cooked it has the consistency of a thick soup and all of its starch is quickly accessible to the diastatic action of the malt.

Mashing.—The mash is then pumped to the mash tun and water, or liquor from the spent slop tank if a sour mash is desired, is introduced in sufficient quantity to make the ratio of the total mash 40 gallons of liquid per bushel of grain and the batch is agitated while the mashing operation proceeds under temperatures and conditions approximately equivalent to those previously described under “mashing processes.”

Fermentation.—At the conclusion of the mashing operation the whole contents of the tun are pumped, usually to an inclosed cooler. In this type of cooler the mash is forced through a double pipe system and is cooled by a counter current of water down to 70° to 80° F. This is a radical departure from Scotch and Irish practice in which only the wort is used for fermentation. A small portion of the mash is bypassed to an auxiliary mash tank which forms part of the yeast propagating system. The main mash is pumped from the coolers to the fermentation tanks and a certain amount of yeast is added from the yeast growing system. Fermentation soon commences and the temperature is controlled by means of cooling coils. It will be observed from the diagrams that the heating and cooling operations are effected by means of coils within the tanks. After completion of the fermentation the “beer” is pumped to the “beer well,” a tank which is fitted with an agitating device thoroughly to stir the beer and prevent any settling.

Distillation.—At this stage of the process there are several interesting variations from Scotch and Irish methods of distillation. Note, on the diagrams, that by means of a bypass system the beer well may be connected to either the whiskey or spirit stills; these are both termed beer columns, although they are really distinct kinds of stills.

Various economies and several different methods of operations are effected by the aid of an elaborate piping system. Both the whiskey and the spirit stills are equipped with heat exchanging apparatus so that the still vapors passing through the heat ex-
changers give up their latent heat to the beer as it is pumped through the apparatus on its way to the stills. In other words, pre-heating of the beer is effected by means of the latent heat of the still vapors.

The whiskey still consists of a column equipped in the head with two rectifying plates and one washing plate. In this very efficient arrangement ascending alcoholic vapors are rectified so that their alcoholic content is increased from approximately 6 per cent to 72 per cent. This effects in one continuous operation, and more efficiently, the same doubling of concentration achieved by the European pot still equipped with a doubler as shown in Figure 15 in Chapter VIII. The rectified vapors then pass through the heat exchanger and then into the condensing system. As they emerge from the condensing system they are tested for strength and content of secondary products.

Another advance over European practice at this point is the fact that by means of the control system it is possible either to pass the condensates back to the column for reflux purposes or to withdraw them to a test box. By these means, a whiskey of almost any desired secondary product content can be produced at the will of the distiller, depending on the rate of reflux employed. The distillate when diluted with distilled water to about 100 proof (50% by volume) is ready to barrel as whiskey.

The spirit still is a typical continuous alcohol rectifying still equipped with heat exchanging device for pre-heating the beer fed from the beer well and with various rectifying units for removing both lower and higher boiling impurities, especially aldehydes and higher alcohols. By means of control and concentration devices a practically pure, 96 per cent spirit can be produced.

These spirit units recover more than 98 per cent of all the alcohol present in the beer and produce 90 per cent of this alcohol as high grade U. S. P. spirits and the remainder as heads and a washed fusel oil. Such a unit will use about 40 pounds of steam per gallon of alcohol produced. The largest of these units now in use produces 18,000 gallons of spirits per day of 24 hours.

Figure 31 shows a mash recovery system. Here the spent
still liquor, or slop, is received, agitated, and passed over a screen to filter out the solids. The solids are fed to a press to squeeze out residual moisture. The liquor is discharged to the spent slop tank, while the damp solids are then fed to a rotary drier of standard design, which drives off any remaining moisture. A blower delivers the dried solids to a receiver fitted with a hopper which feeds the material to a packaging device. Recovery of solids is approximately 12 to 15 pounds per bushel.

Unless legislation or peculiar local conditions require total evaporation the thin slop is discharged to the sewer or part is returned if process calls for “slopping back.”

