The vinous fermentation decomposes the sugar and alcohol is formed; it then stops, and the alcoholic portion is extracted. If this is not done, fermentation commences again.

This second fermentation destroys the alcohol, and vinegar is formed.

If the operation is allowed to continue, the vinegar is also destroyed by putrefaction.

This illustrates the difference in products resulting from the transformation and decomposition of the same substance. First, germination or mashing destroys the starch contained in the grain and produces grape sugar; this in turn decomposes and forms carbonic acid and alcohol.

The alcohol, that is to say the hydrogen which it contains, unites with the oxygen of the air, the alcohol is lost and a substance called acetaldehyde is formed. This in turn is changed into acetic acid, diluted with water. This solution is vinegar.

It may be readily understood that alcohol when formed and obtained by distillation is heavily charged with impurities. While the sugar is undergoing the process of decomposition, a portion of it forms a fatty substance, while another portion is transformed into a gaseous body called ether.

The fatty part is known as fusel oil; the ether is due to the part of the sugar which, after having passed through the vinous fermentation, has continued on its destructive course until reaching the stage where putrefaction sets in, and the substance, being decomposed, reverts back to the elements.

These impurities being lighter than water vaporise with the alcohol and pass over with it; the oil and a portion of the ether are condensed in the worm, while the lighter body, which is known by its offensive odor, being set free, escapes in the air. This accounts for the harshness of all newly distilled liquors.

It is from this oil and ether that they obtain their respective flavors. This harshness wears off in course of time; the oil becomes purified and partly absorbed in the wood, while the ether escapes through its pores.

When new whiskey or high wines are intended for the manufacture of fine alcohol suitable for compounding spirituous liquors or wines, these impurities must be removed, which is done by another process, called rectifying or leaching. (See Leaching.) There is also another method employed which is called refining with chemicals. (See Alcohol Refining.)

ALCOHOL WITHOUT DISTILLATION.

It has been stated that alcohol is obtained only by distillation. This is true as far as the practical method is concerned; nevertheless, to prove beyond a doubt that alcohol exists in wine or beer before distillation, and is not formed but only eliminated, during the latter process; and furthermore that it is not contained in unfermented wine or beer; but is the direct product of fermentation, the following experiment will furnish convincing proof.
Take a small quantity of wine, cider, or beer, being satisfied that no spirits of any kind have been mixed with it; pour this liquor into a glass tube, say a half an inch in diameter, and two feet long; fill this half full of the liquor; then drop into this tube small pieces of carbonate of potash, (this must be perfectly dry), the carbonate will soak up all the water; continue this by degrees, and when the water is all taken up, the pure alcohol will gradually rise to the surface, and stand in a distinct stratum over the other contents.

This method is very frequently adopted for testing the alcoholic strength of wines, cider, beer or ales.

When it is necessary to know the exact quantity contained in any liquor, a graduated tube is used for the purpose.

The tube is somewhat similar to that of a thermometer, only a good deal larger; the length of the tube is divided into one hundred equal parts; this is done on a strip of white paper which is pasted on the outside of the tube. By this means the exact quantity or percentage of alcohol contained in any liquor can be ascertained.

**Absolute Alcohol.**

In the preceding part of this work it has been explained how alcohol is obtained from sugar; how it is formed; how it is separated from the wine or beer, how purified, etc. This purification is practically speaking an incomplete distillation; or if the distillation be complete, the condensation is incomplete, since it is well known that alcohol vaporises easier than water, and its vapor is more difficult to condense than steam, and yet, all the water can not be separated from the spirits. In this manner, the alcohol retains a portion of water so firmly that it can neither be withdrawn from it by distillation, nor by cooling.

In order to procure it absolutely anhydrous, a body must be presented to it which has a greater affinity for water than the alcohol itself.

When such a body is presented it fixes upon the water so firmly that it cannot evaporate with the alcohol at the boiling point of the latter.

When it is desirable to obtain alcohol in such a shape, quick lime is used for the purpose. An ordinary glass retort with one ounce of quick lime, broken in small pieces, and one ounce of strong alcohol poured over it as soon as it is placed in the retort, is all that is required.

As soon as the two ingredients are placed in the glass retort, it is connected with the receiver, and is allowed to remain twenty-four hours.

During this time the lime gradually combines with the water, which the alcohol may contain; this slacks the lime, and in doing so, loses its own identity, whereby the alcohol is left free, and can be distilled off by applying a gentle heat. This should be done by placing the receiver over a water-bath. The distillate will be found to be Absolute Alcohol.
ALCOHOLIC ETHER.

During the process of distilling high wines for the production of alcohol, the first body that comes over and passes through the worm is a gas or what may be properly called a stench. Its odor is remarkably offensive to the eyes and lungs. This gas instead of condensing escapes in the air.

It originates during the process of fermentation.

When the yeast, introduced in the unfermented liquor in order to induce fermentation, has passed the vinous action, it enters the acetic; and while the sugar is being converted into alcohol the yeast having passed both vinous and acetic stages, enters into the last destructive action (putrefaction), and by the time alcohol is formed, is totally decomposed. The volatile portion of this putrefied body being lighter than alcohol, expands when heat is applied, and is forced over by the alcoholic vapors.

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FUSSEL OIL.

Fusel oil is formed during the process of fermentation. It is the fatty portion of the grain. It forms an imperfect combination with other bodies, such as acids, ether, etc.

The peculiar flavors of all whiskeys are due to the presence of this oil. When extracted from the liquor, and purified, it forms the basis of other flavors such as apple oil, pear oil, etc.

MANUFACTURE OF VINEGAR.

