Some distillers ferment and distill only the first drawing, while others mix the three together and ferment. In many instances where the proper facilities for malting are lacking, barley-malt is used instead of malted rye.

In this case the proportions are one bushel barley-malt to six bushels rye-meal, and eighteen gallons of water to the bushel of grain.

CORN WHISKEY.

There is in all probability more corn consumed in the production of whiskey than any other grain. There are a great many methods employed in converting the substance of this grain into spirits.

A percentage of barley-malt, be it large or small, is usually mixed in with corn-meal. This may vary from one bushel of malt to twelve of corn meal, up to seven of corn to five of malt. The steeping of the grain, in mashing, differs according to the theoretical ideas of the distiller. This accounts for some whiskies being much superior to others, when produced from the same substance.

The flavor and quality of whiskey depend principally on the manner employed to extract the substance of the grain, (what is termed mashing). The longer it is boiled after steeping, the more fatty matter, and the more acid will be extracted, this fat forms fusel oil, the acid reverts into poisonous gases. These are changes which take place during the process of fermentation.

The proper manner of producing good corn whiskey is with the following ingredients and proportions:

Use five bushels of coarse corn-meal to one bushel ground malt, and eighteen gallons of water to the bushel of mixed grain.

Boil one-half of the water, then mix it with the same quantity of cold water. This should bring it to 155 degrees temperature.

Draw one-half of this into the mash tub, and while stirring, sprinkle the meal into the water until it becomes well mixed and the substance resembles thin gruel; repeat this stirring at intervals of fifteen minutes for the space of two hours, then allow it to settle.

When clear, draw off two-thirds into broad shallow pans, in order that it may cool rapidly. This will prevent the formation of acetic acid. When cooled down to 80 degrees, run it into a fermenting tub, and add to it two per cent. of fresh brewer’s yeast.

When fermentation is about to stop, (See page 20) run it into the still, and conduct the operation according to the directions under the head of Running a Charge. Having drawn off two-thirds of the liquor from the mash, heat one-half of what remains to a temperature of 180 degrees. Run this into the mash tub with the first; mix thoroughly as in the former case; allow it to repose 45 minutes, then run it off into the cooling pans. Repeat this the third time with the balance of the water heated to 190 degrees; allow it to stand one hour, and draw this off into a separate tub.

Mix the second and third drawings together, and use this mixture in the place of water in the next mashing.
GIN.

The method here given is employed in New York, Buffalo, and Cleveland, Ohio.

Take 112 pounds barley-malt,
228 pounds rye-meal,
96 gallons water.

Heat the water to 162 degrees Fahrenheit.
Sprinkle the malt in this water together with the rye-meal, stirring the substance briskly while doing this.

Let this infusion remain for three hours; then bring the strength of the mash down to 1.047 specific gravity, this is done by adding cold water. This will bring the temperature down to 80 degrees Fahrenheit.

Run this liquor off clear from the dregs into a fermenting tub, and add half-a-gallon of brewer's yeast. This must be allowed to ferment for forty-eight hours only.

The clear liquor is then run into the still and undergoes the process of distillation; the low wines being kept separate from the sweet liquor.

It will be readily understood that forty-eight hours of fermentation have not been sufficient to extract all of the substance from the grain. A quantity of saccharine matter still remains.

The low wines which have been obtained are mixed with the dregs and sediment and all run into the still together and distilled.

When the liquor has been secured, the first and second distillates are mixed together with fifteen pounds of bruised juniper berries and a double handful of hops, this substance then undergoes another distillation.

The gin produced by this process is fully equal to any in the country and far superior to that made from grain spirits.

If found too expensive, this system can be modified to suit the occasion. If found to be too highly flavored, reduce the proportion of juniper berries or vice versa. For instruction in the manner of conducting the distilling operation, see *Running a Charge*.

RUM.

The solution from which Rum is distilled consists of the juice as well as parts of the sugar cane, and in many instances the residue of sugar boiling establishments, principally in the West Indies, Jamaica, Barbadoes, St. Croix, etc. The production of rum differs from that of whiskey, inasmuch as no brewer's yeast is employed.

When a sufficient quantity of refuse is gathered together it is put into a tub, saturated with water and well stirred; it is then allowed to stand until fermentation sets in, which in the first instance is very slow; that is at the commencement of the sugar boiling season. The reason of this is, that they have no yeast to start the first batch. After this however there is no further trouble, as the yeast gathered from the first serves to excite the next batch.

When the fermentation is complete (See page 21) the liquor is distilled in the same manner as brandy, whiskey, or gin.

When first made, rum has a peculiarly disagreeable
flavor which wears off as the liquor grows older. When there is a good demand for rum, and the sugar crop is bountiful, rum is made from molasses, or molasses and sugar, as well as from the refuse. That which is made from the scumings and other waste matter alone is called Sugar-spirit.

ARRACK (OR ARRAK).

This is a species of Rum produced in the East Indies. The ingredients used for the purpose are rice and the juice of the cocoa or palm tree. The process is very peculiar especially in obtaining the material.

The operator provides himself with a number of earthen pots with small necks. With these fastened to his girdle or belt, he climbs up the tall trunk of the cocoa tree; having reached the boughs, he cuts off certain small buds with a knife and applies one of the bottles or pots to the wound and fastens it with a cord, and so on until all of the pots have been disposed of. These pots receive the juice as it flows from the wounded parts of the tree. This operation is usually performed in the evening, as the flow of juice is greater at night than in the day. In the morning the pots are taken down and the juice emptied into a large vessel or tub, where it undergoes fermentation; after which it is distilled into low-proof liquor.

A quantity of ground rice is then macerated and fermented in the same manner; this, when distilled, produces another quality of low-proof alcoholic substance.