_Aging._—Whiskey as first produced by any of the processes described is raw and unpleasant to the taste and disagreeable in odor. It has been known for very many years that by storage for a period of time, changes in the odor and taste are produced which result finally in the ripe smoothness of taste and pleasant odor associated with good whiskey. Despite much work the whole chemical nature of these changes is still incompletely known. As the late William Howard Taft concluded from an investigation made during his presidency: “It was supposed for a long time that by the aging of straight whiskey in the charred wood a chemical change took place which rid the liquor of fusel oil and this destroyed the unpleasant taste and odor. It now appears by chemical analysis that this is untrue—that the effect of the aging is only to dissipate the odor and modify the raw, unpleasant flavor, but to leave the fusel oil still in the straight whiskey.”

Actually, comparative analysis of old and new whiskey shows a somewhat greater content of secondary constituents in the old matured whiskies, especially in the relative amounts of volatile acids and aldehydes. The esters also increase, but to a lesser extent, while the furfural and higher alcohol contents remain practically unaltered. Of course, whiskey stored in wooden barrels increases in proof due to a relatively more rapid diffusion of water through the pores of the wood. In obtaining the analytical results noted above, this change is compensated by
calculation to a uniform base alcoholic strength. The solids content and color of the whiskey increase markedly on aging due to the extraction of tannin, resins and other materials from the wood. The density of color is directly proportional to the solids content in an aged whiskey.

Aging practices differ somewhat. British custom is to store the whiskey in uncharred oak barrels while American whiskies, both Rye and Bourbon, are stored in charred barrels. The color and solids of whiskey aged in uncharred packages are much smaller in amount and more water soluble than those of whiskey stored in charred packages. The charring also results in a "bead" of oilier consistency and greater permanence than the uncharred barrel imparts.

Rye whiskies are stored in heated warehouses, while Bourbons are matured in unheated buildings. As a result the former are stronger in color than the latter. In general, whiskey does not improve at all after about ten years of storage, although there still continue slight changes in composition; nor is there any very marked improvement in desirable character after the first four to six years of storage. The high price of very old whiskies is largely to compensate for evaporation losses which become very marked, and the carrying charges on investment tied up for long terms of years. Storing has its limitations. A fifteen year old whiskey may be a bad whiskey because, as President Taft pointed out, its fusel oil content has increased too much. There are whiskies only two years old far better in flavor than hoary distillates that have been kept in barrels for two decades.

Artificial Aging.—The chemist distinguishes between aging and maturation; that is, between the mere passage of time and the effects thereby produced. If the latter can be duplicated within a short period, the results, from the chemist's and from an economic point of view are much preferable. Hence much study has been given to the subject of the artificial aging of spirits. Many of the more scientific suggestions are admirably summarized by Snell and Fain in an article which appeared in Ind. & Eng. Chem. News Ed. XII, 7, p. 120. They state:
The Legalization of Traffic in spirituous liquors in this country has created a situation which puts a premium on naturally aged alcoholic beverages. To satisfy the demand for liquor at a popular price, the available stocks on hand have to be increased either by blending or accelerated aging.

During the aging process the constituents of alcoholic spirits undergo chemical change. A study of the changes taking place in whisky stored in wood over a period of eight years revealed (5) important relations between the acid, ester, color, and solid contents of a properly aged whisky which will differentiate it from artificial mixtures and from young spirits. High color, high solid content, and high alcohol concentration are generally accompanied by high acid and ester content; low color and solid content go with a small amount of acids and esters. In the aging process the acids are at first formed more rapidly than the esters. Later the esters form more rapidly so that by the end of the fourth year they are present in the same amounts. The equilibrium reached at this period is maintained. The amounts of higher alcohols increase in the matured whisky only in proportion to the alcohol concentration. The oily appearance of a matured whisky is due to material extracted from the charred container; this appearance is almost lacking in whiskies aged in uncharred wood. The improvement in flavor of whiskies in charred containers after the fourth year is due largely to concentration. The higher content of solids, acids, esters, etc., of rye over Bourbon whiskies is explained by the fact that heated warehouses were used for maturing rye whiskies and unheated warehouses for maturing Bourbon.

The aging of brandy, similar to that of whisky, takes place in oak casks. The conjoint action of the oxygen of the atmosphere and the resins, gums, and tannins extracted from the wood are responsible for the improvement of the liquor. These compounds, being capable of easy oxidation, pass through a series of reactions. Aromatic compounds particularly agreeable in taste and odor are formed.