Vinegar is a solution of water and acetic acid. This substance, like alcoholic spirits, is subject to impurities. As alcohol owes its origin to the decomposition of sugar, vinegar in like manner is obtained through the destruction of alcohol.

There are several methods by which vinegar is produced. There is however but one principle, which is the action of the air upon alcoholic substances.

When vinegar is made from wine, beer, or cider, the liquor is exposed to the air. The action of the elements produces a slow fermentation; this fermentation decomposes the alcoholic portion of the liquor, wine, or beer, and acetic acid is formed.

When refuse vegetable matter is employed (as farmers often do), it is put into a barrel or hogshead, with eighteen or twenty times its bulk of water. The saccharine matter which it contains, soon ferments and is converted into alcohol, and from alcohol into vinegar.

When, as is often the case, there is not a sufficient quantity of saccharine matter present, instead of fermenting, the whole mass turns to putrefaction.

The great bulk of vinegar which is employed in pickle and preserve establishments, is made from new whiskey, or high wines. The apparatus used for this purpose is called a "generator," and is constructed and operated in the following manner.
VINEGAR GENERATOR.

This consists of a tub, which may be large or small, built for the purpose. Say ten feet high, by four feet wide. It should be made of beech, maple, or ash wood. The tub, A, Diagram No. 13, stands on end, on a scaffold two feet from the floor.

Instead of the upper head, B, being placed at the top, it is fitted two feet below the upper end of the staves.

This head, or shelf as it may be called, is perforated with small holes, four inches apart. In these holes are placed straws or pack cord. Between these small holes there must be a number of half-inch holes into which glass tubes, C, are inserted. These tubes project upwards to near the top of the staves.

The sides of the tub from the shelf down to within two feet of the bottom is also perforated with numerous large holes. This tub is nearly filled with beech shavings which have previously been saturated with strong vinegar. The generator is now ready for use.

CONVERTING ALCOHOL TO VINEGAR.

To perform this operation, wine, beer, ale, porter, cider, whiskey, or alcohol may be employed.

When the two latter are used they must first be reduced to the consistency of wine or cider.

The substance to be converted into vinegar is poured in at the top of the tub to within one inch of the upper ends of the glass tubes, and as it filters through the shell it is replaced by fresh liquor.
As the liquor filters through or between the straws or pack cord, it diffuses itself over the shavings, and forms a very thin liquid layer which presents to the air a surface many thousand times more extensive than was produced by any former method.

It is erroneous to suppose, as some do, that the shavings have anything to do with the formation of vinegar, except in supplying the necessary surface.

The object of perforating the tub on all sides is to secure a free circulation of air. This is indispensable. As the cold air enters through the holes in the sides of the tub it comes in contact with the alcohol which is diffused over the shavings. The alcohol absorbs a portion of the oxygen in the air; this generates heat, or slow combustion. The temperature within the tub therefore rises, the air becomes warmer and consequently lighter, which causes it to ascend and escape through the glass tubes. As it escapes, the cold air rushes in and thus the interior of the tub is continually supplied with fresh air.

In this process of manufacturing vinegar it is necessary before commencing the operation to saturate the interior of the tub as well as the shavings with strong vinegar and also to mix a little with the material to be employed.

**VINEGAR BY THE QUICK METHOD.**

For this purpose an ordinary still is employed. The grain is mashed and fermented in the same manner as for the production of whiskey. It is then run into the still.

As the vapors arise, instead of being conducted to the worm, and there condensed into liquid, they pass directly through a number of tubs filled with beach shavings. These tubs are so arranged that the first empties into the second, the second into the third and so on and finally comes out of the last one very strong vinegar.

The foregoing methods are intended for manufacturing purposes; vinegar intended for family, or hotel use is prepared in a different manner. Some choice vinegars are obtained by artificial flavoring, as is the case with what is called French vinegar.

**FRENCH VINEGAR.**

This is prepared in the following manner:

1 ounce long pepper.

1 ounce ginger.

1 ounce pyrethra.

Bruise these, and put them into a saucepan over a rather brisk fire. Add one and a half gallon of white wine.

When it comes to a boil, remove it from the fire; transfer it to a porcelain vessel, and let it stand in the sun, or over an oven, in fact, any warm place will answer.

As it cools, add more wine heated as before, about three quarts at a time; transfer this into a wooden keg; place the keg in a warm place, and as the liquor cools add more warm wine, three quarts at a time, until it amounts to ten gallons, then add to this three quarts of strong vinegar.
FRENCH VINEGAR POWDER.

For the use of travelers, tourists and explorers, who find it difficult in many countries to procure good vinegar, a powder is prepared in the following manner:

Wash half a pound of white tartar with warm water, then dry it thoroughly. Pulverize it as fine as possible. Soak the powder in good, sharp vinegar and dry it again. Repeat this ten or twelve times. The drying process can be accomplished either in the sun or an open oven.

By this method a thoroughly impregnated vinegar powder is produced, so powerful that a few grains will convert water into vinegar in a moment.

The explanation of this process is that water evaporates much more readily than acetic acid.

By soaking the powder in vinegar and drying, the water evaporates and leaves the acid behind; this combines with the solid matter and becomes fixed. When the soaking is repeated, and again dried, more acetic acid is retained by the tartar. It will be readily understood therefore that the oftener the operation is repeated the stronger will be the powders.

DISTILLING VINEGAR.

Vinegar is sometimes distilled in order to strengthen it. This operation is the opposite of distilling liquors. Water is more volatile than acetic acid, and as the water evaporates by distillation the vinegar becomes stronger and is withdrawn from the bottom of the still richer in proportion to the amount of water extracted.

