DISTILLATION OF ALCOHOL.

Steam is turned on carefully, so as to heat the liquid gradually, in order that the operation may be slow, but continuous. The alcoholic vapor soon rises above the first plates of the column and passes entirely through the latter, and by way of the cap and the pipe into the condenser. Immediately on reaching the distillation, the vapor is condensed, and returned upon the upper plates of the column through the return pipes, where it is volatilized and constantly recharged with alcohol, to be again recondensed until the water in the condenser is sufficiently heated to permit the lighter alcoholic vapor to pass into the convolutions of the horizontal coil without being reduced to the liquid form.

As soon as the water in the condenser is sufficiently warm, the vapor passes by the pipe into the cooler, where it is converted into a liquid as it comes over. This is the point at which the closest attention should be paid to the heating, because it may happen that the vapor, by heating too abundantly, may not be entirely condensed, and may pass off in a gaseous state, or may flow off as hot liquid.

The first product of the distillation always contains the ethereal principles which are generally the least abundant; that which follows is more or less pure; then follows, in due course, well-flavored alcohol; and last, the product containing the essential oils, which, in some substances, are quite abundant. Each product should be separated and set aside, so that those which are most contaminated with impurities shall not be mixed with those which are least so. It must be remarked that well-flavored alcohol can be obtained only when the strength of the apparatus of Derosne, and we may be excused from repeating it.

Care should be taken during the progress of the rectification to keep up a constant supply of fresh water in the cooler, so that the liquor may always flow quite cold, without, however, reducing the temperature so low as to interrupt the operation, which will certainly happen if the cap of the cooler is not kept moderately warm; because, in that case, the cold water, by reason of its weight being greater than the warm water, will immediately pass through the latter into the condenser, and will then rapidly condense the alcoholic vapors, which, instead of passing into the cooler, will return to the column by the return pipes.

The operation is complete when the liquor which flows through the proof vessel marks not more than 3° or 4°; but it is better to suspend the operation as soon as the heavy phlegm (backings or feints) indicates 10°, because the product which then passes over is highly charged with essential oils, and is not worth the time spent in saving it. Moreover, this last product, by reason of its nature, adheres strongly to the surface of the plates and the coils, and renders the cleaning much more difficult.

The apparatus should be cleansed as soon as the operation is finished, so as to take advantage of the hot water in the condenser. For this purpose the stopcock is opened to draw off the water contained in the boiler; then the cock of the pipe is opened to empty the hot water from the condenser on to the plates, to remove the essential oils which remain in them. The condenser and boiler being empty, the cocks and are closed, and the plate is removed; then by means of a pipe, the water in the cooler is entirely emptied into the boiler, so that the steam coil may be covered to the depth of 18 or 20 centimeters. When this has been done, the screw plate is returned to its place and secured, and a strong heat applied. Ebulition soon begins, and the steam which escapes from the boiler in great abundance, carries with it all the essential oils adhering to the different parts of the apparatus. After
fifteen or twenty minutes, when it is perceived that the
steam no longer has any taste, the heat is cut off, and
the apparatus left to cool gradually, in order to avoid
cracking the soldered joints by cooling too quickly.

The application of steam as a means of heating in
rectification is without contradiction the best of all, but
if the operation is conducted over the open fire, care
must be taken not to allow the naked bottom of the still
to be exposed to the fire when the waste liquor is drawn
off from the boiler; it must never be entirely emptied, but
must remain covered by at least ten centimeters of liquid.

The bad-flavored spirits resulting from rectification
can be rectified anew by adding to them nearly an equal
quantity of water, so that they may be at 40 or 50 de-

degrees Cent.; this addition of water is indispensable to
set the essential oils free, and it is for this reason that
we said above that alcohol should never be rectified at a
higher degree than 50°.

This method may at first glance appear to be contrary
to the principles we have laid down, in saying that the
more nearly alcohol approaches a state of purity the
more readily it is deprived of its essential oils and acids,
in view of the low temperature at which it is vaporized.
But it must also be observed that alcohol, having a strong
affinity for essential oils, when it is concentrated, dis-
solves them in large proportions, and forms with them
an intimate union.

It is in this manner that the aromatic spirits and es-

sences, of which we shall speak hereafter, which con-
tain a large quantity of different essential oils, pass over
by distillation entirely without change of character,
while, if they be diluted with two or three times their
volume of water before being rectified, the alcohol, which
has greater affinity for the water than it has for the es-
sential oils, will separate from the latter to unite with
the water, and the essential oils will be set free. The
liquid, then, which results from this rectification will be
almost entirely free from the essential oils which will be
found in the boiler of the rectifying apparatus, collected
together on the surface of the fluid contained therein.