These two are then mixed together and are re-distilled, the product being Arrac. In other parts of India, the juice and seeds of the tree are all fermented with the rice and then distilled.

RECTIFYING.

This is also known as "Leaching," and consists of a system by which liquors are purified by filtration through ground charcoal.

The tub used for this purpose is called a Leach-tub. This is built of ash wood, the usual size being five feet in height by seven feet in breadth.

A perforated false bottom is fitted twelve inches above the regular one. This false bottom is made to rest on four cross bars; these in turn are supported by small upright posts.

The holes in this false bottom are one-quarter of an inch in diameter, and one inch apart. A coarse linen cloth is stretched over these apertures, and the seam well caulked with the same material.

Twenty-five bushels of coarsely ground charcoal is packed over this cloth; this is covered over with loose bagging of any description, and over the bagging some loose boards, and a sufficient quantity of stone to keep them in position when submerged.

The liquor to be rectified is run into this tub, and as it filters through the charcoal, the fusel oil is held by the charcoal while the alcoholic substance passes through. Thus the liquor becomes purified.
The rectified liquor is drawn from this tub by means of a brass cock placed at the side of the tub on a level with the bottom. In order to facilitate drawing off this liquor, a quarter-inch tube is adjusted to the inner side of the tub, and extends from the top, downward and through the false bottom. This allows the air to enter as the liquor is withdrawn, and to escape while the space between the real and false bottom is being filled.

High wines, a new whiskey, when purified in this manner is known as pure spirits, and used by compounders for adulterating purposes. If re-distilled through a column, it is called French high-proof spirits.

There is also another method by which liquors are purified without the use of charcoal or leach tubs, known as the chemical process. (See Alcohol Refining.)

THE COLUMN.

The column forms the principal portion of the alcohol still. It acts in the same manner upon vaporised bodies as the doubler, with twelve times its capacity; that is to say, whereas the doubler condenses once, the column condenses twelve times during one operation, thereby increasing the alcoholic strength of the liquor at each condensation.

The column, as seen in diagram No. 8, is composed of twelve sections, each of which is a cylinder, made of sheet copper, eighteen inches in height, and thirty-six in breadth, with a flat bottom in the centre of which is a four-inch hole.
Two copper pipes pass through this bottom; one a four-inch, A, through the centre; the other a two-inch, B, near the edge. The four-inch pipe projects eight inches upwards, and sets exactly upon the four-inch hole and flush with the bottom plate, to which it is firmly soldered.

The two-inch pipe or "plunger" is carried upwards seven inches, and extends sixteen inches through the bottom of the cylinder, thus projecting downwards into the next cylinder below, and reaching to within two inches of the bottom of it; this is also firmly soldered into the bottom plate. A copper pan called a "cap," C, twelve inches across the bottom, and sixteen inches wide at the rim, is placed inverted directly over the four-inch pipe, and two inches above it, with the lower edge reaching down to within two inches of the bottom plate.

This pan is held in position by three legs, soldered first to the sides of the pan, then to the bottom plate. A straight one-inch brass cock, D, extends outward from the side of the cylinder and on a level with the bottom plate.

The upper and lower edges of the cylinder are turned outward, forming a flange, by which means the sections can be connected. This completes one section of the column.

The bottom and top sections differ from the others, inasmuch that the top one is covered over, a four-inch exit pipe, E, being fitted in the center of its dome, and a cap-hole, F, near the edge of the cover.

The two-inch pipe, B, of the lowest section, instead of passing through the bottom, is made to pass through the side near the bottom plate, in which there is no four-inch aperture; the inlet pipe, G, enters through the side, and opens near the bottom of this section.

The first, or lowest section, is placed upon a scaffolding, two feet higher than the breast of the still.

The connecting pipe, G, from the still enters this at the side, three inches above the bottom plate and discharges two inches above the bottom.

The two-inch pipe, B, from this bottom section enters the breast of the still, and is carried down inside the still to within two inches of the bottom. (See K, Diagram No. 7.)

The second section is then placed on the top of the first, the third on the second, and so on to the top one. In placing these sections one over the other the side cocks, D, must be in line, and fronting the still.

These cocks, D, which are used in charging the column, are connected with a one-inch copper pipe, H, placed in a vertical position, and extending from the upper section to one foot below the lowest one.

The upper end of this pipe is closed; the bottom soldered to a one-inch brass cock. This pipe serves to charge the column, and also to empty it of its contents when necessary. It will be seen that, when these cocks, D, are all closed, excepting the one at the bottom, and water is let in to the column from the cap hole, F, on the upper section, as soon as the water reaches to the height of the uppermost plunger B which rises seven inches, it will overflow and pass through this plunger, to the next section. This is con-
tinned until the overflow of water reaches the bottom section, when it will flow from the bottom plunger, B, which has been left open for that purpose. The column is then, what is called “charged,” each section containing seven inches of water on its bottom.

As the sides of the pans, C, which are placed over the four-inch pipes, A, reach to within two inches of the bottom plates, it will be seen that they are submerged to the depth of five inches.

When the vapors as they ascend and pass through the four-inch pipe, G, come in contact with the bottom of the lowest inverted pan, they cannot escape upwards, but they spread and are carried down its sides, forced to pass through the water and escape outside the pans to the upper part of the cylinder, and enter the next pan above, or condense into liquid.

The heavy bodies, such as water and oils, are condensed; this increases the bulk of water, and causes it to overflow into the two-inch pipe, B, which carries it back to the cylinder below it, and so on to the bottom cylinder, whence it passes to the still.