Aging of spirits involves oxidation. It is this reaction which one attempts to hasten by the processes devised for accelerated aging. Methods for aging spirits artificially fall into four main classes as follows: (1) treatment with air, oxygen, or ozone; (2) exposure to actinic rays; (3) electrolytic treatment; and (4) use of catalysts. Combinations of these methods are likewise employed.

Treatment with Gaseous Oxidants

A recent example of the first type provides for treatment (17) of the liquor with oxygen while exposed on large wooden surfaces which have
been impregnated with a solution obtained by extracting seaweed ash. Brandy (28) is artificially aged by bringing it into contact with activated charcoal which may first be treated with a current of air or oxygen. Oxidation may be accelerated by the use of compressed air (6). The liquid to be treated is run into a tank which can stand a pressure of several atmospheres. Compressed air enters from the bottom of the tank. The length of time required for treating by this process depends mainly on the pressure of the air, the nature of the liquid, and the extent of aging desired. In a special apparatus (21) for this purpose, the liquid is sprayed or atomized in a chamber containing air under pressure by delivering from two oppositely disposed nozzles with a double cone between. Intimate mixture is obtained. As a modification of methods for treatment with oxygen in high concentration, beverages such as brandy, cognac, and liqueurs (13) are cooled to a temperature below $-18^\circ$ C., saturated repeatedly with air while at this temperature, and afterward stored in a warm room until the acids combine with the alcohols forming esters. According to a Canadian process (26) oxygenating gas is bubbled through new spirits in a vat. The gas, after passing through the liquid, rises through a mass of shavings or cuttings of charred or desiccated wood (preferably oak) over which a counterflow of the spirits is maintained by withdrawing liquid from the bottom of the vat and discharging it into or over the wood.

Alcoholic beverages, such as whisky, cognac, etc., are also treated with air (2) which has been subjected to a high-tension electric arc. This air contains oxides of nitrogen. The claim is made that the flavor is improved. Aging has been accomplished (4) by bringing the liquid in contact with bodies such as oak chips or shavings which have been treated with ozonized air or oxygen. This prevents local excess concentration of the ozone. Apparatus has been developed (1) for the production of ozone for use in the accelerated aging of liquors. Sizes up to 300 kw. with capacities up to 10 to 12 kg. of ozone per hour are available. Concentrations of 2 to 4 grams of ozone per cubic meter can be obtained in air or oxygen, with an energy consumption of 25 to 35 kw-hr. per kg. of ozone. Treatment of liquor with ozone gives a mellowing effect in a short time which can be obtained otherwise only after months or years of storage. Analysis shows a decreased aldehyde content and an increased ester content. A suitable ozonizer for liquor treatment is a special 50-watt size with a capacity of 100 liters per hour.

**USE OF ACTINIC RAYS**

For artificial aging of wines and liquors by the action of ultra-violet light (7), a vapor electric arc having a quartz container is used. The
liquor is passed over this lamp in a thin film. In several processes actinic
rays are used in combination with oxygen or an oxidizing agent.

One process (16) subjects them to light from a neon lamp ranging
from yellow to orange in color, in the presence of oxygen. Another (20)
subjects them to ultra-violet rays after addition of a small amount of
hydrogen peroxide, inorganic and organic peroxide, or ozonide.

As another variation (19) wine, cognac, etc., are aged and improved
by pretreating with ultra-violet light the water used in their preparation.
The water may also be aërated or treated with oxidizing agents. The
product after addition of the water is sometimes irradiated.

**Electrolytic Treatment**

Beverages are artificially aged by an electrolytic treatment (14) pro-
ducing hydrogen and oxygen in the liquid. The electrodes and the dia-
phragm between them are impregnated with insoluble inorganic salts or
oxides capable of producing oxidation and reduction effects in the presence
of the oxygen and hydrogen produced.

