume making is, as is well known, of great antiquity, and the process has remained almost unchanged until the present day. The processes of extraction are expression, distillation, maceration, and enfleurage.

Expression is a simple process, but it is rarely used, as it can only be profitably employed when the plant is rich in volatile oils. The skins of oranges and citrons are examples. The parts rich in essences are placed under the press, and the oils are extracted mechanically (Fig. 31). The mixture collects a good deal of water, but by reposing, the essences separate and are removed by decantation (Fig. 33). In expression a piece of apparatus for removing the skin of fruit (Fig. 33) is sometimes used. It is called in French a zestreuse. The petals actuate two graters, which remove the skin in a short space of time.

Distillation is of ancient origin, and the apparatus used in the manufacture of essential oils is often very crude, and only recently has the naked fire given place to steam as a source of heat. The products of distillation are usually received in flasks (Fig. 33), called Florentine receivers, which permit of the separation of the essential oil from the water. The watery portion contains a certain proportion of essence which cannot be removed; but this water can itself be used for a perfume. It is in this manner that rose water, orange flower water and others can be prepared. The delicate plants are treated as follows: The interior of the still is divided by a diaphragm pierced with holes, on which the plants are placed, this being submitted only to the action of the vapor which rises from below. The products are received as before. Distillation cannot be used for many plants, as the essential oil would be decomposed by a temperature of at least 100°C.
Maceration is applied to those substances which cannot stand a high temperature without being decomposed. This operation is performed by plunging the plants or flowers in a bath of old or fine fat, treated gently on a water bath. The fatty materials receive the essence and a perfumed oil or pomade is the result, and the essence can be extracted from this by means of alcohol. Paraffine is largely used at the present day. Rectangular frames with glass bottoms are used, the size being about 0.97 m. long by 0.64 m. wide. The fat is laid on the glass to a thickness of 0.0067 m., the flowers are thrown on this and they are allowed to remain from 12 to 72 hours, the flowers being changed as often as necessary. If the oil is used, the plates of glass are replaced by coarse linen saturated with oil. When the operation of absorbing the odor of the flowers by the oil is finished, the oil is obtained by pressure. To shorten this long operation M. Piver has invented the following apparatus. A square closet 2 by 3 meters in size is divided longitudinally into two parts, communicating with each other. Wire cloth screens receive the fat. Between each screen a thin sheet of glass or tinned copper is secured at one side only. This receives the flowers. The fat which is placed on the wire gauze is converted into thin, vermicelli-like threads. The flowers are placed upon the tinned copper plates and the closet is closed. Two pairs of bellows, one on each half, keep up a current of air. By this method the fat absorbs the perfume from the air with great rapidity, thereby obviating the danger of the fat becoming rancid. For several years past, the two methods of procedure just given have been displaced by a process which permits of relieving the plants of their odors in a very short time. The solvents are chloroform, sulphide of carbon, petroleum ethers, methyl chloride, etc. This invention is due to M. Millon and has since been perfected by MM. Piver and Naudin. The process comprises three operations: 1. The dissolving process; 2. distillation at a low temperature; 3. the evaporation of the last traces of the solvent. Fig. 34 represents the apparatus. The odorous parts of plants or flowers are introduced into a digester, A, being inclosed in a wire basket, E. A vacuum is obtained by means of a pump, D, and by means of this vacuum a known quantity of the solvent is brought up from R, by the tube mm'. After having