The alcoholic vapor being much more volatile than water, passes through the water, and ascends around the exterior of the pan, concentrating in the upper portion of each cylinder, and entering into the next section above, where it meets a like obstruction, and is again purified of its watery element, and so on to the top section where a pipe fitted to B connects it with the goose (See diagram No. 9) in which it is again subjected to a like treatment, but in a different manner.

That portion of the alcohol apparatus called the goose, is the last through which the vapors pass on their way to the worm, and is in itself a powerful condenser. (See Diagram No. 9.)

It consists of twenty-four joints, A, of four-inch copper pipe, each forty-two inches in length, and while in an upright position six inches apart, are joined together by means of semi-circular elbows, B, at top and bottom, thus forming a continuous conduit; one end of which is connected with the top of the column, and the other with the worm.

A two-inch pipe, C, connects the lower portion of each bend with a pipe, D, in such a manner as to carry off any liquid that may be condensed at the lower curves of the goose. This pipe D is closed at the end nearest to the worm, while the other end passes to, and enters the upper chamber of the column at the side, then downward to within one inch of the bottom plate. This condenser or “goose,” when complete should stand in a tub or tank in the form of two acute angles, “or conduplicate” so that the part which connects with the column may be nearest to it, while the last section will be nearest the worm.

When placed in the goose-tub, there should be a space of one foot between the inner edge of the tub and the copper work.

Seven-eighths of the goose must be submerged in water when in operation, one-eighth remains above the surface.
Near the upper edge of the tub is a three-inch tin pipe to carry off the surplus water; this is called the overflow pipe. The supply of water is obtained by means of a two-inch iron pipe which enters the tub in the centre of the bottom. A circular covering is placed directly over this inlet and about two inches above it, extending from the centre about eighteen inches; this causes the water to spread as it enters, instead of rising to, or near the surface as would be the case were it not checked in its ascent.

Some of the large alcohol distillers use a double goose in the same tub. The vapor enters both at the same time by means of a Y joint and exits to the worm in the same manner.

**DISTILLATION OF ALCOHOL.**

This branch of the business has given rise to more scientific research than all other branches combined, the principal aim being to find a means of producing alcohol in its purity, free from water or other elementary bodies. How far this investigation has been successful will be demonstrated as we proceed.

The high wines from which alcohol is produced are subjected to another and far more complete distillation than that by which they were obtained. For this purpose, a complicated apparatus is used.

This consists of a still, a column, a condenser (called the goose), and the worm, each of which have been previously described.

By this system we now obtain alcohol at 190 degrees of proof or 95 per cent. pure alcohol. The still
may be of wood, iron, or copper, and heated by steam. A six-inch copper pipe connects the lower chamber of the column to the centre of the surface of the still.

The Column is divided into twelve equal sections, called chambers. These chambers are so constructed that as the alcoholic vapors pass from the still into the lower chamber, the heavy bodies condense and are returned to the still; the alcoholic portion being lighter, passes through, and ascends to the second chamber, and thus from one chamber to another, each section in turn rejecting the condensed portion and returning it to the chamber next below and finally back into the still.

The alcoholic vapors having reached the upper chamber, pass through this and are conveyed through a connecting pipe to the goose, where they are again condensed; the heavy bodies returning to the column, and the lightest portion of the vaporized substance proceeding on its way until it reaches the worm, where it in turn is condensed into liquid, and this liquid is alcohol. (See Column and Goose, pages 52 and 57.)

In connecting the different portions of the alcohol apparatus, place the still on the lower floor of the building, the worm tub on the next above, the goose tub one floor above the worm tub, and the water tank (or reservoir) on the roof.

These tubs are usually built on scaffolding outside of the building. The receiving tubs are placed on the same floor with the still. The column runs up through two floors, its upper section being two feet below the level of the bottom of the goose tub, while the bottom plate of the column is two feet above the surface of the still.

The liquor which is to be converted into alcohol must first be reduced to 95 proof, what is called 10 per cent. below proof. It is an established fact that when the column of water predominates over that of spirits, it facilitates the separation of the two bodies. The still is charged in the same manner as the whiskey still (see Running a Charge), after which the column is charged, the goose and worm tubs are filled with water, steam is turned on to the still, and in the goose tub. The water in the goose tub is heated by means of a one-inch steam pipe from the steam boiler. When heated to the temperature at which alcohol boils, the steam is shut off. This heating is done in order to facilitate the running of the charge.

When the liquor within the still becomes heated to the boiling point of alcohol, the vapors ascend, and pass into the lower section of the column, causing a loud rumbling, and crackling noise. This is caused by the hot vapors passing through the cold water with which every section of the column is charged.

As the noise ceases, a low rumbling is continued, until the hot vapor passes from the first to the second section when the rumbling is heard again as before. This is repeated at every section until having reached the upper chamber the vaporised body passes from it into the goose, the rumbling noise then ceases and is followed by a low monotonous sound which continues to the end of the operation.

As soon as it is found that the vapor has reached the last section of the goose, cold water must be let
into the goose tub from the bottom, very gradually at first, and increased as occasion may require. The water which serves to cool the worm, is also let in from the bottom as soon as the liquor commences to flow from the tail of the worm.

Regulating the flow of water in these two tubs to correspond with the pressure of the ascending vapors requires the utmost caution. It may be said that the whole art of alcohol producing is concentrated in this. The water in the goose tub must be kept up to the boiling point of alcohol; if heated beyond this point it will cease to act as a condenser, the watery vapor will pass together with the alcohol and thus reduce the proof. If on the other hand the water is too cold, the alcoholic vapors condense and return to the column, this action cools the column and prevents the alcoholic vapors from rising and the whole operation is suspended. When the liquor commences to flow from the tail of the worm, it will be seen that the first fifty or seventy-five gallons will be below the standard, this must be run into the low-wine tub.