In aging and maturing alcoholic liquors by electrolysis (10, 11), a
depolarizing cathode and a current of low intensity are used. The cathode
is formed of a carbon electrode surrounded by manganese dioxide and
carbon contained in a porous pot. The anode is formed of a nonoxidizable
metal such as gold. The electrolysis is effected in the presence of the
substances which the spirits will extract from oak wood. For this purpose
the spirits are allowed to remain for some time before treatment in oak
casks. Sometimes oak shavings are added to the spirits during treatment.
The electrolysis will, owing to cataphoresis, assist in the extraction. The
electrolysis may be effected in oak casks between anodes on the outside of
the cask and a cathode inserted through the bunghole. Pads of moist linen
or cotton are placed between the anode and the surface of the cask. The
vats and casks are supported on insulators which may be bowls containing
a liquid such as vaseline oil. The passage of current is maintained con-
tinuously for eight to ten days, according to the conditions adapted for
each application.

Apparatus (8) for treating liquids such as wines, spirits, etc., with
electrical currents of high voltage and low amperage, consists of two point-
and-disk separators placed oppositely in parallel circuits connected to the
terminals of a transformer, so that one alternation of the transformer cur-
rent will pass through one circuit and the other alternation through the
other. Barrels containing the liquid to be treated are inserted in each
circuit. By the use of this method there is no heating of the liquid, and
loss by volatilization of the aromatic compounds contained in the liquor
is minimized. Another process (9) ages wine, cognac, and arrack by passing a high-tension electric discharge through them. The combination of the electrolytic treatment with the use of air, oxygen, or ozone has likewise proved effective.

Suitable apparatus (23, 24, 25) combines treating liquor in barrels with a gas, such as air, oxygen, or ozone, and the use of an electric current to accelerate aging. An electrode is inserted through the bunghole of the liquor container, and the liquid either alone or together with a fine wire of high resistance connecting the electrodes serves as conductor. Heating of the liquid occurs in either case.

An ingenious process (18) includes saturation of the liquid with oxygen, followed by the transformation of this oxygen into ozone by means of discharges of electricity through the liquid. The oxygen is introduced into the liquid under pressure and the electricity is discharged at short intervals through the liquid. Impurities from distillation are oxidized and the flavor is improved.

**USE OF CATALYSTS**

Artificial aging of spirits is aided by the use of catalysts. The vapors may be passed over finely dispersed metal oxides such as those of copper, nickel, and titanium (27) at 150° to 180° C.

Suitable catalysts for oxidation (22) are oxides of cobalt, cerium, vanadium, and uranium. Catalysts for ester formation are oxides of lead, molybdenum, silicon, uranium, and cerium. The best flavors are produced by the use of oxides of lead, copper, nickel, molybdenum, cobalt, titanium, and silicon.

Charcoal and charred sawdust have likewise been found to catalyze the maturing of spirits. The rising vapors, inside or outside the cask, may contact catalytically acting charred sawdust or charcoal (29) without the catalyst, however, coming in contact with the liquid. Other catalysts may be employed in this way, alone or together with the charcoal or charred sawdust.

A similar method (3) for maturing potable alcoholic liquors is to mix the vapors from a pot still with heated air, subdivide the mixture into narrow streams, and pass this through a narrow conduit heated to about 150° C. The streams are joined and the treated vapors condensed. The heated metal walls are supposed to act catalytically to produce the desired result.

**MISCELLANEOUS PROCESSES**

Spirits are also aged (15) by separating alcohol and water, and removing the fusel oil from the concentrated extract of oils, etc., by treat-
ment with petroleum ether. The concentrated extracts are subjected to accelerated aging by one of the methods described above, and again mixed with alcohol and water free from fusel oil.

According to another process (12) an extract prepared from oak wood, such as is used in making the usual storage vats, is added. The wood, which may be the heart of the larger branches of the trees or the waste obtained in making casks, is disintegrated and submitted to two successive extractions with aqueous alcohol and a final extraction with water. The alcoholic extracts are distilled \textit{in vacuo} at a low temperature, the residue is added to the aqueous extract, and the mixture is evaporated \textit{in vacuo} to obtain the extract in the form of a dry solid.

The old principle of acceleration of a chemical reaction by heat is applied to wines and spirits by storing them in closed vessels and agitating \textit{(30)} for some months at 43° C. A rocking, effected by oscillating a platform on which the cask rests, rather than by a tremulous vibration, gives the desired results.