THE CONTINUOUS RECTIFIER.

This is a comparatively new French invention. It was first introduced, and is now in use at La Maison Caille, Paris, France, which is no doubt the most extensive rectifying works in that country, if not in the world.

This new system is so different from the American as well as the English methods, that it is with a somewhat reluctant feeling that I now for the first time attempt a comprehensible elucidation of this complicated French method for the production of fine deodorised alcohol. My reluctance is owing to the fact that my practical experience in the working of the apparatus has been rather limited; not sufficient in fact to warrant me in passing upon its merits, or imperfections.

This new system, it is claimed, possesses the following advantages:

**First:** Economy in time and fuel.

**Second:** The double action by which fine alcohol is distilled in one part of the apparatus at the same time that the feints, or low wines, are being distilled off in the other part.

**Third:** In keeping the alcohol column sweet and clean by excluding low wines from its chambers.

**Fourth:** The system of employing three-way cocks which act simultaneously by closing one outlet and opening another.

**Fifth:** By utilizing the exhaust steam from one still to run off the low wines and feints in another.
CONSTRUCTION OF CONTINUOUS RECTIFIER.

Two boiling kettles or stills (A and AA, Diagram No. 16) built in the usual manner, are placed on a brick or stone floor, six feet apart. A stout platform is built in the rear of this intervening space upon which rests the column B, and an appropriate scaffolding to support the colonette C. The column is sixteen feet in height by forty-two inches in diameter, and is composed of eight sections, each section forming two chambers. The colonette is nine feet in height, by twenty-four inches broad, and is composed of six or eight chambers, each chamber forming one section.

Each of these sections is formed into a cylinder, with an out-turned rim extending two and a half inches, by which the different sections are secured when in position.

Each of the large sections contains a perforated copper plate, (N, Diagram No. 14) which is both riveted and soldered in the centre of each, giving it the appearance of a huge strainer.

These plates are perforated with quarter inch holes, one and a half inch apart. The holes are punched in with an ordinary hand punch on a block of wood; when the plates are hammered after punching, it leaves the holes three-sixteenths of an inch which is the proper size.

When the eight large cylinders are thus prepared, a bottom plate (F, Diagram No. 14), is riveted to one of them, and a dome covering is riveted to another. These two form the top and bottom of the column.
Seven plates are then prepared which extend to the outer edge of the out-turned rims of the cylinders. These are also perforated in the same manner as the centre plates.

A five-inch copper pipe, D, is then inserted through the side of the cylinder containing the bottom plate. This pipe is bent downward and extends to within four inches of the bottom plate. A one-and-a-half-inch pipe E extends (six inches outward) from the side of the cylinder on a level with the bottom, both pipes being fitted with a brass collar-flange.

The column is then set up as follows: The section which is fitted with a bottom is placed on the platform with one of its two pipe connections facing each of the two stills; a loose perforated plate is placed over it, then an open section, and another loose perforated plate.

This is continued up to the last open section, the loose plate in this case being different from the rest. A copper basin, C, is soldered on to this plate midway between the outer edge and the centre.

This basin is six inches broad by six inches in height. A pipe, B, of one and a half inches diameter is passed through the side of the topmost section, one inch below its centre plate. This pipe is bent downward in such a manner that when the upper section is put in place, the pipe will reach to within one and a half inches of the basin. This is termed a "plunger."

The top, or domed section being in place, the colo-nette is built up in the same manner, and clamps adjusted. (The clamps are described further on.)

The pipe connections are then adjusted. Two large three-way cocks (D, and DD, Diagram No. 16) are placed, one over the centre of each still; these two cocks are connected by means of a five-inch copper pipe, I, with a T joint, V, in the centre by which they both connect with the column, B.

From the opposite outlet of each cock another five-inch pipe (H, and, HH, respectively) connects the two to the bottom of the colo-nette, C. It will be seen that by opening these cocks on to the column it closes them on the colo-nette and by reversing the action they open on to the colo-nette and close on the column.

The return pipes from the column are connected by means of another three-way cock, d.

A one-and-a-half-inch pipe, W, leads from the bottom of the column to the centre of the intervening space between the two stills, and is connected to the three way cock, d. From this cock two pipes, J, J, diverge in opposite directions, and pass through the breast of each still, and are carried to within two inches of the surface of the steam coil which covers the bottom of the stills.

A one-inch three way cock, Y, serves to connect the colo-nette to the stills in like manner. In this instance the cock is adjusted to the bottom of the colo-nette, from which the two pipes, K, K, diverge, and are carried to, and through the breast of the two stills, near the bottom.

These return pipes serve to convey the condensed liquid, as it accumulates, back into the stills.

The steam fitting comes next. As a general rule, the steam boiler is placed in some outbuilding, or in
and opening 2 and 4, the exhaust passes off into a
tub known as the exhaust tub, the contents of which
serve to feed the steam boiler. By closing 1, 2 and
3, the exhaust passes from still, A, into and through
the coil of still, AA, and escapes through 4. This will
be more fully explained hereafter.

The dome of the column is connected with the
goose, L, and the goose, L, with the worm, M, in the
same manner as the American column, which has
been fully described in a preceding part of this book.

The colonette however differs in its connections.
Instead of a goose and worm, it connects from its
dome to what the French term, Le petit condensateur,
which acts in the double capacity of goose and worm.

A special description of which will be found under
the head of “French Condenser.”