The last products of the rectification, that is to say,
the feints or backings should, on account of the large
quantity of essential oil they contain, be made the object
of a special rectification. The alcohol obtained from them,
its nature not what care has been taken with the opera-
tion, still retains a very unpleasant odor, of which it
can only be deprived by many rectifications.

We have often been asked what is the proportion of
well-flavored alcohol that can be obtained from a successful
rectification. This question is very difficult to be answered.
The proportion is very variable; it is dependent on the
nature of the liquor to be rectified, on the method of
extracting the saccharine matter, and on the manner of
distilling. The quantity of well-flavored alcohol ob-
tained will be in inverse proportion to the quantity of
essential oils contained in the liquor.

The loss by rectification is usually estimated at five
per cent. of pure alcohol.

It must be observed that the capacity of the rectifying
apparatus has a very great influence on the production
of three-six of good flavor (bon goût). Small apparatuses
will not furnish the same quantity in proportion; they
are always more difficult to manage, and the stream of
flow has not the regularity which characterizes the large
apparatus. It is certain that the more extensive the ap-
paratus the better will be the quality and the larger the
quantity of the three-six obtained.

Purification of (Backings) Phlegm (Spirits of bad taste, from Beets,
Potatoes, Grains, &c.). By M. Ortlin.

The first process is founded on the oxidation of the
substances infecting the alcohol, by means of hypochlor-
ous acid, which renders the offending substance highly
volatile, and facilitates its separation from the alcohol by
distillation.

For ten hectolitres of alcohol, 1st, dissolve one kilo-
gramme of chlorate of potash in a sufficient quantity of
boiling water, and add this solution to the alcohol, stir-
ing it thoroughly; 2d, three and a half kilogrammes of
commercial hydrochloric acid are added and well
mixed. After digesting 24 hours, during which it is occasionally stirred, it is distilled in the usual way; managing the fire so that the alcoholic vapors shall be at a higher temperature than 46° Cent., when they reach the cooler. The product is purified alcohol. The dose varies with the amount of impurities contained in the alcohol.

In the second process, for ten hectolitres of badly flavored alcohol, dissolve 1.6 kilogramme of bichromate of potash in five litres of hot water; this solution is mixed with the alcohol, which has been previously diluted with four hectolitres of water; after being well stirred, 1.8 kilogramme of sulphuric acid at 66°, diluted with 1.8 kilogramme of water, is added. They are mixed by prolonged stirring. After being digested for several days, and the liquid from being yellow has changed to green, five hectolitres of water are added, and it is distilled in some good apparatus. The separated product of this rectification is purified alcohol. The proportion will be diminished on account of the removal of the infecting substances.

The bichromate of potash, under the influence of the sulphuric acid, parts with one-half of its oxygen, and produces the sesquioxide of chromium; the free and nascent oxygen unites with the amyl alcohol, producing valerianic acid, which is much less volatile than alcohol, and does not pass over during the rectification.

CHAPTER VIII.
DISTILLATION OF BRANDIES.

Spirits, the density of which varies between 40° and 60°, is generally called brandy (eau de vie); but this name is most usually applied to the product of the distillation of wine, although we do say (in France) grain brandy, cider brandy, &c. Brandy is, therefore, only a mixture of alcohol and water, obtained by distilling fermented liquids, and which contains in addition certain foreign substances that are peculiar to these liquids, such as acetic, and hydrocyanic acids, a volatile oil, and especially a coloring matter which it extracts from the casks in which it is stored.

The distillation of brandies, unlike that of alcohol (or spirits heretofore described), is so conducted as to preserve in the spirits the aroma which distinguishes them, and which constitutes their peculiar merit. This operation should be effectuated on the principles hitherto set forth, and by means of the apparatus of Derosne or Egrot, or by a simple apparatus, as is done in many places; but in the last case the product must be redistilled, in order that it may have the proper degree of alcoholic strength.

Brandies from Wine.

The quality of brandies is dependent on many circumstances, especially the maturity of the grapes, the perfection of the expressed juice; the care given to the vinification; on the conduct of the distillation of the wine, which should be observed carefully to prevent the extractive matter from being burnt during the operation; on the intimate union of the volatile principles with the alcohol during the distillation; on the aroma of the wine which has been more or less retained in the product of distillation, &c. &c.