The lines of attack on the problem are sound and can be expected to give results when properly applied. Details as to application vary in different processes. Some are in commercial use today in our newest large industry.

\textbf{Literature Cited}

(2) Brabender Elektromaschinen G. m. b. H., German Patent 500,708 (1928).
(16) \textit{Ibid.}, 557,806 (1930).
(17) \textit{Ibid.}, 572,351 (1932).
Dosing.—It is also claimed and has probably been practiced that the addition of small proportions of the materials listed below either singly, or in combination, will improve the flavor and appearance of whiskey.

Acetic Acid
Allspice
Almond shell extract
*Beechwood creosote
Caramel
Caraway seed
Cedar wood extract
Cherries, dried
Cherry juice
Cinnamon
Cloves
Glycerin
Glycerite of tannin
Oak extract
Peach juice
Peaches, dried
Plum juice
Plums, dried
Prune juice

*Beechwood creosote is said to have been the material used during prohibition for imparting the smoky taste to bootleg Scotch whiskey.
One of the less scientific methods for accelerating the matura-
tion of whiskey was aging for comparatively short periods in
old sherry wine casks. This method was claimed not only to be
very effective but also is probably the least objectionable. As a
variation the casks could be subjected, before filling with whiskey,
to a forced seasoning. The process consisted of placing the casks
bung down and drying them thoroughly by forcing a current of
warm air through the bunghole. Then enough wine to wet all
the inner surface was poured into the cask, the cask revolved to
ccoat all the wood and the wood impregnated by forcing in warm
air under pressure.

Blending.—On account of the inherent variability of a prod-
uct made in relatively small batches like pot still whiskey; and
the natural fluctuations in the qualities of the raw materials avail-
able for patent still whiskey, the practice of blending whiskey of
different distillations and different years arose early in the life of
the industry, to enable the distiller to market a more uniform
product. Later, the custom extended to the blending of the
products of different distilleries and of distillates from both pot
and patent stills. Still later, and in the United States possibly
even more after the repeal of prohibition, the practice of spread-
ing the flavor of an old whiskey over three to five times as much
diluted "silent spirits" was exceedingly common.

In Great Britain the business of blending has assumed great
importance within the industry as can be shown by reference to
the Directory of Whiskey Brands and Blends which lists 3428
Scotch, 487 Irish, and 128 Scotch and Irish blends founded upon the output of 122 Scotch and Irish distilleries.

The practice has both good and bad features. For example, the blender can take the distillers' output and by skillful blending produce a product of uniform characteristics year after year with little variation. Again, qualities desired of whiskey vary according to the locality. For example, Scotland, Canada and Scandinavian countries favor stronger whiskies than those drunk in England, France, Belgium, Holland, Australia and India. It is hard to say what the United States now favors, probably a strong whiskey. The blender can meet these geographical differences in taste by skillful blending. On the other hand, cheap and inferior blends have often been foisted upon the public under misleading names.

Blending formulae are secret, and the practice as carried on by some of the oldest and most conservative blenders approaches an art. At its crudest it consists of pouring the various whiskies into a blending tank according to formula, dosing, coloring and stirring the mixture and then allowing it to rest for 24 hours. The blend is aged in a cask for a short time and then bottled.

This gives a raw whiskey, imperfectly blended, and fit only for a cheap trade. A good blender proceeds more as follows: First, he selects various fine malt whiskies. He blends these carefully, marrying one whiskey with another every three months until the desired body and flavor are obtained, and then ages them in an uncharred oak cask for about two years. When he deems the blending and aging to be complete, he mixes the product with patent still spirit and Lowland or equivalent malt, stirs them up and allows them to age again in an uncharred oak cask for a year or more.

Scotch pot distillers have admitted the necessity of blending both pot and patent still products, except when the pot still spirit has matured for a considerable number of years in wood, in which case they consider it unnecessary. They claim that it is the pot still product which imparts character to the blend and that consequently it must always be employed in preponderating propor-
tion in the blend if the reputation, which the best classes of Scotch whiskey have gained, is to be maintained.