THE CLAMPS.
French distillers and rectifiers when constructing a column, or other works of that description, instead of employing large flat iron rings, together with screw bolts, in order to secure the different sections one over the other, use what are called Clamps (see cut). These possess a great advantage over the iron flange system. The time required in building up the column is lessened by more than half. In case of a leak, a light tap with a hammer on the two or three clamps where it occurs will stop it at once.

These clamps are forged by hand of what is known as horse-shoe iron.

**Description of Diagram No. 16.**

A. **AA.** Two ordinary still kettles.
   B. French column.
   C. Colonetta.

D. **DD.** d. Three three-way cocks.
   E. Steam feed pipe.
   F. F. Exhaust steam pipes.
   G. Try cock, or side cock.

H. **HH.** Two vapor pipes to colonetta.
   I. Main connecting pipe for vapors.
   J. J. Two return pipes from column.

K. **K.** Two return pipes from colonetta.
   L. Goose tub.
   M. Worm tub.
   N. Condenser tub.
   O. Two discharge cocks.
   P. Return pipe from goose to column.
   Q. Air chamber.
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DESCRIPTION OF DIAGRAM NO. 16.

A. AA. Two ordinary still kettles.
B. French column.
C. Colonetta.
D. DD. d. Three three-way cocks.
E. Steam feed pipe.
F. F. Exhaust steam pipes.
G. Try cock, or side cock.
H. HH. Two vapor pipes to colonetta.
I. Main connecting pipe for vapors.
J. J. Two return pipes from column.
K. K. Two return pipes from colonette.
L. Goose tub.
M. Worm tub.
N. Condenser tub.
O. Two discharge cocks.
P. Return pipe from goose to column.
Q. Air chamber.
R. Return pipe from condenser to colonette.
S. Safety cock at foot of air chamber.
T. Connection between upper and lower condensers.

1, 2, 3, 4. Four globe exhaust valves.
5, 5. Two screw caps used when charging stills.
6, 7. Two steam globe valves.
8, 8. Two pipes leading to exhaust tub.

TO OPERATE THE CONTINUOUS RECTIFIER.

Fill the still, A, with the liquor which is to be converted into alcohol, until it commences to trickle from the side cock, G.

Close the cock, and remove the charge hose, screw on the charge cap, 5.

Turn on the steam gradually at 6. Close exhaust valves, 1, 2 and 3. Open 4.

Open valve, D, on to the colonette, C.

Open valve, D D, on to the column, B. This puts the apparatus in the first running order.

As soon as the liquor becomes heated to the boiling point of alcohol, the vapor rises and will pass through the colonette in about fifteen minutes. When this vapor reaches the condenser it is checked, condensed, and returned to the colonette, this continues an hour or more, when the liquor begins to flow from the outlet of the condenser.

As soon as this occurs, the water must be turned on at the bottom of the condenser tub. This must be done very gradually and regulated according to the run of the liquor. Should the volume of water be excessive, it will prevent the flow of the liquor. If it should be insufficient, the liquor will run at a temperature of 90 or 100 degrees instead of 60 which is the proper temperature.

When the cold water has been so regulated that the proper temperature is attained, allow the low wines, together with the ether and other foul odors, to run off into the low wine tub.

When the liquor begins to run sweet close cock, D, from the colonette. This opens it on to the column.

Open return cock, d, on to pipe J, which leads through the surface of the still, A, to near its bottom. In the course of about two hours, the alcoholic vapors will pass through the column, the goose, and enter the worm, which condenses them into liquid, and 75 per cent. alcohol will flow from the outlet at the rate of 120 gallons per hour.

As soon as the flow of alcohol commences the water which is used for cooling, must be regulated. That which enters the worm tub serves to reduce the vapors to liquid. The water which enters the goose tub regulates the alcoholic strength of the liquor. While this charge is running off, the other still, AA, is charged, in the same manner as the first. When this is done, the side cock, G, closed, and the screw cap, 5, adjusted.

Change the exhaust valves as follows: Close 2, open 3 and 4. This will conduct the exhaust steam through the coil of still, AA, and will escape through valve 4, into the exhaust tub.

It will be found that by the time the high proof alcohol is run off, through the column, and indicates
an increase in temperature, that the liquor in the second still has run off its low wines through the colonette.

At this point two persons are requisite to make the change, one is stationed at three way cock, D, and the other at DD. These two cocks are reversed simultaneously. This action turns the first still, A, on to the colonette, and the second on to the column. The cocks on the return pipes being changed in like manner.

The exhaust valves, as well as those which supply the steam, are then changed.

6 is closed, 7 is opened. 3 and 4 are closed, and 1 and 2 opened.

Then the remains of the first charge is run off as low wines through the colonette, by the heating power which is supplied by the exhausted steam.

When this is accomplished and no more alcoholic substance remains in the first still, A, open side cock, G, open valve, 4, close 1, 2 and 3. Open discharge cock, O, and allow the drags to run off.

Remove the screw cap, and charge the still anew.

By this means the fine alcohol flows continually day after day without cessation.

It may be remarked that the first passage of the low wines through the colonette and condenser causes a delay of about one hour, and that of the alcohol, another delay of two or more hours. The cause of this is due to the fact that the water in the condenser and goose tubs was cold, and had to be heated by the ascending vapors, to the boiling point of alcohol. When once the water has been heated and is main-

ained at the proper temperature this difficulty is overcome and the process thereafter continues as long as the two stills are kept in alternate operation.

THE FRENCH CONDENSER.

The construction of this device may be explained as follows:

Two copper cylinders are formed in such a manner that when placed one inside of another there shall be a space of one inch between the two, through which the vapors pass.