Supposing the charge to be twenty-five barrels.

As soon as the liquor indicates 92 sp. grav. on the stem of the hydrometer, it must be allowed to run into the alcohol tub.

The water in the warm tub is to be kept at a temperature of 60 degrees Fahrenheit. It will be observed that when the proof of the running liquor indicates a fall in alcoholic strength, and a rise of temperature, it shows that the spirits have all been extracted from the still, and what has not been secured is contained in and is passing through the different sections of the column. This is ascertained by drawing some of the liquor from the try cock, (See F, Diagram No. 5) pouring it on the breast of the still and touching it with a lighted match; if there be any spirits remaining in the substance, it will burn, if not, the steam should be shut off, as well as the flow of water in the tubs, and the still emptied and charged anew.

This will save much time in conducting the second operation. Not only this, but will also keep the apparatus in a proper condition.

If the operation is allowed to continue to the end, the heat must be increased, the water in the goose tub shut off, while the supply into the worm tub is increased.

When the low wines have all passed over, a mixture of water and fusel oil follows; this continues until nothing but clear distilled water is obtained. This part of the operation is called running off the column, or cleaning up, and occupies about three hours.

This is the ordinary method of producing alcohol. Such as is used for artificial purposes.

When pure inodorous alcohol is required the liquor from which it is obtained is subjected to another operation called Leaching, which is one system, or Refining, which is another. (See Rectifying, also Refining.)
ALCOHOL REFINING.

What is called Refining differs from Rectifying. In the latter case ground charcoal is employed to absorb the oils and ethers; while in the former, the oils and ethers are completely destroyed and the alcohol obtained free and inodorous.

In order to be more explicit on this subject it will be necessary to refer to the first production of alcohol and examine into the chemical laws which govern the formation and separation of different bodies.

There are two powerful agencies which act on all substances by opposite methods; these are heat and cold.

Heat is the great antagonist of atomic affinity; it transforms solid bodies into liquids, vaporises the liquid and converts it into gases.

Cold on the other hand causes the atoms to combine, gases are condensed to liquids, and liquids to solid matter.

When bodies become separated by the agency of heat, they form other combinations, which differ from the first; as has been proven in the transformation of starch into sugar, and sugar into alcohol. These new unions take place only when the different components are within the sphere of each other's attraction.

When whiskey or high wines is heated the affinity of the component parts of which it is composed, that is,—alcohol, water, fusel oil and ether,—is destroyed. There being no other bodies present with which they can unite, they remain free; as shown during the process of distillation, ether being the most volatile escapes first and is lost in the air; alcohol vaporises next, followed by fusel oil; while water, being the heaviest body, comes over last.

As the alcohol vaporises, a portion of the oil and of the water is carried over with it. This does not form a chemical compound, but a mixture, as each body can be afterwards separated and obtained pure.

To this cause is attributable the difficulty of obtaining alcohol free from impurities by the ordinary means of re-distillation. With the new system, however, this obstacle has been removed, years of research and practical experience having resulted in the successful introduction of this improved method of which the author of this book is the inventor. The manner of operating is somewhat similar to the usual method by which all alcohol is distilled. The same apparatus is used, the same amount of heat is employed and the same system of condensation. The only exception being the introduction of chemicals into the liquor at the exact moment when the affinity of the constituents is destroyed by heat.

For this purpose a wooden tub, V. Diagram No. 10, is placed a few feet above the still, usually on the floor above it. A one-and-a-half-inch copper pipe connects the bottom of this tub to the center of the surface of the still, with a stop cock, W, directly over the still and another, Z, at the tub connection. This tub is called the chemical tub.

When all is ready and the still is charged, which in this case must be with liquor containing fifty-five per
cent. of water, then proceed in the following manner:

While the liquor in the still is heating, dissolve in a tub with hot water twenty pounds of pearl ash, and in another tub the same amount of soda. When properly diluted pour both of these solutions into the chemical tub, V.

This proportion is intended for a charge of twenty-five barrels.

When the liquor in the still becomes heated to the temperature at which ether vaporises, which is 96 degrees Fahrenheit, (this being the time when the elements begin to separate), allow the contents of the chemical tub to flow gradually into the still by first opening the upper cock, Z, to permit the pipe to fill, then the lower one, W, so that the solution may pass very slowly into the still.

As soon as this alkaline mixture, which forms a powerful base, comes in contact with the fat of which fusel oil is composed, it acts upon it at once by expelling all less powerful bases, and uniting with the fat, forming soap, or properly speaking a solution of soap and water. This solution spreads all over the surface of the liquor as a scum. This new union not only destroys the fusel oil but prevents the heavy bodies from vaporising, while the alcohol being so much lighter rises and is carried over.

When condensed, it is found to be a perfectly pure spirit, free from taste or smell.

The advantages gained by this method are very plainly evident; it absorbs the fusel oil at the moment when the temperature is most favorable for its complete separation from other components; it
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saves the time, labor and consequent expense of subsequent rectification, during which operation it is necessarily exposed to the action of the atmosphere.

DISTILLATION OF VOLATILE Oils.

These oils are obtained by distillation and when dissolved in alcohol, their solutions are called Essences. These essences are employed for flavoring liquors, confectionery, etc. Oils of this description are met with in all kinds of plants, in the leaves, the bark, the roots, and in the flowers.

In some instances the same plant may furnish different oils, such as the orange tree, which furnishes one from its leaves, another from its flower, and a third from the rind of its fruit.

These oils are obtained in the following manner:

The substance from which they are to be extracted is allowed to steep in cold water twenty-four hours, after which it is run into a still and heat applied. The water vaporises and passes over into the worm, and is condensed, passing from the outlet in liquid form.