The production of cheap and palatable Scotch whiskies involves a different set of considerations. It is necessary for pot still spirits to mature in wood in order that they should acquire a pleasant flavor. Patent still whiskies, on the other hand, although they are improved by aging in wood, change to a less extent and mature much more quickly. It is stated that by blending immature pot still with patent still whiskey the pungent, unpleasant taste of the former is attenuated or toned down and that the mixture then becomes "a palatable and not unwholesome spirit." Such a mixture, if stored in wood, would mature in a shorter time than would the pot still whiskey alone.

The proportion of pot still to patent still whiskey in these cheap blends is varied chiefly in accordance with the price at which they are planned to sell. The cheapest blends may contain as little as 10 per cent of the former and even less.

Irish distillers contend that it is unnecessary to blend aged Irish pot still whiskey with patent still spirits, but admit that such blends are made for the cheaper trades. By British law the age of the whiskey in a bottle is determined by the age of the youngest whiskey in it, irrespective of the amount of that whiskey. Let us suppose that there are fifteen whiskies in a bottle, averaging fourteen years and making up 99 per cent of the contents, while 1 per cent is a whiskey aged five years. The legal declarable age of that whiskey is five years. White lies have been told on labels bearing such inscriptions as "Whiskey in this bottle is fifteen years old." It is true that there may be whiskey in that bottle aged fifteen years, but the real story is not there.

Post repeal American blending practice is still, at the time of this writing, in a chaotic state. The same general principles of desirable and undesirable blending are applicable as in British practice. The details of blending in this country as well as the tremendously complicated system of combined federal and separate state legislation are in an almost continuous state of flux so that there is little to gain by recording them. With the advent
WHISKEY MANUFACTURE

of repeal in this country, stocks of aged whiskey were much below the anticipated demand. Hence, most such stocks were “blended” or “cut” with very new whiskey or even with diluted alcohol and other materials, colored with caramel, dosed with “prune juice” and “bead oil” and sold quickly. Very shortly the flood of federal and state regulations appeared. These range from requirements that a “blended whiskey” shall contain not less than 20 per cent of four year old “U. S. P. Whiskey” to requirements similar to the British, that blended whiskey shall bear on its label the age of the youngest whiskey it contains. The reader is referred to Chapter XIII on interpretation of analysis for further details on this topic.
CHAPTER X
BRANDY, RUM, GIN
AND
OTHER DISTILLED LIQUORS

BRANDY

Brandy is the product prepared by distilling wine, wine lees and/or grape pomace and often by blending the results of these operations.

It is a yellowish-brown liquor of sweet, smooth ethereal flavor and of fine bouquet. Alcoholic content is usually from 45 to 55 per cent by volume.

As first made it is normally colorless, and the familiar yellowish-brown hue is obtained either naturally by aging in oak casks or artificially by addition of a solution of caramel.

The fine flavor and bouquet result from the secondary constituents of the brandy and are dependent upon a number of factors, principally raw materials, operating methods, aging, etc. The secondary constituents consist of various esters (acetic, butyric, oenanthic, valerianic), acetic acid, volatile oils, tannin, fixed acid and coloring matter. Ethyl pelargonate (oenanthic ester) and other volatile constituents are thought to be mainly responsible for the flavor.

Because of the fine quality of its products France is commonly thought of as the home of brandy. However, other countries are also large producers: e.g., Spain, Egypt, South Africa, Australia, Algeria, Germany and the United States (California). Spanish and Algerian brandies are of very high quality. Egyptian brandies are made from imported grapes (Asia Minor and Southern Turkey) and have a strong flavor. They are not so fine and compete with the cheaper brandies. Australian and
South African brandies are of fair quality. South African “dop” brandy is an “eaux de vie de marc.”

Brandies are produced in various parts of France. The best are produced in the Cognac district which is located in the two departments, Charente and Charente Inférieure. The region is also divided, according to the fineness of the wine, into the Grande (or fine) Champagne, the Petite Champagne, the Borderies and the Bois. Next in order of commercial merit are those made in the Armagnac, including the Marmande district.

Other parts of France in which brandies are produced are: le Midi, Aude, Gard, Hérault and Pyrénées Orientales. Brandies from these districts are commonly known as the “Trois-Six de Montpellier.”