The quality of brandies depends, too, on the age of the wines; on their variety and state of preservation; for all wines are not equally suited to the manufacture of good brandies. Old wines yield a much better article than the new. The product of sweet wines is excellent. Spoiled (turned) wines produce brandy of very inferior quality. White wines are preferable to red wines for distillation, because, as a general rule, they yield better brandy than the latter. This results from their not having been vatted on the skins and stalks of the grape. They contain a much smaller proportion of the essent-
tial oils which are found in the husk of the seed, and which dissolve in the must under the influence of the alcohol generated during the fermentation.

It is remarked that, as a general rule, the wines which produce the best brandies; those of Charentes, for example, are more or less inferior as table wines, and are quite difficult of preservation. They are called Vins de Chaudière.

Wines that have the taste of the soil communicate it to the brandy extracted from them. This is the reason that the wines of Scysel and Dauphiné yield a brandy having the odor and flavor of the Florentine iris, while those of Saint Peray yield a brandy with the odor of violets, and we observe the taste of brimstone in the wines of Côte-Rôtie, that of slate in the wines of Moselle, that of amber in the wines of Holstein, &c.

When brandy has just been made it is colorless. If it is immediately bottled, as is done with Kirchenwasser, it will never acquire any color; but as it is usual to preserve it in oak hogheads, it attacks and dissolves a certain quantity of coloring and extractive matter from the wood, and then acquires a reddish-yellow tint.

Brandy should be very clear, very white when new; a light amber tint if three or four years old, and very yellow if it is very old. It ought to be agreeable to the taste, or at least should be free from empyreumatic and foreign flavors.

Brandies are greatly improved by age. They lose a little of their alcohol when kept in barrels; but their elements combine more intimately; they lose the slight taste of the still, which the most carefully prepared brandies retain for some time, and they become at last more oily and more potable. Brandies are easily preserved, as temperature exercises no influence on their quality. To prevent evaporation, they should be carefully sealed; for it costs a good deal to keep brandies, especially when they are new.

The brandies most esteemed are those of the department of Charente; and the cantons which yield the best are Champagne, canton of Blanzac, 16 kilometers from Angoulême; the country of Cognac; that of Jarnac on the right bank of Charente, 12 kilometers from Cognac; Rouillac, 22 kilometers northeast of Angoulême, and 20 kilometers northeast of Cognac; Aigre, 91 kilometers from Ruffec. All the brandies of this department, and those of some cantons of Charente-Inferieure are known to the trade as Cognacs, and participate more or less in the qualities of those we have cited. Generally all of these brandies are noted for a purity of flavor and delicacy of perfume which is attempted to be imitated in vain.

Champagne brandies are divided into two sorts, or two different qualities; the first is known as fine Champagne, and the second as country brandy (de bois); the latter not so highly prized.

Next to the Cognacs, the brandies of Saint-Jean-d'Angely are most highly esteemed. Their softness and purity of taste often cause them to be confounded with the former.

The brandies of Charroute-Inferieure are known under the name of Cognact de Saintonge and of Ausais. They have much less reputation and quality than those of Charente, because of a certain taste of the soil which is peculiar to them, and because of their wanting in delicacy. The brandies of Surgères, Mauzé, and Rochelle are different varieties from this department. The first are most esteemed.

The brandies of the two Charentes, as made, weigh usually from 60° to 65°, but they are delivered to the trade only at from 68° to 70°; the medium, aged and old brandies are put on the market at from 49° to 59° (Centesimal). All of them are put up in very neat and well-hooped barrels. The casks (barriques) contain from 300 to 350 litres; the vessels of less capacity are called quarters.

The brandies of Marmande are manufactured in the department of Lot-et-Garonne. Although quite fine, they have an earthy taste, which reduces them to the rank of common brandies.
Among the common brandies, those of Armagnac hold the first place; they are distinguished by a taste of the soil, which is quite pleasant and improves very much by age. They are manufactured in the departments of Gers, of Upper and Lower Pyrenees, as well as in the Eastern Pyrenees; they are sent to market gauged at 50°, in tolerably well-constructed tierces of very thick wood, which contain 400 litres or more.

The brandies of Montpellier are the most common and most sought after. They have a very feeble bouquet, and but little delicacy. They are put on the market in casks; their alcoholic strength varies from 50 to 60 degrees.

There are few vine-growing countries that do not produce brandy. The departments which produce the most, after those already named, are, Ardèche, Aude, Bouches-du-Rhône, Dordogne, Gard, Haute-Garonne, Hérault, Landes, Loir-et-Cher, Loire-Inférieure, &c.

The name of proof is given to the different degrees of potable brandies; thus, the preuve de Holland, or Dutch Standard, corresponds to 19 degrees Cartier, or to 50° centesimal. A liquor of this degree, when agitated in a glass vial, produces small bubbles, which will remain for a while; this happens neither for a higher nor a lower degree of strength.