It will be found, however, that the oil has been carried over with it, and can be seen floating on the surface. The supernatant oil is drawn off and put up in bottles with ground glass stoppers, and is ready for use.

The separation of the oil from the water may be effected by the use of a glass syphon. It may also be done by an arrangement called a Florentine Receiver. A glass vessel, narrow at the top, so as to present only a small surface for evaporation, is fitted with an escape tube close to the bottom; this tube is bent upwards to a height a little lower than the mouth of the vessel. As soon as the distillate, dropping into the vessel, has reached \( \alpha \), the level of the upper bend in the escape tube, the water flows over at \( \beta \), into a suitable vessel, and continues to escape as fast as the supernatant oil accumulates on the surface, until the water has all been thus displaced and separated. The illustration will make this easily understood.

For oil heavier than water, the escape tube is fitted at \( \alpha \), allowing the water to flow off as the oil below displaces the supernatant water.

Some substances yield their volatile oil very readily, and therefore require little or no maceration previous to being distilled; in this case the substance is introduced into the still with an equal bulk, or perhaps more, of water. This plan may avoid any loss of oil which might occur by exposure during the period of maceration.

The water-bath may be made to yield a higher degree of heat, if necessary, by adding a proper proportion of salt to the water in the outer vessel or bath.

The still employed for volatile oils, etc., will be easily understood by Diagram No. 11. The ordinary worm is replaced by a condensing jacket, C.
A is the still.
J the charge hole.
I the exhaust cock.
B an alembic passing through a hollow jacket, C.
H is a barrel, situated above the level of the jacket, containing ice-water.
G the stop-cock regulating the flow of water into F.
F a funnel, to receive the water, set into the upper side of the lower end of the jacket.
D an escape pipe, leading to a waste tub, by which the water passes off as fast as it enters at F.
E a glass jar to receive the distillate.
The principal oils which are obtained in this manner are:
Oil of juniper berries.
Oil of orange-peel.
Oil of Bergamot.
Oil of roses (known also as otto of roses).
Oil of peppermint.
Oil of wintergreen.

APPLE OIL.

This oil is a chemical product of which fusel oil forms the basis.
Take 2 parts fusel oil.
4 parts acetate of potash.
2 parts sulphuric acid.

Distill by means of a water-bath still. The product will be a volatile liquid with a strong and very agreeable odor. For “Water-Bath Still” see page 73.
Add to this ten times its volume of 95 per cent. alcohol. Bottle at once using ground glass stoppers.
PINE APPLE OIL (CALLED BUTYRIC ETHER).

Take 2 parts alcohol.
2 parts butyric acid.
1 part sulphuric acid.

Mix all together and dissolve in twelve times its weight of alcohol.

EXTRACTS

In the production as well as in the compounding of liquors, more or less flavoring matter is employed. These flavors consist principally of Extracts, Essences and Tinctures.

Extracts are obtained by different methods.
First: by expressing the juice from the plant.
Second: by soaking in cold water and then pressing.
Third: by boiling.

These processes are technically called Pressing, Infusion and Decoction.

The liquor thus obtained is filtered, then evaporated, leaving a pulpy, pasty mass. This is Extract.

This substance can be kept for years. One ounce of this extract contains as much active matter as several pounds of the vegetable substance from which it is extracted.

As an illustration let us take a quantity of liquorice root, say ten pounds.

Pour on to this seven gallons of boiling water.

Allow this to remain a few days, then press out the liquor and filter it. It will be found to be clear and transparent. Let it evaporate in an open vessel.

A dull black substance resembling pitch will remain. This is the extract, and is known as Spanish liquorice.

It will be seen that evaporation in the open air has not only changed the color but also the taste.

This proves that the only true method of obtaining extracts is by evaporating in a closed vessel, such as the still. In this manner the properties of all vegetable matter can be extracted pure and unchanged for flavoring or for imparting an aroma to wines or liquors.

Some substances yield their extractive matter readily by simple infusion; others require infusion, boiling water, and sometimes decoction; others, again, yield only sparingly in water, and require alcohol, diluted or pure as circumstances demand. Percolation is also sometimes employed. The substance is first ground to powder, and then packed in a cylindrical or a funnel-shaped vessel, having an outlet at bottom. The liquid is poured gradually into the upper part, filters through the powder and drops from the bottom exit into an appropriate receiver, and afterwards evaporated.

The best method to be adopted depends entirely upon the substance to be operated upon.

THE WATER-BATH STILL.

The still used for distilling cordials is of a peculiar design. The boiler consists of two parts somewhat similar to a carpenter's glue-pot. The part, C, diagram No. 12, which is intended to contain the sub-
stance to be distilled is shaped in such a manner that it may fit inside of a larger kettle, A, leaving a sufficient space between the two to hold as much water as would be contained in the smaller one when filled to two-thirds of its capacity. These stills are made to be connected, or disconnected at the pleasure of the operator.

The material to be distilled is put in the inside kettle; water is let in to the outer one until it reaches to three-quarters the height from the bottom which is indicated by a small cock, G, placed there for the purpose.

The connection is made to the worm by a loose joint of pipe, J, bent in the proper shape; brown paper saturated with raw flour-paste is wound around the seams, then the heat is applied. The process of distilling is conducted in the same manner as for whiskey or brandy.

The water in the outer compartment of these stills can be heated by steam, either with or without a coil of pipe; what is known as live steam answers all ordinary purposes. Where steam can not be had a fire underneath, whether of wood, coal, coke or fagots is all that is required. The usual capacity of stills of this description is about forty to sixty gallons. Compounders and manufacturers of essential oils, perfumes, essences, and extracts use much smaller ones, ranging from two to ten gallons capacity.