Two copper cylinders (See 1, Diagram No. 17), each five feet in length by four feet in breadth with ends contracted four inches cylindrically, and five inches longitudinally (each end), forming the shape of the mouth and neck of a fruit jar. Then a perfectly flat rim, extending from the inner portion of each neck, six inches outwards, is firmly soldered to each end of both cylinders.

These two being ready, two other cylinders 2 and 3 are formed of a uniform diameter. They are each five feet in length by fifty inches in breadth. To one of these, 2, is adjusted a four-inch copper pipe, C, one inch below the upper edge of the cylinder, as it stands on end, and another, D, five inches above the other end, on the reverse side. A one-and-a-half-inch pipe, G, is adjusted at the extreme end of the cylinder on a line with the first four-inch pipe. All of these pipes are made to project twelve inches outwards. This cylinder is placed on the outside of one
made after it is placed in the top. The pipe connections are in the sides of the top, the pipe connections are strips which are soldered to the drum, and secured strips which are secured by means of iron and to the upper surface is secured by means of iron which is soldered to the bottom of the top, which is soldered to the bottom of the top.

This constitutes the condenser. It is then provided with a safety cock, a, which is mounted on the center, to which is attached a vacuum chamber, b, in the center, to which is (see Fig. 4, Diagram No. 19) placed in a vacuum chamber. The lower one is then connected by a four-inch pipe. The upper one is then connected by a four-inch pipe. The upper one, the lower one, and the inner side of the bottom of the upper drum, and the inner side of the top, which is soldered to the bottom of the top, which is soldered to the side of the lower

The upper section is then placed above the lower section, which are mounted in this shape. Known as double drum's, which are mounted in this shape. Known as double drum's, the upper edge of the cylinder is formed in the manner, with the exception of the lower section, (see Fig. 3, Diagram No. 17) is

The lower section is known as the upper section of the condenser.
of the contracted ones, 1, and is firmly soldered at both ends, to the extending rims of the inner one.

This then is known as the upper section of the condenser.

The lower section, (See Fig. 3, Diagram No. 17) is formed in like manner, with the exception of the second four-inch pipe, D, which is placed one inch below the upper edge of the cylinder.

Four stout galvanized iron legs, twelve inches in length, are then soldered to the bottom of each section, which are, when in this shape, known as double drums.

The upper section is then placed over the lower one, and the legs soldered to its surface, at the outer edge. (See Diagram No. 18.) In placing these two sections the four-inch pipe which is placed five inches above the bottom of the upper section must be in a diagonal line, over the corresponding pipe which projects from the upper side of the lower section. These two pipes, one of which is the outlet of the upper drum, and the other the inlet of the lower one, are then connected by a four-inch pipe, D, (see Diagram No. 18) bent in a semi-circular form, with a vacuum chamber, E, in the centre, to which is attached a one-inch safety cock, F.

This constitutes the condenser. It is then placed in a tub built for the purpose; the legs, J, J, J, upon which it rests, are bolted to the bottom of the tub, and the upper surface is secured by means of iron straps which are soldered to the drum, and screwed to the sides of the tub. The pipe connections are made after it is placed in the tub.
A circular iron plate is placed over the centre of the bottom of the tub, where the water is let in, in order to force the water to spread as it enters.

When this condenser is connected to the colonette and the vapors enter the upper section, the rotundity of the inner cylinder causes a diversion in three directions. There being but one inch space between the two cylinders, the action of the cold water on both sides causes a rapid condensation of the vapors, which are returned to the colonette in a liquid form.

This continues until the water in the upper portion of the tub becomes heated up to the boiling point of alcohol. At this point the more volatile portion of the vapors pass through the outlet of the upper section into the inlet of the lower section and are there condensed into spirits, called low wines, or feints.

EXPLANATION OF DIAGRAM No. 18.

A, B. Two double cylinders.
C. Inlet.
D. Connecting pipe from upper to lower section.
E. Air chamber (or vacuum).
F. Cock used when necessary to relieve section A, when running foul.
G. Return pipe to convey the condensed liquid back to the colonette.
H. Outlet for alcoholic liquors.
I, I, I. Supports between upper and lower sections.
J, J, J. Three legs upon which the structure rests inside the tub.
THE ACTION OF THE COLUMN.

It has been explained in describing the American column, that the cause of the purification of alcoholic vapors within the column was due to their passage through the water, or condensed liquid, at the bottom of each successive chamber. The present system differs in as much that the action is reversed and the condensed liquid is made to pass through the ascending vapors in the form of rain drops as will be clearly demonstrated.

When the alcoholic vapors pass from the still and enter the lower chamber of the column, they spread and are carried through the perforated plates of the various sections and escape, through the pipe on the dome, into the goose.

The cold water in the goose tub causes the vapors to condense. This condensed liquor is conveyed from the lower curves of the goose, through the return pipe, P, (Diagram No. 16) into the upper portion of the column, and is discharged into the basin, C, (Diagram No. 14) which is placed on the surface of the perforated plate. As this basin overflows, the liquid spreads over this plate, being prevented from passing through the perforations by the force of the rising vapors. This continues only until the bulk of the liquid has increased to the extent that its weight equals the pressure of the rising vapors.

Here the purifying operation commences, both forces being equalized, the heaviest portion of the liquid as it drops through the perforations falls on the surface of the plate below.

Its lighter substance being again vaporized, ascends with the lightest portion of the rising vapors. By this means, of one force acting against the other, and with a well regulated steam pressure, the liquid on each plate will attain a uniform depth, of about two inches at the upper section, and gradually increasing on the lower plates up to four inches near the bottom. This however is only temporary. While this dripping, condensing, and re-evaporating is progressing, the water in the goose tub becomes heated; its condensing power is gradually decreased, and the accumulation of liquid on the upper plates of the column diminishes. This is succeeded by a proportionate decrease on the underlying plates, down to the bottom of the column.