_Eau-de-vie_ is the French name for brandy. It is used there in a rather broad sense and may embrace spirit distilled from wine, cider, perry, marc, cherries, plums or other fruit and also to mixtures of such spirits, or to a blend of any such eau-de-vie with any “alcool d’industrie” which is a name for either grain or beet alcohol. In view of this all-embracing nature of the term it is customary for a Frenchman to qualify his order for an eau-de-vie by specifying “un fine,” or “fine champagne,” or “un cognac.”

True brandies may be classified into the following grades:

_First._—Distilled from high quality light white wine not less than a year old.

_Second._—Distilled from second grade wines or spoiled and soured wines which have been specially treated before distillation.

_Third._—Distilled from grape pomace which may have been refermented with sugar and water. The term “grape pomace” includes the skins, pulp and possibly the stems of the fruit. These brandies are naturally of very inferior quality. They are known as Marc Brandies or “eau de vie de marc” from the French term for pomace. During prohibition a similar product was supplied in the United States by bootleggers under the name “grappo.”

_Fourth._—Certain incrustations are left on the sides and bottoms of fermentation tanks and aging barrels. They are called
"wine lees" and usually contain from 20-35% of potassium acid tartrate (Cream of Tartar) and up to 20% calcium tartrate. They also contain yeast cells, and protein and solid matter which had settled out from the grape juice. By acidifying the lees with sulphuric acid and distilling, a product of exceedingly strong flavor and odor is obtained which is used to give character to diluted silent spirits, and the product is marketed as brandy.

**Distillation.**—In the Cognac district the brandy is made either by the large distilleries or by the farmer himself right at the vineyards. It receives very little rectification, when distilled, in order to conserve the secondary constituents which produce the bouquet and flavor.

For this reason, the simplest pot stills or slight modifications thereof are generally used. The only usual modifications are the pot still with "chauffe-vin" and the "à premier-jet" still. Capacity of the stills as a rule is about 150 to 200 gallons.

A "chauffe-vin" is a heat exchanging device for preheating the wine before it reaches the still kettle. It consists of an arrangement whereby the neck of the pot still passes through a wine container so that the vapors, prior to condensation, give up part of their heat to the wine in the tank. See Figs. 12, 13.

The "à premier jet" is a device for returning the distillate to a heat exchanging attachment at the head of the still. By this arrangement the newly rising still vapors give up part of their heat to the first distillate which is thus vaporized. Some rectification of the still vapors takes place. The à premier jet gives some effect of continuous rectification as compared to discontinuous operation with the ordinary pot still and the resulting product is stronger but not of such fine quality. These brandies are usually considered more suitable for liqueur manufacture than for direct consumption.

In the simple pot still process, two distillations are used, which may be compared with the process of whiskey making in the Scotch pot still distilleries; the two distillates are respectively termed "brouillis" and "bonne chauffe," the terms being directly equivalent to the "low wines" and "spirits" of the whiskey distiller. The stills are worked very slowly and regularly, ten hours
are usually allowed to complete the distillation of a batch. The quality of the resulting brandy, still depends to a great degree on the judgment and skill of the operator.

In other districts where the wines have a strong, earthy flavor somewhat more elaborate apparatus is used. The La Rochelle district uses the *Alembic des Iles* which is a pot still with rectifying equipment. The Midi uses a continuous distilling column of the kind in favor in this country, excepting that it is equipped with a faucet or tap at each plate. This arrangement enables the operator to distil at higher or lower strengths at will.

The wine used in the manufacture of Cognac contains from 6 to 11 per cent of alcohol, or from 12 to 22 per cent of proof spirit; the average strength is from 7½ to 8½ per cent of alcohol or from 15 to 17 per cent of proof spirit. The final distillate as run from the still is about 25% over proof or 60 to 65% in alcoholic content.

**Aging.**—Following distillation the brandy is aged in oak casks. Considerable care must be taken in the ripening process if the distiller wishes to market a good product. Four or five years at least are required to develop the right bouquet, flavor and mellowness. The finest brandies are sometimes aged for twenty years or even longer.

