vantage that the apparatus takes up less space. According to Maerker, a marked advantage of this apparatus is that the wine, which circulates from plate to plate in the column, is constantly exposed to the rising vapors which, at the end of their tortuous passage, become much enriched. These columns, in the distilleries of MM. Collette, at Allennes, Moers, and Seclin, each treat 20,000 kilos. of maize and 300,000 beets in twenty-four hours. All yeast used in fermentation must be perfectly pure.

SECTION II.—PURIFICATION OF ALCOHOL.

The industrial alcohols which have already been described are obtained by a preliminary distillation in the state of what is called in French flegmes. By this name is understood aqueous liquids containing 45° to 75° of alcohol. These flegmes contain other impurities which are more volatile than ethyl alcohol; for example, the aldehydes. To rid the alcohol of these and other impurities is the reason why the alcohol should be rectified. Rectification is dependent upon fractional distillation; that is to say, the separation of liquids by order of their volatility. In the alcohol manufacturer's language, there are five classes of liquids, that they name as follows: 1, poor alcohol; 2, middling good; 3, fine alcohol; 4, extra fine; 5, absolute alcohol. Two methods are chiefly employed in the purification of alcohol: 1, the physical method, which includes rectification, use of absorbent materials, electricity, etc.; 2, the chemical method, in which substances are employed which have the property of destroying the principal impurities and the disagreeable odor.

Physical Method.—Several years ago the filtration of alcohol through animal black (bone black) was in favor. The price of materials having increased, it was found necessary to abandon the process. In Germany and Sweden they largely employ wood charcoal. The filters are large tubular vessels provided with two bottoms. These filters hold about 150 kilogrammes of charcoal, each filter permitting of the filtration of 60 liters of alcohol at 50° in 24 hours. In the construction and management of these filters the utmost economy must prevail. Fig. 13 represents a battery of filters arranged according to the best practice. Cal-
cined charcoal must be used. Unfortunately, charcoal does not possess its remarkable disinfectant qualities for a great length of time and the revivification presents many difficulties, so that it can be only pursued in a country where charcoal is cheap. Oils are very good absorbents of the odorous principles, but their application in regard to alcohol is very limited.

Soap has been equally recommended by M. Kletzin- 
sky, as a deodorizer, etc. For 20 liters of poor-alcohol use one kilogramme of Marseilles soap. Alcohol distilled by this method has no odor and is more concentrated than the primitive alcohol, the soap retaining the water. The soap can be used over again by removing the impurities by a current of steam.

Chemical Method.—The chemical substances employed for the purification of alcohol are divided, according to M. Larbaletier, into four groups.

1. Oxidizing Agents.—The metallic oxides, nitric, chromic, hydrochloric and other acids; the permanganates, the hypochlorites, ozone, oxygen, air, etc.

2. Substances used empirically without explaining their mode of action, such as sulphuric acid and alum.

3. The method of M. L. Naudin, in which, on the liberation of hydrogen, the aldehydes absorb two equivalents of hydrogen, which transforms them into the corresponding alcohols. Alcohols which include a large proportion of aldehyde, ethylic, propylic, butyric, and other compounds are acted upon by the hydrogen produced by electrolysis, which acts upon them, producing ethylic, propylic, butyric and amylc alcohols.

4. Products in which the action is due to certain special properties; for example, the alkalies (potassium, sodium, ammonium), lead acetate, etc.

SECTION III.—RECTIFICATION OF ALCOHOL.

The rectification of alcohol necessitates three series of operations. The first comprises the distillation of alcohol at a temperature of 68° (C.) This first operation gets rid of the ethers and the more volatile alcohols and a part of the aldehydes. The second operation, which is conducted at 68° to 100°, gives a good quality of alcohol, mixed, however, with aldehydes. From 100° to 102° the remainder of the alcohol distills, which constitutes the third operation. The part lost in this operation is 5 per cent.
Apparatus for Rectifying.—The apparatus generally employed (in France) is that of M. Savalle and of M. DeRoy. There are two systems employed by M. Savalle. The one necessitates the application of water for cooling the condenser, and in the other this operation is performed by a current of air. The exhaust steam of an engine is used in this apparatus to heat the still (Fig. 14). This steam is conducted in coils around the inner portion of the still. A regulator governs the temperature and allows the proper temperature for distillation to be maintained. Two hundred thousand liters of alcohol a day can be rectified in this machine, as it is of very large size.

The apparatus is put in operation by charging the still with the alcohol at 40° to 50°. Steam is then admitted into the serpentine coil of pipe. The liquid heats slowly and the vapors rise through the column, which gradually becomes heated, to the tubular condenser, when water is admitted and the vapors are condensed.