The brandy trade is subject to great vicissitudes, on which the price of the commodity depends. These vicissitudes induce very uncertain speculations, which may result in heavy profit or as serious loss to the operator. It is also subject to the chances caused by a good or bad wine crop. These circumstances will soon be learned by a tradesman who follows his business with any skill. His prudence will teach him to lay in his stock during those years when brandies are at a moderate price, but as brandy in store is the occasion of much expense, it is necessary to know how to calculate this expense, together with the profit which an advantageous sale will produce. In this calculation he should take into consideration the value he would receive, if his money had been put at interest. It is rare that five years in succession pass without there being a scarcity of brandy which causes the prices to advance considerably, thus giving the dealer who has a stock on hand a profit far above his expenses and the interest on his money.

(Marc Brandy) Brandy from the Grape Pomace (Marc de raisin).

All vine-growing countries produce marc brandy. Languedoc, especially, furnishes it in great quantity, converted into spirit of wine, or trois-six, which is diluted or reduced to make the marc brandy. Burgundy, Champagne, and Lorraine distil a good deal, and the production of these countries is always insufficient for their own consumption.

The marc of the grape, notwithstanding the care that may be taken in pressing it, always contains a certain quantity of wine, and consequently alcohol. In the south there remains in the marc a certain portion of sugar that has escaped the vinous fermentation, which is always incomplete, and of which the most energetic pressure cannot deprive it. This sugar, being decomposed, will still further increase the volume of spirits.

Usually the process for obtaining marc brandy is very objectionable; the following is the method pursued in vine-growing countries:—

The marc, on leaving the press, is borne to a deep pit in the earth; sometimes plastered with clay, in which it is packed and pressed as it is brought. When the pit is full, it is covered with straw, vine leaves, and twigs, over which is thrown a thick bed of earth to prevent contact with the air. The whole is left to ferment for about six weeks.

When it is thought that the fermentation is completed, they commence to distil the marc. For this purpose the boiler of a simple still, having a grating on
the bottom, is filled to about three-fourths with the marc, then a sufficient quantity of water is poured in to prevent the marc from burning in the still. It is then closed by luting, and heat applied. The first product of this operation is very weak, and must be rectified or re-distilled to produce potable brandy at 50 degrees.

The marc, thus submitted to a sort of dry fermentation, evolves an amount of heat sufficient to decompose it promptly, and cause it partly to putrefy if care is not taken to be assured from time to time whether the fermentation is completed.

A preferable method, which is adopted by some proprietors, consists of mixing the marc in a vat with tepid water at 25 to 30 degrees, to cause a new fermentation from which is drawn a light wine called piquette, and which is distilled separately. The marc is then distilled with a small quantity of water.

The better process for distilling the marc, in our opinion, consists in fermenting it with a small quantity of tepid water in a hermetically closed vat, then to draw off the liquid and use it to fill the still, the steam from which might be utilized for distilling the marc in a cylindrical apparatus of very simple construction. By this means would be obtained at the first jet a brandy at from 50 to 55 degrees free from empyreuma, and infinitely superior to that obtained by any other process now in use.

Brandy from the marc has a very disagreeable odor, and always retains an acid and penetrating taste which it is very difficult to remove. This insupportable taste is due to the presence of an essential oil, which, according to M. Aubergier, exists already formed in the skin of the grape, and which is not developed in the course of and by the distillation, as has hitherto been thought. This chemist, on rectifying some marc brandy in a water bath, with a very gentle heat at the beginning of the operation, and regulated so as to obtain a spirit at 36 degrees Cartier, perceived that the first portion of alcohol was partly free from the acid principle which strongly impregnated the brandy he rectified.

"I undertook," said he, "to repeat the operation, and divided the product into three parts; the first constituting all the spirits drawn off up to the period when I ascertained that the admixture of a small quantity of water caused it to become a little milky; I changed the receiver, and that which came over, until it became necessary to increase the heat sufficiently to cause the liquor to flow in a continuous thread, constituted my second product. After having continued the heat in order to draw off all the alcohol contained in the liquor, I obtained for my third product only a thick milky liquid.

I took the first product, and after repeated distillations with gentle heat, I obtained an alcohol almost free from the odor of marc brandy. I conceived the hope, that on repeating the rectification I might obtain a spirit absolutely free from this bad taste, but I tried in vain through three other operations; my alcohol has not the most agreeable flavor, and I think it altogether impossible to free it from a principle so tenacious.