By this time the vapors course their way through the multitudinous bends of the goose and enter the worm, where they are liquidified into alcohol. As soon as the alcohol commences to flow, a stream of cold water is allowed to enter the worm tub, from the centre of its bottom.

This stream is so regulated as to ensure the proper condensation of the alcoholic vapors, which should flow at 60 degrees temperature.

Water is then let in to the goose tub. This must be done with the utmost precaution; should the flow of water be excessive the alcoholic vapors will condense in the goose, and be returned to the column, thereby causing a cessation of the flow of alcohol; should the water be inadequate, the vapors will rush through the goose in the same state as they emerge from the column. This increased pressure forces the
contents into the worm, completely filling the outlet. The great condensing power of the worm continues to act, causing a vacuum between the outlet and the goose connection, the temperature of the running liquor increases rapidly, while the alcoholic strength diminishes. If this continues, the apparatus runs foul, and if not relieved in a short time, the bottom of the still is blown out, or the column bursts. This will serve to illustrate the cause of, and the manner of obviating, this calamity. Should this occur at any time, or while running any kind of a distilling apparatus, there is but one remedy:—Shut off both steam and water, until the apparatus has regained its normal condition.

The colonette acts in precisely the same manner as the column. Its annexed condenser, however, differs from the goose and worm.

As the vapors from the colonette enter the upper portion of the condenser, the space between the two cylinders being but one inch, and the condenser being immersed in cold water,—the condensation is much more rapid than that produced by the goose or worm. The condensed liquor drops to the bottom of the upper section and is returned to the colonette, while the more volatile vapors pass through pipe D, (Diagram No. 18) to the lower section, and are condensed into low wines.

These two double cylinders, which constitute the condenser, are usually placed in one tub, and the cold water introduced from the centre of the bottom, thus the fresh water as it enters, spreads, and forces the surface water as it becomes overheated, to over-

flow from the side of the upper portion of the tub, where a tin channel is placed for the purpose of conveying it to the exhaust tub. In some cases, however, where the ceiling is not of a sufficient height to admit a tub of such dimensions, the two double cylinders are placed in separate tanks and on two different floors, the connecting pipes passing through the flooring.

THE EPROUVETTE.

Old fashioned distillers receive the liquors as they flow from the outlet, called the tail of the worm, into what is known as the distributing box. This consists of a common square copper box which is attached to the side of the worm tub, at the place where the lower portion of the worm passes through the tub.

Various pipes lead from the bottom of this box to different receiving tanks. The strength of the running liquor is ascertained, by dipping it from the box, immersing a hydrometer in it, and at the same time plunging a thermometer in the liquor to find its temperature. The adoption of the device known as the eprouvette dispenses with this tedious method.

The eprouvette is composed of two copper pots one inside of another. The large one, B, (Diagram No. 19) being twelve inches in height by eight inches diameter. The inner one, A, fifteen inches in height by six inches across. These two pots contain but one bottom. The inner pot has an out-turned lip, K, extending half an inch and reaching around one-half the circumference of the rim. This double pot is
Facts About Alcohol

At all times, the strength and temperature of the running liquor remain the same. The distillation box, as soon as the liquor begins to flow, the hydrometer shows the lowest point at which the liquor flows from the worm to enter the still. The liquor is carried through the spout, into the box where it is carried through the spout, into the still, into the outer box, and overflows into the pipe, into the outer box, beyond the inner pipe. As the water of the still, so the upper pipe, a thermometer, the water and its pipe. The pipe, C, leaves from the outlet of the worm and enters the distillation box, resting on the center...
placed in the distributing box, resting on the centre of its bottom.

A pipe, C, leads from the outlet of the worm and passes through the end of the box near its top and through the sides of both the outer and inner pots near their bottom. A spout, D, is formed on the side of the outer pot, two inches below the upper edge, opposite the inlet pipe. A thermometer, E, fastened on a wooded frame is suspended to the back edge on the inside of the inner pot, opposite the outer turned lip. A hook which is fastened to the exact centre of the back of this instrument and bent to fit the edge of the pot, serves to keep it in position. As the liquor flows from the worm, it enters the inner pot and overflows over the lip K, into the outer, from whence it is carried through the spout D, into the distributing box H.

As soon as the liquor begins to flow, the hydrometer, F, is immersed in the alcohol, where it remains during the run of the whole charge. Thus indicating the strength and temperature of the running liquor at all times.

FACTS ABOUT ALCOHOL

It may be interesting to some of the readers of this book to know that of all liquids known to science, be they natural or artificial, crude or refined, dense or rarified, alcohol (next to water) is the most wonderful, the most perplexing, the most subtle, and yet the most flexible, and its uses the most diversified.
Its scope as a useful as well as a destructive agent appears to be unlimited.

THE PROPERTIES OF ALCOHOL.

Alcohol is a light, transparent, colorless fluid, very mobile, highly volatile and inflammable; when hydrated, it burns with a pale blue and smokeless flame; but when anhydrous, the flame is whitish, and deposits carbon on a cold body.

It mixes in all proportions with water, undergoing no chemical change, and therefore easily separated again from water. In its mixture with water heat is evolved and temporary expansion, but ultimate condensation when the normal temperature is restored; this condensation, however, only occurs when water is present in certain proportions; when it exceeds these the mixture undergoes sensible expansion.