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Some prefer to have these small stills made of heavy tin. Any tinsmith can construct one at a very small cost. A worm, L, for a ten-gallon still should be thirty feet in length, graduating from 2½ inches in diameter at the top down to ¾ of an inch at the bottom, forming a coil of ten circles, and placed in a tub, K, four feet in height by two and a half in breadth; this must be firmly secured. (See *Worm*.)

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**ESSENCES.**

**ESSENCE OF GIN.**

The following is the English method of preparing it. Use for this purpose the finest spirits.

Take 1 gallon spirits 20 above proof,
2 ounces caraway seeds,
2½ ounces fennel seeds,
1 pound juniper berries.

Grind the seeds, and bruise the berries; stir them thoroughly into the alcohol and place this mixture in a still, adding one quart of soft water.

From this, distill just one gallon and no more. What remains in the still is of no use, as it is of a very disagreeable odor.

This essence should be put into bottles with ground glass stoppers, until required for use. The best method is to let the seeds and berries macerate and digest in the spirits five days before distilling.

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**ANOTHER METHOD.**

Take 10 pounds juniper berries,
1 pound fennel seeds,
1 pound caraway seeds,
¾ pound lemon peel,
¾ pound orris root,
¾ pound orange peel,
2 ounces cardamom seeds,
3 ounces hops.

Put these ingredients in an earthen jar, with spirits enough at 120 proof to cover them.

Allow them to remain six days; then add two gallons of water, and distill slowly to within a half a gallon of the quantity placed in the still.

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**RED RATAFIA.**

This Liqueur, as it is called, is very popular in many parts of Europe, and also in the United States. It is far superior to the cordials in general use. The manner of preparing it is this:

Take 24 pounds ripe red cherries,
4 pounds ripe black cherries,
3 pounds ripe raspberries,
3 pounds ripe strawberries.

Bruise the cherries and berries together.

When well bruised, allow them to remain in that condition twelve hours, then press out the juice, measure it, and to every quart add half a pound of brown sugar.

When the sugar has been properly dissolved in the juice, filter through a coarse linen bag.
When filtered, add to it three-quarters of a gallon of fine rectified spirits. This concludes the first operation.

The second is as follows:

Take 4 ounces cinnamon,
1 ounce mace,
2 drachms cloves.

Bruise them together in a mortar.

When well bruised, pour one gallon of good clean proof-spirits over them, then add a half gallon of soft water.

The water-bath still is then prepared and the spices together with the liquor in which they are steeping are put into it.

Next apply a gentle heat to the still and draw off one gallon by distillation. This distillate is called spiced spirit and is generally kept on hand in all places where cordials are manufactured.

Add of this spiced spirit a sufficient quantity to the material obtained by the first process to make it agreeable to the palate, which will be about one quart. This is the only true way of preparing this liqueur.

There is another method adopted by some of the manufacturers, which is to allow the juice of the fruit, after being pressed, to ferment several days, to increase the viscosity of the liquor, but in doing this the rich fruity flavor is greatly diminished.

When prepared according to the manner first stated and it is desirable to strengthen the liquor, it is done by adding more spirits, and thus still retain the fruity flavor.

Another system is also employed in the distillation of the spices. The spices are tied up in a linen bag, and suspended by a hook in the still, thus allowing the vapor of the spirits to pass through them while ascending. In this case, more spirits is required to obtain the same result.

All fine French liqueurs are prepared in this manner.

ANISETTE.

This celebrated liqueur is compounded and prepared to a very large extent in France and Italy. It is made in the following manner:

Take 20 pounds green anise,
3 pounds star anise,
1 pound coriander seed.

First:—Wash the green anise in soft water; grind the coriander; then put the whole in 40 gallons of 95 per cent. alcohol; add to this four gallons of water, and run this all together into a water-bath still.

Apply a good heat, and distill thirty-five gallons. Then pour ten gallons of water into the still; apply more heat, and distill again, run off six gallons, and mix it with the first run.

Try the alcoholic strength of the liquor; and reduce it with soft water to 80 per cent.

Second:—Make a syrup of six hundred pounds of sugar, dissolved in thirty gallons of water; when boiled three minutes, filter through flannel, and when cold, add this to the distilled liquor.
Mix it well, then filter through felt filters, and the anisette is ready for bottling.

The operation of distilling French liquors, such as anisette, absinthe, curaçao, maraschino, etc., should be performed in a regular cordial still, fitted with a water bath.

**Absinthe Suisse.**

Absinthe is a product of Switzerland. It is well known on both continents as a powerful stimulant and is highly esteemed by the French. The greater portion used in this country is imported in bottles direct from the country whence it originated. The manner of producing this liquor was for many years kept a profound secret, being handed down from father to son for generations. It is now prepared to a certain extent in this country by French cordial manufacturers, who have succeeded in producing an Absinthe which when ripened by age, is in every way equal to that which is imported, and, in fact, can not be distinguished from it.

Take 20 pounds long absinthe (wormwood),
24 pounds small absinthe
33 pounds green anise seed,
33 pounds long fennel,
33 pounds star anise,
4 pounds coriander seeds,
10 pieces hyssop.

Put all of these ingredients into 125 gallons of fine spirits at 190 proof.

Allow this to remain twenty days, stirring once every day, at the expiration of which time the whole substance is put into a cordial still, together with fifteen gallons of water, and distilled.

The distilling in this case requires great precaution in its management. The heat must be kept uniform throughout the whole operation, so that the liquor will flow very regularly; not too fast, as that would render the product bitter; not too slowly, as it would be milky.