I redistilled the second product many times with a gentle heat, so as to draw off one nearly three-fourths of a tolerably pure alcohol, and the rest highly charged with oil. Finally, on rectifying the third product, I obtained one-third of alcohol like the foregoing; I then added the last fourth of the second product to the remaining two-thirds, thus highly charged with oil. In subjecting this to a new distillation the first portion obtained was scarcely troubled on being mixed with water, an evident sign that it contained very little oil. The second, which I permitted to run so long as it was limpid, contained a much greater quantity of oil, the presence of which was easily detected by pouring the spirit into water, when it was immediately clouded. Here I changed the receiver and continued the distillation, but at the end of the operation I only obtained a milky liquor, having on its surface a thin stratum of oil, notwithstanding, this last product was at twenty-three degrees by the areometer of Baumé.

"Finally, on re-uniting this last product to the second and adding enough water to reduce the mixture to fifteen degrees of Baumé, the liquor became at once very
opaque, and was, a quarter of an hour afterwards, covered with quite a considerable quantity of oil, which I collected with the greatest care. It appears to me that this oil is entirely volatile, since after more than ten distillations it has not left the least trace of its presence in the residuum remaining in the water bath. I may also remark, that this residuum having been subjected to very violent ebullition, was impregnated with neither the taste nor odor which characterize marc brandy.

"This oily principle has all the properties of the essential oils; its peculiar aroma, the acrid and insupportable taste which is also peculiar, prevents its being confounded with any of its kind, and authorizes me to give it the name of volatile oil of the grape. The following are its chemical properties:

1. It is very limpid and without color at the moment of its separation from the alcohol; but light causes it in a short time to assume a light lemon tint.

2. Its odor is penetrating, its taste is very acrid and insupportable; both the odor and taste are peculiar to it.

3. It is very fluid.

4. It burns with a blue flame, diffusing in the air the odor of marc brandy.

5. When subjected to distillation the first portions which are volatilized preserve the aroma, but the product acquires an empyreumatic odor, which causes me to suspect that it may contain a small quantity of fixed oil derived from the seed. The liquor contained in the retort very soon acquires a lemon color which deepens during the operation, and leaves a very light but considerable carbonized residuum, which induces me to believe that this volatile oil is somewhat less light than others.

6. It dissolves in one thousand parts of water, imparting to it both its odor and taste.

7. It dissolves sulphur when in a state of ebullition, and deposits it when cold.

8. Finally it forms soaps with the alkalies.

"I obtained nearly 32 grammes of this oil from 150 litres of brandy.

"Its aromatic odor sui generis caused me to think that it was not, like empyreumatic oil, the product of distillation, as has been believed up to the present time, but rather a volatile oil peculiar to the grape, and which must have its place in one of its parts.

"I then distilled all of the parts of the grape one after the other and separately.

"The seeds diluted with alcohol yielded quite a transparent liquor, having the very agreeable flavor of the almond. This same almond flavor is also reproduced by a distillation of grape seed with simple water. It is not, then, the seed which imparts to marc brandy the unpleasant flavor which characterizes it. The stems, when distilled, only produce a very slightly alcoholic liquor.

"But the skin or envelope of the grape, when separated from the seed and the berry, and alone subjected to fermentation and distillation, yields a brandy altogether like that from the marc. Therefore, I repeat, the disagreeable taste of those brandies does not come from an empyreumatic oil which is the product of distillation; it is not due to acetic ether; nor yet, is it the effect of an oil contained in the seed, as has been published for many years. Its true cause is a volatile oily substance, contained only in the skin of the grape, having a taste and odor so acrid and penetrating that a single drop is sufficient to infect ten litres of the best brandy, and hence, I conclude that the brandies of Cognac and Andaye are superior to others, because they alone are obtained from the distillation of white wine, which, not being fermented on the grape, is not charged with this oil, which is the product of the skin alone."

M. Aubergier has also made many very interesting experiments in regard to the vinification and purification of brandies from wine and marc. He draws the following conclusions from his experiments:

1. There exists a volatile oil of the grape.

2. This oil exists only in the envelope of the grape.
3. It is this oil, improperly called empyreumatic, that infects the marc brandies.

4. On fermenting the must, separate from the pulp, the skin, and the seeds, in hogsheads having no other opening than that necessary for the escape of the carbonic acid, a wine will be obtained, the distillation of which will yield the largest results in brandy of the best quality.

5. Two kinds of brandy may be obtained from this same marc. That obtained by washing will be equal in quality to the wine brandy, and the other will be no worse than ordinary marc brandy.

6. If magnesia is macerated with marc brandy from which a greater portion of the essential oil has been already removed, it will be completely purified.