Before filling, the casks are thoroughly sterilized, either by steaming, or by scalding with several changes of boiling water. Following this, the cask is filled with white wine to dissolve any objectionable coloring matters or substances which might affect the flavor of the brandy and drained.

**Blending.**—Aged brandies are very often blended, since they may vary in characteristics according to source of raw materials, district of production, and year of vintage. Blending has been found necessary to produce a product of uniform characteristics year after year. As in whiskey blending, cheapening may also be a desideratum.

Formulae are, of course, secret and are based on the experience of the blender. They are generally varied each year, to some extent, to compensate for the variation in characteristics of the brandies available. The methods of procedure outlined under
Blending in Chapter IX on Whiskey apply, on the whole, to brandy blending.

Many imitation brandies are on the market and it is very doubtful how much of the brandy consumed is genuine. Imitation brandies are made as a rule by cutting strongly flavored brandy with diluted, rectified grain alcohol, coloring and sweetening with caramel and cane-sugar syrup, adding small amounts of aromatic substances, and dosing with either "lees oil" or an extract of oak wood chips.

Various extracts are used to give to the brandy aged and other characteristics. For example a wine distillate extract of cedar wood chips, 1 to 10 (about 500 c.c. per 100 liters finished product), gives wine and brandy a herb-like, typically aged character. A wine distillate extract of bitter almond shells (100 to 300 c.c. per 100 liters finished product) gives in addition to the herb-like flavor a pleasant aroma resembling vanilla. The same quantities of extract of either dried, green walnut shells or dried, stoned plums round out the flavor nicely. Orris root, coumarin, cinnamon, Pekoe tea and vanilla are also used although the wine laws of some countries prohibit their employment. Many of the products listed as dosing agents in Chapter IX on Whiskey have also been used.

British Brandy.—This is a compounded spirit prepared by re-distilling duty paid grain alcohol with flavoring ingredients or by adding flavoring materials to such spirits. The flavoring materials used in any one case are a trade secret, but in general are to be found in the lists mentioned.

Hamburg Brandy.—This is an imitation grape brandy made by adding flavoring to potato or beet alcohol.

Rum

Rum is a spiritous beverage prepared by fermentation, distillation and aging, from molasses and the scum and foam which form on the top of sugar cane juice when it is boiled. Fresh sugar cane juice may also be used when the cost of sugar production makes it profitable. High quality rums are made from mashes containing comparatively small amounts of skimmings (scum).
So-called "Nigger rum" is made from mashes consisting principally of the skimmings and other waste products of the defecators of sugar cane factories.

Rum is a yellowish-brown liquor of fine bouquet and sweet, smooth, alcoholic taste and flavor which cannot be successfully imitated artificially. The alcohol content of the genuine product should not be less than 78 per cent by volume. "Nigger rum" has a raw, sour, burnt taste and flavor.

When first made, rum is normally colorless and the familiar yellowish hue is obtained by aging in casks. If an exceptionally dark color is required it is dosed with caramel.

Because of the fine quality of its products Jamaica is commonly thought of as the home of rum. However, rum is produced in all countries where sugar cane is abundantly grown; e.g., British Guiana, West Indies, Brazil, southern United States, Madagascar and the East Indies.

Jamaica rum is graded into three classes, namely: 1. "local trade" quality for home consumption, 2. "home trade" quality for consumption in the British Isles, and 3. "export trade" quality for export. Local trade rum, the lowest quality, is distilled with particular emphasis on its alcoholic strength to the neglect of the other substances, chiefly esters, from which the flavor is derived. The flavor of this grade is, therefore, decidedly inferior.

The "home trade" quality constitutes the bulk of the exported rum. It has a full flavor, and chemically is characterized by a higher proportion of esters of higher fatty acids. It is generally accepted that these acids result from bacterial decomposition of the dead yeasts found in the distilling materials. As compared with "local trade" goods the "home trade" have a fuller and more fruity aroma and a marked spicy residual flavor is noted on dilution. Sometimes, even, an excess of the higher alcohols and esters which produce this result will also cause an objectionable cloudiness on dilution with water. On occasion "home trade" rums will have a noticeable burnt flavor resulting from over-distillation by direct fire.

"Export trade" Jamaica Rum is manufactured principally for European, especially German, consumption. This class of goods