The exact heat required in this instance can only be learned by experience; the operator must be guided by the flavor and aroma of the running liquor, during the process.

When the charge is nearly run off, a fact which is ascertained by comparing the amount distilled, with that which has been put in the still, keep a strict watch for the feints, or low wines; this is indicated by the running stream diminishing in size and the liquor becoming milky.

At this stage of the operation, the receiver must be changed, and the feints run off separately, as they are not suitable for mixing with the clear running. The quality of the product will depend in a great measure on the proper observation of this latter precaution.

If quantity is more an object than quality, or if a second quality is desired, as soon as the feints appear, add more water to the dregs in the still and distill again; this second drawing may be mixed with the first or used as second class goods.

When the distillation is completed, the next thing is to color the liquor.
For this purpose take as follows:
5 pounds mint leaves,
2½ pounds melissa leaves,
3½ pounds hyssop,
5 pounds small absinthe,
5 pounds liquorice root (cut).
1½ pounds citron peel.

Put these ingredients in the liquor which has been distilled, and allow the whole to remain until the desired color is obtained; then draw it off into another cask and reduce the alcoholic strength to 120 proof, or in other words, 60 per cent, and it is ready for bottling.

MARASCHINO.

Take 70 pounds of peach pits, put them into 35 gallons of fine 95 per cent. alcohol.

Allow them to digest four weeks; then pour this substance, pits and all, into a cordial still arranged with a water bath.

Add to this, when in the still, the tincture of 5 pounds of peach flowers.

Distill slowly to prevent the oil from rising, which would impart a bad taste.

As soon as the feints begin to show, (see Absinthe), change the receiver; stop the operation by withdrawing the fire; add 10 gallons of water to what remains in the still; continue the distillation, reserving the last run to be worked off on the next charge.

Reduce the first to 30 above proof, (65 per cent.)

then add 90 gallons of syrup, the same as prepared for Ratafia. (See page 77.)

CURACOA.

This liqueur, when properly made, is one of the most popular in use. It is in great demand by connoisseurs both here and in Europe.

For this purpose, use only the finest quality of high-proof alcohol.

25 gallons alcohol (refined),

55 pounds green orange peel,

50 pounds yellow orange peel,

4 gallons soft water.

Allow the ingredients to infuse ten days, stirring twice each day, after which it is put in a water-bath still, and distilled very slowly.

As soon as twenty gallons have been drawn off, stop the operation; change the receiver; then add ten gallons of water to the material remaining in the still, and continue the distillation until all is run off.

The second run is kept apart and used for preparing a subsequent charge.

The first liquor drawn from the still is the ordinary curacao, before being sweetened, which is done in the same manner as maraschino.

DOUBLE CURACOA DE HOLLANDE.

This is prepared by redistilling the first drawing of the still, mixed with five gallons of water. The coloring is made and put in afterwards; and is composed of the extract of Brazil wood, campeachy wood and yellow wood.
ON BLENDING AND COMPOUNDING.

The term blending, as used in the wine and liquor trade, denotes the mixing of two or more substances, of the same nature, such as strong and weak wines, high flavored brandies with those that are deficient in fragrance, old and new whiskeys, etc.

When wines and liquors are reduced by adding water, and a fictitious alcoholic strength imparted to the mixture, it is called *adulteration*. If drugs and chemicals are employed in connection with alcohol and water, the product is known as a compound. These three operations constitute the art of the compounder. This branch of the business is very extensive and has reached such perfection that experts are often deceived.

The successful results in this as well as in other branches of the business depend in a great measure on the ability and resources of the operator.

The art of artificially imparting qualities to new wines and liquors, identical with those produced by age, as well as the reproduction of chemical compounds, requires not only tact and skill but a certain amount of practical experience, and a thorough knowledge of the composition of alcoholic products.

In preparing the ingredients which are to be employed in the production of artificial wines or liquors the first care is to see that they are properly dissolved, otherwise the union will be imperfect. The improper treatment of one ingredient will sometimes destroy the whole batch; or one substance may neutralize the effect of another. In either case the operation will prove unsuccessful.

It is well known that oil and water will not unite. Oils, fats and some acids form new compounds when mixed with alkalies; some substances will dissolve in alcohol or ether; many ingredients which are not soluble in alcohol are readily dissolved in water.

Roots, herbs and spices when employed, are steeped from seven to fifteen days in spirits and used in the form of tinctures.

It is evident therefore that whatever ingredient is used, unless it is treated according to its constitutional requirements, it will either neutralize the effects, or cause the destruction, of some other body, thus possibly producing an obnoxious scent that will diffuse itself throughout the whole mass.

COMPOSITION OF WINES AND LIQUORS.

Analytical experiments have from time to time been made by expert chemists with a view of ascertaining the nature and qualities of the constituent bodies of which wines and liquors are composed.

The result of these experiments show that, with the exception of the flavoring principle, the component parts are nearly, if not quite, identical, and consist of alcohol, water, sugar, tannin, tartaric acid, acetic acid, fusel oil, glycerine, ammonia and a volatile ether.

When these ingredients are reunited, in the same proportion as they existed before being separated, it will be found that instead of a reproduction of the
wine or liquor as it was before undergoing the analytical operation, a disagreeable repugnant, unpalatable mixture will be the result.

This proves that chemical bodies after having been once set free can not be successfully reunited. Certain changes take place at each successive operation, not in the separating of the component bodies but in their reuniting. No two liquids can be mixed without creating more or less friction. Friction generates heat; heat expands and separates the particles. These particles lose their identity in uniting with others and thus form new compounds, as will be seen under the head of Alcohol Refining.

PERCENTAGE OF ALCOHOL IN WINES AND LIQUORS.