Distilling Apparatus of M. Villard, of Lyons.

M. Villard, of Lyons, has two kinds of apparatus specially intended for distilling the marc of grapes and other solid or semi-fluid substances which contain alcohol. These apparatus will yield products far superior to those obtained from the common still. Indeed, until the invention of M. Villard became known, a peculiar coppery taste, and a greenish tint, were the inseparable characteristics of marc brandy. This disagreeable flavor might have been called the taste of the still. Some savants, among others M. Aubergier, attributed this to an empyreumatic oil, or to a volatile oil, derived especially from the skin of the grape. These hypotheses were powerless to explain the coppery taste and the greenish tint which indicated the presence of copper. The experiments made by Mr. Higgins, of Jamaica, upon molasses, which, when heated by the common methods, gives this empyreumatic taste, persuaded M. Villard that it was due to the solution of copper in the acetic ether, which, according to this chemist, is produced by the distillation of substances brought too directly in contact with a brisk fire, having a heat of 400° or 500°. If the vaporization of alcohol can be effected by means of an agent which does not yield so great a degree of heat, the steam of water, for example, which does not exceed a temperature of 100°, is to be presumed that this heat being sufficient to vaporize the alcohol which is volatilized at 78°, cannot develop either the empyreumatic or peculiar oils of M. Aubergier, or the acetic ether of Mr. Higgins.

M. Villard then determined to heat the substances to be distilled by driving through them a current of steam, which, by rapidly penetrating the strata of marc, as it were molecule by molecule, might disengage the alcohol without permitting, at the same time, the formation of essential oils or acetic ether.

He has succeeded, not that he pretends to have entirely removed the taste which is peculiar to marc brandy, but his productions have neither the coppery taste, the greenish tint, nor the flavor of still, which is so remarkable in others, and which constitute a great part, if not the whole of the disagreeable flavor that affects this kind of spirits.

Doubtless, the idea of continuous distillation by steam is not new, for many manufacturers have employed it; for a long time it has been public property. But inventors, whose principal object was the manufacture of trio six, only occupied themselves with producing, by a continuous process, steam more or less saturated with alcohol, which, on leaving their receiver, was directed into the apparatus where the separation of the vapors was effected by the aid of coolers, more or less ingenious, but always metallic.

In 1847, M. Villard conceived the altogether novel idea of bringing into service, as a condenser, the substance under treatment. Alcohol is vaporized at 78°, and water only at 100°. If under the ordinary pressure of the atmosphere we direct into the bottom of the mass, a current of steam which very readily unites with alcohol, it is clear that the mass, when heated to 78°, will disengage its alcohol alone, until it has attained 100°. When this maximum temperature is reached, it will evolve the steam of water mixed with the alcohol that has not been driven off, at a lower temperature, either because of its more
intimate union with the particles of the material under treatment, or because the temperature has been raised too rapidly for it to escape.

It is proper, then, to heat the mass containing alcohol rapidly up to 78°, by the assistance of any medium which may serve as a vehicle for the alcohol in quantity, may unite with it readily, and which may be separated from it without difficulty; then to retard the elevation of the temperature to 100°, as much as possible, or to reduce it below that degree, if it should be unintentionally reached.

If the steam is driven into the more or less cold mass, the problem will be solved, and all the distillable spirit will find its way into the coil, if the following precautions are taken, viz.:—

1. To effect the elevation of temperature slowly, progressively, and regularly, by making the refrigerant more compact and compelling the heat to penetrate it, layer by layer, or rather, atom by atom, which will enable the substance most easily vaporizable to escape first.

2. To maintain the temperature below 100 degrees by an equally cold obstacle, which must be heated by it. The marc of the grape is well adapted to perform this office. A cold material, finely divided and penetrable, it may be compelled to take any desirable form or density. Why may it not then serve for a purifier and condenser as well as metallic substances? It is only necessary to arrange it in closely packed layers, to heat it slowly, and to press it somewhat against the vessel containing it so as to increase the adhesion and force the steam to follow a regular course of which the operator may be certain; for two bodies of different densities, like metal and marc, are never as completely united at their points of contact as two bodies of the same nature and the same density, and an agent thrust between them by any impelling force will support itself upon that which affords the strongest resistance to force a passage through the other, and find a way of escape.

It is, therefore, evident that if the idea is adopted of employing the marc, or other solid substance, as a purifier and condenser, it is absolutely necessary, in order to its realization, to resort to its rational and methodical arrangement by packing regularly, and forcing it against the walls of the containing vessel. It is in this that the new invention, first conceived by M. Villard in 1847, consists, and of which his apparatuses of the present day are at bottom a new but very much improved application.