Its mixture with water exhibits a higher specific gravity than the mean of its constituents. This, according to Rudberg, is greatest when 53.739 volumes of alcohol are mixed with 49.386 volumes of water at 59 degrees Fahr., the resulting compound measuring only 100 volumes, and having a specific gravity of 0.927.

Anhydrous alcohol boils at 173.1 degrees Fahr. When diluted with water, its boiling point rises in proportion to the amount of water added.

Alcohol has never been frozen. At 166 degrees below zero it becomes of the consistence of castor oil, but does not solidify. Between 15 degrees below zero and 99 degrees above, it expands with great regularity at the rate of .00047 part of its volume for every degree of rise in temperature. At other temperatures its expansion is anomalous.

TESTS FOR ALCOHOL.

Pure alcohol is colorless; is neutral to test paper; evaporates entirely by heat, leaving no residuum; its boiling point should never be below 170 degrees Fahr.

Fusel oil, if present in alcohol, will be discovered by the use of nitrate of silver, in the following manner:—Dissolve 10 grains nitrate of silver in 1 ounce pure distilled water. Into half a tumblerful of the alcohol drop 25 drops of the nitrate solution. If fusel oil is present, a black powder will be found floating on the surface. To make this test effectual, it may sometimes be necessary to wait some hours before examining the result, under exposure to a strong light, in order to discover the least traces of fusel oil.

Its presence may also be detected by half-filling a test tube with alcohol, and slowly filling up the tube with pure concentrated sulphuric acid. Impure spirit will become colored in proportion to the amount of fusel oil in the alcohol.

A very effective test of the strength of alcohol is based on its strong affinity for chloroform. By using a graduated glass tube, a measured quantity of chloroform is introduced, and a given quantity of alcohol is added. When well mixed together and then left to subside, the chloroform takes up the pure alcohol, and the water, being lighter than chloroform, will float on the top. It will be understood that to
make this test effectual, the quantity of chloroform must be large in comparison with the amount of the alcohol to be tested.

For all general purposes, the specific gravity of alcohol will be a correct test of its actual strength.

PHYSICAL EFFECTS OF ALCOHOL.

That alcohol is beneficial to health under certain conditions is attested by the numerous prescriptions which contain it, in whole or in part, which are issued by learned physicians both here and abroad.

The proof that it is a malignant destroyer may be found everywhere. Not only among the poor outcast and habitual inebriates who have passed the boundary line and have become irremovable drunkards, but among the wealthy or well-to-do denizens of our land; and what is somewhat surprising is the fact that many of its slaves are men of high social and professional repute.

Alcohol is a fantastical fluid replete with capricious freaks. It is soothing, and yet exciting. It is reliable when properly employed, and withal a veritable fiend, robed in the guise of a saint, ever ready to lure its victims to mental, if not bodily destruction, should they be so unfortunate as to overstep the safety mark.

This however need not detract from its many good qualities, nor can it efface its virtues.

This enigmatic fluid may be looked upon as the most astonishing curative substance known to science and an inestimable boon to the human family.

It may appear somewhat ludicrous, although it is an everyday occurrence, that the medical faculty in general, while condemning the promiscuous use of alcohol (a commendable action on their part), are in the constant habit of prescribing it to their patients.

To some, light wines; to others, heavy wines, or bottled ales and porter, and in many instances brandy, rum, whiskey, etc.

As a rule when prescribing strong liquors, the attending physician will remark, "get the best French brandy," knowing full well (or he should know), that in ninety-nine cases out of a hundred, pure French brandy is unprociable.

Why French brandy should take precedence over other liquors of the same alcoholic strength is a question that medical men find rather difficult to answer. They may, if disposed to be communicative, inform you in a confidential manner that there is something about French brandy that does not exist in other alcoholic liquors.

What is that something?

It is an acknowledged fact, authenticated by our most celebrated chemists, that alcohol, no matter from what source it may be obtained, whether from grapes, apples, pears, peaches, cane sugar, wheat, corn, rye or other vegetation, is identically the same in every respect, that is to say, when freed from its impurities.

What are its impurities?

Fusel oil, with minute particles of acids, sugar, glyceroine, tanin, etc.

It has also been demonstrated that fusel oil is the chief offensive ingredient, and that it exists in all unrectified spirituous liquors. Thus, the benefits to be
obtained when strong liquors are prescribed may be attributable to the alcoholic portion of the dose.

Whence then comes this tendency to discriminate in favor of the French rather than the American product, when both possess like qualifications?

These remarks are not intended to apply to wines, beer, ales or porter, which are known to possess invigorating properties, but are confined to distilled products.

**ALCOHOL AS AN ANTISEPTIC.**

There are three powerful antiseptic substances used throughout the civilized world for various purposes, one of which purposes and an important one, is their aptitude in preventing decay in other bodies.

These three substances are known as *Alcohol*, *Sugar*, and *Vinegar*.

One only of these three may be viewed as a natural product, and that only partially so, since starch is convertible into sugar. It may be worthy of notice that sugar, alcohol and vinegar—all three emanating from one source—act upon organic bodies with nearly equal force in preventing decay.

Compare this with the fact that the starchy envelope which surrounds the germ contained in every seed is capable of preserving its vitality for thousands of years. It may then be possible for the attentive observer to form some conception of the power which not only exists, but is in a manner indestructible, in this saccharine family, over which even the action of fire only serves to set the component atoms free, that they may rejoin and take part in elementary systems and assist nature in reproducing similar plants or seeds.

**ALCOHOL AS A STIMULANT.**

It has been demonstrated how, when sugar has undergone what appears to be a complete transformation, the beneficial portion remains, or more properly speaking, is transferred to the newly formed substance—Alcohol.