It has been found by distillation that wines and liquors contain alcohol in the following proportion, which however, is subject to variation, especially in wines, some vintages being richer in saccharine substance than others, thereby producing more alcohol.

100 gal. Rhine wine contain 12 gal. Alcohol.
100 " Cider " 9 " "
100 " White wine (Barrac) " 10 " "
100 " Porter " 7 " "
100 " Ale (old) " 7 " "
100 " Ale (new) " 4 " "
100 " Lager beer " 3 " "

One brand, only, of each of these wines and liquors was experimented upon. Some brewers produce much stronger ales and beer than others.

The same may be said of distillers. Rochelle brandies are generally higher in proof than those of cognac, while American whiskies are supposed to be 100 proof. Cider is also variable owing to the quality of the fruit, as well as the manner of production.

HINTS FOR COMPOUNDERS.

In compounding wines, liquors or bitters, there are many obstacles which present themselves.

The spirits may be but poorly rectified, in which case no satisfactory result can be obtained.

If the oils, acids or alkalies, are not properly dissolved they will fail to unite, and in many instances counteract or neutralize the effects of each other. When tinctures are employed in improper proportions, they act in nearly the same manner.

TO REMOVE A BAD TASTE.

If a bad taste has been imparted to whiskey through the indiscriminate use of essential oils or
tinctures, it can be partially if not wholly removed by adding to every forty gallons of the liquor one pound of dried apples and half a pound of dried peaches.

Cut them up fine and allow them to steep in the liquor ten days; then filter the liquor. A bad taste is removed from brandy by treating it in the same manner, using one pound of ordinary raisins and half a pound Malaga raisins, instead of the apples and peaches.

**FLAVORINGS FOR COMPOUNDED LIQUORS.**

**FOR BRANDY.**

A quarter of an ounce of oil of cognac dissolved in sixteen ounces 95 per cent. alcohol will flavor forty gallons of pure spirits.

**FOR GIN.**

A half of an ounce of oil of juniper berries will flavor forty gallons of spirits.

**FOR FRUITY FLAVOR.**

Five pounds of prunes, bruised in a mortar with five pounds of raisins, and steeped eight days in five gallons of spirits, will impart a fruity flavor to two hundred gallons of liquor.

**FOR AN ASTRINGENT FLAVOR.**

Five pounds of black tea boiled thirty minutes in six gallons of water, then pressed to extract the substance and mixed with five gallons of proof spirits, will supply an astringent for five barrels of liquor.

**FOR AN ARTIFICIAL BAY.**

Sweet oil and sulphuric acid both produce a fictitious bay on liquor.

**FOR THE BED-BUG FLAVOR.**

What is called the bed-bug flavor is produced by a few drops of strong ammonia in a barrel of liquor.

**SIMPLE FLAVORINGS.**

Compounders usually make use of the following ingredients when an acidity is required: Cream of tartar, acetic acid, acetic ether, tartaric acid, citric acid, etc., where in fact a small portion of strong vinegar would answer the same purpose.

Tannin, catechu, and kino are employed to impart an astringent, where black tea answers a better purpose.

If liquors require sweetening use plain white syrup.

If they require coloring use burnt sugar, which is called "caramel" by the French; and "coloring" by liquor dealers.

Oil of neroli, anise oil, orris-root, ambergris, musk, civet and vanilla beans, are frequently employed for flavoring liquors. These as well as many other ingredients used are of no use whatever in compounding liquors. The flavorings which have been given under their respective headings will be found quite as good, and sometimes far superior.
FORMATION OF ALCOHOL.

The formation of alcohol is a subject which has received the utmost consideration. Careful and diligent research as well as practical experience teaches us that this substance does not exist in plants. It is not formed in the air. Neither is it an artificial product.

Upon further investigation we find that it is a chemical compound, the result of putrefaction.

Alcohol constitutes the intoxicating portion of wines, beer and liquors.

These liquors all undergo the process of fermentation; this destructive action decomposes the sugar which is contained in the solution, and as the component particles become disunited, alcohol is formed. Of this we have abundant proof as will be shown in the succeeding remarks.

As alcohol owes its origin to sugar, the latter, or a large portion of it, is also a chemical product. Grape sugar is formed by the action of the elements, principally from the starch contained in the grain. This chemical transformation is the first which takes place when the seed begins to sprout, and is called germination.

This is explained in the following manner: It is well known that the germ of every seed is surrounded by a mass of starchy matter to protect and preserve it.

If however this seed becomes damp and the temperature is favorable, it absorbs water and oxygen from the air; this produces heat, which causes carbonic acid to be thrown off. The starchy matter undergoes a change and forms a new substance called diastase. This new substance is capable of exciting fermentation.

Germination is produced on a large scale by the process of malting.

CONVERSION OF STARCH INTO GRAPE SUGAR.

Starch as it exists in plants is not soluble in cold water until it is acted upon by the power of heat.

If a quantity of starch from plants or seeds be placed in an oven heated to a temperature of 300 degrees Fahrenheit, it becomes soluble in water and changes into gum. This gum, when boiled in a weak solution of sulphuric acid, becomes a limpid fluid called dextrose.

When the boiling is continued a few hours, the acid is removed by neutralizing with chalk, the liquid is filtered and evaporated, and it will be found that a mass of solid grape sugar will remain, which will exceed in weight the starch from which it was produced.

This operation then has produced the same result as germination or malting, in converting starch into sugar.

CONVERSION OF SUGAR INTO ALCOHOL.

The second chemical action is the transformation of the sugar into alcohol, which is known as fermentation, and consists of three continuous actions.

The first is the visous, the second, the acetic, and third and last, putrefaction.