The peculiar advantages presented by the apparatus of M. Villard will be so apparent to the educated and practical distiller, that we consider it scarcely worth while to go into any lengthy discussion of the subject. We may, however, remark that, in theory, his apparatus rests on three essential principles:—

1. Uniformity of pressure (one atmosphere).

2. A progressive difference in the specific gravity of the alcoholic vapors; alcohol being lighter than phlegm, phlegm lighter than water; the vapor of water being heavier than the vapor of the other two pushing them before it.

3. The difference between the degrees of heat necessary to the evaporation of alcohol and water.

The application of these principles leads to a distillation by analysis, in which the substance treated plays the part of condenser.

The apparatuses used by M. Villard are of two kinds. The first consists,

1. Of a steam generator of any convenient form.

2. Of three distillatory vessels having movable covers to facilitate the charge and discharge. They are connected by pipes furnished with stopcocks, to convey the vapor at will from the upper part of one to the lower part of another.

3. Of a cooling coil connected with an alcoholic pipe, which is common to the three vessels. (See Fig. 2, Pl. VII.)

Description of Apparatus (Fig. 2, Pl. VII.):—

1. Distillatory vessels for receiving the solid materials.

2. Pipes of communication between the vessels, from the top of one to the bottom of the other.
3. Covers of the entire breadth of the vessels, and closed by screw clamps.

4. Cocks attached to the pipes, serving to direct the alcoholic vapor at will into the cooling coil, when at the commercial standard, or into the bottom of the next vessel, if in the state of phlegm or low wines.

5. Alcohol pipe. This pipe, common to the distillatory vessels, serves for conveying the spirituous vapors to the cooling coil.

6. Discharge cocks for the distillatory vessels, for drawing off the water resulting from condensation.

7. Alcoogene, or analyzing cylinder, the object of which is to prevent foreign substances from passing into the coil with the spirits.

8. Flake stand or coil cooler.

9. Cooling coil or worm.

10. Steam generator (a tubular boiler).

11. Steam box.


13. Steam pipe, conveying the steam from the boiler to the distilling vessels. This steam is delivered into a box common to three other pipes, which conveys it to each of the vessels.

14. Steam pipes connecting the secondary box with each vessel.

15. Carriage on which the apparatus is moved from place to place.

The material to be distilled being methodically arranged in each vessel, in one or more layers of greater or less thickness according to its character, is heated by steam from the boiler. The steam, by its ascensional motion, removes all the alcohol it contains.

The condensation and return of vapors, occurring as the parts of the mass are penetrated, the more highly spirituous vapor, being the most volatile, will be the first to escape into the cooling coil.

This method of distillation, then, is divided into two stages. In the first all the good brandy, that is, the commercial article, is obtained. In the second the phlegm is distilled through fresh materials, which condense it afresh, but at the same time it serves for heating the mass.

From the explanation just given, we may readily conclude that there is much economy in this method of distillation, since the phlegm, which in the common apparatus, unprovided with a metallic rectifier, constitutes about one-half of the whole product, is thus distilled without loss of time or fuel.

The charging and discharging is managed very readily.

The second apparatus, which was constructed more particularly with a view to the distillation of beets, depends on the same principles; the condensation of the alcoholic vapors by the material to be treated. The means only differ.

Instead of three vessels communicating with one another as in the former, the latter consists of a single column, but so arranged that the charge is continually made at the top and the discharge at the bottom, without causing the least interruption to the distillation.

The product is of a constant alcoholic degree, and, as we have said, the flow from the coil is uninterrupted.

The following is a description of the apparatus. (Fig. 1, Pl. VII.)

1. Distilling column.

2. Steam chamber.

3. Hurdles or baskets containing the marc, beets, or other solid matter.

4. Toothed rack for assisting in the removal of the hurdles.

5. Feed pump for the steam boiler.

6. Steam boiler.

7. Alcoogene for the same purpose as the corresponding piece in the first apparatus.

8. Flake stand and coil.

9. Carriage for transporting the apparatus.

This apparatus presents decided advantages over the other, whenever large quantities of material are to be heated.

Both are portable when of small dimensions (the illustrations are for the portable apparatus; modifications which a stationary apparatus would require will naturally suggest themselves), and at the present time
are fully sanctioned by experience; a number of them being in operation both in France and in other countries. Moreover, the numerous infringers of his patents, which M. Villard has sued to conviction and damages during the last few years, are the best evidence of the value of his apparatus.

The price varies from 3000 to 20,000 francs, and the minimum of production is never less than 5 hectolitres of spirit of 50° or 55° Cent.