It has been shown that alcohol is the basis of all wines, beer, ales, porter, bitters and other stimulants; it has been proved that alcohol is the life and the preserver of these various liquids, without which the whole fabric would fall to decay.

In the face of all this, who is there bold enough to aver that alcohol when properly employed is not as beneficial to the system as sugar or bread?

A surfeit of either will cause excreting pain and distress. The numerous ailsments which are the direct results of over eating outnumber those that are due solely to the use of alcoholic substances.

The action of alcohol upon the nerves is that of a stimulant. It excites them according to the quantity taken, at times to an unnatural degree of activity.

This heightened action is carried to the heart, causing it to beat with greater force; thus quickening the circulation of the blood; the stimulus is thereby conveyed to the brain.

When alcohol is taken in small quantities it serves as a moderate excitant. It gives tone to the mental faculties and promotes mirth and merriment.

When taken in large quantities the effect changes
The sense of exaltation gives way to moroseness; disagreeable thoughts flash through the brain, the intellect is weakened, images and fantastical ideas succeed each other with bewildering rapidity. The brain whirls; the victim loses his balance and falls.

If left alone, the office of the brain relaxes its functions and a state of torpor resembling sleep follows, after which a sickly reaction takes place lasting from one to five days. This however is not always the case. There are instances when from the very moment of imbibing the first potion a sensation as if of hatred seems to overpower every good feeling. The victim imagines himself at enmity with some imaginary foe, resents every offer to tranquilize his mind. To use a slang phrase, “he is full of fight”; and unless some friend knocks him down and conveys him home he is very apt to commit a treacherous act or assault on some inoffensive creature usually weaker than himself. Curious as it may seem this state of inebriety gives rise to the same low cunning that is so remarkable among the insane. No amount of intoxicants will suffice to subdue the animal strength of this class of inebriates.

Neither in appearance nor demeanor can the least sign of alcoholism be discerned.

None but habitual drinkers are ever affected in the manner just described. It appears that alcohol acts with unequal intensity upon different parts of the nervous system. It makes choice of certain regions of the brain. This is proven by the unequal excitement which is produced upon different persons of diverse temperament.

In one, it stimulates energetical powers of action and thought; in another, it excites jealousy and envy; a third is surfeited with vanity and egotism; a fourth becomes demented; the fifth, joose and merry.

People with harsh and discordant voices imagine themselves vocalists; orators without eloquence, misers who become spendthrifts, as well as wise men who make fools of themselves, may all be considered in this same category.

ADULTERATION OF LIQUORS, ETC.

The system of adulterating wines and liquors is not, as is generally supposed, confined to the production of the lower grades of beverages. On the contrary it is known to be a universal custom, and is in many instances of great benefit to the wine or liquor so manipulated, as by this means the offensive ingredients which form part of the wine or liquor become modified or neutralized.

French brandies of every description, from Cognac to La Rochelle, undergo more or less adulteration.

Some of these brandies are too high flavored, others are almost devoid of these qualities.

Some are remarkably astringent while a large portion are what is termed flat. There appears to exist some peculiarity in all brands by which they are easily distinguishable, especially by experts.

These various crude products are usually conveyed to some one or other seaport where the blending is consummated. Large quantities of alcohol enter
into this blending process; in many cases ten parts of reduced alcohol to two parts of the mixed brandies.

The greater portion of alcohol that is exported from the United States to France is returned to us as French brandy. It must be admitted that there are a few exceptions; these however do not benefit the public in general, as they are confined to private importations.

This may appear strange. Nevertheless when the cause is made apparent it may be more readily understood.

Newly distilled brandies are without exception harsh, rank, disagreeable and in some cases noxious (the same may be said of all other alcoholic liquors); where it is practicable to allow these to repose a few years they become mellow and what is usually termed ripe. The wood in which they are stored, usually oak or ash, seems to absorb the offensive odors and at the same time supply an astringent (tannin). Producers cannot afford to wait so long a time, and there being no demand from consumers for the newly distilled liquors, they are obliged to dispose of their product to what we in this country call Compounders, or Rectifiers, and in France Fabricants, or (vulgarly) empôisonneurs, which means poisoners. These experts by means of art and artifice will produce in a few days an article that will compare favorably with from four to six year old brandy; and were the two offered to any, save an expert, the preference would invariably be in favor of the mixture rather than the pure, but new distillate.

There is a strange peculiarity about mixing alcoholic liquors that is not generally understood; or, if understood, is often overlooked. It is this:—

When alcohol and water are united, it is generally assumed that if one hundred gallons of 95 per cent. alcohol and an equal quantity of water are mixed (both being at a temperature of 60 degrees Fahr.) that the amount and strength of the mixture will be two hundred gallons of proof liquor. So positive are a good many liquor dealers of this that it is doubtful whether or not the following explanation will suffice to convince them of their error.

100 gallons of 95 per cent. alcohol contain
95 gallons absolute alcohol.
5 gallons water.

Add to this 100 gallons of water and we obtain a mixture composed of 105 gallons of water to 95 gallons absolute alcohol. This proves that, in order to obtain standard proof liquor, ten and one-twentieth of a gallon of alcohol must be added to the first two hundred gallons, in order to offset the ten gallons of surplus water.

The cause of this error is easily explained. When alcohol and water are united heat is generated. This is caused by friction. The friction is due to the commotion which is set in motion by the chemical action of the alcohol on the water, or the water on the alcohol as the case may be.

The mixture for a few hours will show a fictitious alcoholic strength. It may be observed, however, that it has in the meantime, and while undergoing the process, gained a corresponding degree of temperature; both of which disappear after standing a day or two.