Although more especially intended for the distillation of solid materials; both of the apparatuses of M. Villard may, with some slight modifications be adapted to the distillation of liquors.

Cider Brandy. Apple Brandy.

Cider is the fermented juice of apples, and is in some countries a very common drink. The manufacture of cider is as easy and more prompt than that of wine. Its quality is influenced by many circumstances, of which the principal are: the variety, the ripeness and crushing of the fruit, the fermentation of the must, &c.

The varieties of apples are very numerous, but it is not a matter of any importance to particularize them further than to say that, for the manufacture of cider, they may be divided into three classes.

1. Acid (or sour) apples.
2. Sweet apples.
3. Rough apples.

These classes are further subdivided into:

1. Early apples.
2. Late apples.

Acid apples yield much clear juice, of little specific gravity, producing a cider without strength, of not very pleasant taste, and always liable to become turbid, or as they say in Normandy, to *kill* itself.

Sweet apples produce but little juice without the addition of water; furnish a clear and pleasant cider, so long as it is sweet, but which becomes bitter and but little alcoholic when the fermentation is advanced.

Rough apples, that are bitter and harsh to the taste, yield a very dense, highly-colored juice, which ferments for a long time, and which produces a generous cider, susceptible of long preservation.

The early apples produce quite a pleasant, clear cider, but of poor color and but slightly spirituous, and which can hardly be preserved for a year.

Finally, late apples of good varieties yield a generous cider, which may be kept a long time.

The fruit is harvested, says M. Girardin, in September, October, or November, according to its time of ripening, whether early, medium, or late. It is left in a pile for a certain time, to finish ripening, and in order that it may furnish a more saccharine must. The apples are then crushed.

This operation is effected sometimes by means of a vertical stone wheel moving in a circular trough by the power of a horse; and sometimes by a small mill composed of grooved cast-iron cylinders, surmounted by a hopper. The pulp is submitted to the press three several times, between layers of straw, or, better still, between sheets of hair-cloth. The juice from the first pressure is what is called *strong cider*; that from the two last constitutes small cider. It is very weak, because the pulp has been twice mixed with a certain proportion of water.

The juice of apples consists of much water, a small quantity of sugar, a natural ferment, vegetable albumen, a peculiar coloring matter, traces of pectic acid, gallic acid, the malates of potash and lime, a considerable proportion of mucilage, and free malic acid. When the seeds are crushed they communicate to the must a bitter principle and a little essential oil.

The juice is poured into hogsheads with a large bung having a capacity of 600 or 700 litres, where it very soon sets up the alcoholic fermentation, which continues for two or three months. When it is finished, the clear cider may be used as a drink. But if a more agreeable cider is wanted, it should be drawn off into a clean vessel, one month after being expressed, and this should
be continued month after month until it is finished. For effervescing cider, it is left in the hogsheds only a month when the clear liquid is drawn off and bottled.

Usually cider made in summer is potable for four to six months; that made in autumn for six to ten months, and that made during the winter, from ten to twenty months. The best ciders cannot be kept in good condition more than three or four years.

The districts in which cider brandy is more particularly manufactured are Normandy, first; then Picardy and Brittany. The distillation is conducted by the same methods and apparatus as for wines.

As with the alcoholic richness of wine and other drinks, so does that of cider vary according to the season, the ripeness and variety of fruit, &c. It is by no means unusual to obtain nine per cent. of pure alcohol from some ciders, while there are others which yield only four or four and a half per cent.

Ordinarily from seven to eight litres of pure alcohol are obtained from one hectolitre of old cider, or about fifteen litres of brandy at 50°. But these results may be greatly increased if the fermentation is conducted on the principles we have set forth, and a certain proportion of water added to the juice, so that it shall not make higher than six degrees by Baume's ammeter; the fermentation will then be more active and more complete.

Cider brandy has a strong and disagreeable odor, due partly to the presence of malic acid, which may be removed by rectification, but which consumers prefer. Thus, in Lower Normandy, where the manufacture of apple and pear brandies is still in its primitive state, the spirit they obtain is not at all comparable to that obtained from wines, yet the Normans prefer it to the latter, and so strong is the power of habit, that they select that as the best which has the most decidedly empymematic flavor.*

* In many portions of the United States, particularly in the eastern counties of Virginia and the middle portions of North Carolina, distillers ferment and distil the pulp of the apple without expressing the juice. Thus producing a poisonous compound of alcohol with essential and empymematic oils, nauseous beyond measure, and fraught with disease and death to those who are so unfortunate as to have acquired a fancy for a drink so abominable. It is called pug, or pulp brandy.—Translator.