The Savalle apparatus for rectifying alcohol by using air to condense the vapors is represented in Fig. 15. It consists of a still, A, which receives the alcoholic liquor at 45°. In the interior is a steam coil. B is the rectifying column; C and D being condensers. The least volatile vapors are condensed in C. The vapors which are not condensed in C pass into the refrigerator, D, where they are condensed. The still is filled with alcohol to be rectified and the alcohol is poured on the plates. By this means the column is washed and freed from the empyreumatic products of the preceding rectification, and, when the operation is started again, the plates will be charged with alcohol of great strength. This proceeding is economical of fuel. The apparatus being started, the alcoholic vapors rise and are condensed little by little on the plates. This liquid emits in its turn vapors containing very little water, which escape from the column and are analyzed in the condenser, which is formed of a tubulous cylinder, the tubes of which serve for a passage of a current of air which replaces the water. The pure alcoholic vapors which traverse the condenser then go to the second condenser or refrigerator, while the aqueous vapors which are condensed are returned to the column. The second condenser or refrigerator works equally well with air. The apparatus of MM. Deroy is composed (Fig. 28).
SECTION I.—BRANDY FROM WINE.

Cognacs.—Under the name of cognacs are comprised six kinds of liquors, known in commerce under the following names:

1. La Grande Champagne. (Fine champagne.)—These are the cognacs or brandies most highly esteemed. They are distilled in 29 communes of Charente (department). The center of the manufacture is Segonzac, which fixes the market price on the first day of each month. The average production of this brandy is 115,000 hectoliters, at a strength of 70°.

2. La Petite Champagne.—This region comprises 50 communes, of which the center and principal market is Châteauneuf.

3. Les Bordures ou Première Bois.—Under this name are comprised the brandy from 90 communes, which produced 200,000 hectoliters before the advent of the phylloxera. The principal centers are Cognac, Hiersac, Jarnac, Matha, Angoulême, Barberieux, Jonzac, Pons, Saintes.

4. Les Deuxièmes Bois ou Bous Bois.—The center of the production of this variety is Rouillac and St. Jean d'Angely.

5. Saintonage.—This is brandy produced at the border of the department of Gironde from Mortagne to Rochelle. The most estimable varieties prove to be those vines planted in the interior, as the grapes grown along the shore have a very pronounced taste of the soil.

6. Rochelle.—Under this name are included all the brandies produced from vines planted near the sea in a salt, marshy soil. This produces a pronounced taste which improves with age. The center of the manufacture is La Rochelle.

The distillation is made in the winter following the vintage. The product is superior to that obtained by using a wine a year old. The stills used have a capacity of 100 to 500 liters. The apparatus for using the open fire is very crude (Fig. 17). To start the process the alembic or still and the wine heater are filled with
wine: 300 liters of wine in each. By careful distillation 120 liters of liquid can be obtained, which is called the premier brouillis. This wine, which is exhausted, is replaced by wine from the wine heater, which is filled anew. The distillate which is obtained is called the deuxième brouillis. A third operation with the same conditions gives what is called the troisième brouillis.

After the third operation the wine heater is filled with the distilled liquid which has been collected. This is distilled and the quatrième brouillis is obtained. The operation is continued as long as there are any traces of alcohol. The working of the apparatus, Fig. 17, will be readily understood without description. The still with wine heater is figured in Fig. 18. It is composed as follows: 1 is the still; 2, 3, 4, 5, still head and attachments; 6, swan’s neck; 7, the worm in the condenser 8; 9 is the water funnel; 10, strength regulator; 11, overflow; 12, mouth of the worm; 14 is the water bath; 15, water gauge; 16, wine heater; 17,
cover of wine heater: 18, pipe for charging still. The brandy having been distilled, is sold to merchants who doctor it up to suit the taste of consumers and to give it the appearance of age. Not every kind of wood can be used for the casks, preference being given to the wood of Angoulême, which is more aromatic than the wood from places farther north.

 **Armagnac.**—Under this name is comprised brandy distilled in Gers. It is sold at a strength of 52°, but like cognac it is distilled at a higher degree of strength. The manufacturers have very perfect apparatus, which permits of obtaining strong alcohol at the first distillation.

 **Brandy called Montpellier.**—This is prepared in the outskirts of Béziers with choice white and red wines. It is sold at a strength equal to 55° to 60°. The apparatus used is very perfect.

 **Brandy of Marmande.**—Under this name are included brandies made from the white wines in the neighborhood of Marmande. It has become scarce, has a peculiar taste, and is sold at a strength of 55°.

 **Marc Brandy.**—Marc brandy is the product of the distillation of the marc of the grapes. The operation is usually performed with the aid of simple stills. However, improved apparatus is being introduced. Marc brandy has a high standard of about 60°. The principal centers of production are Bourgogne, Franche-Comté, and Lorraine.

### SECTION II.—FRUIT BRANDIES.

**Kirsch or Kirschewasser.**—Kirsch or cherry brandy is prepared from the wild cherry; cultivated cherries give an equally good brandy, but much less perfumed than the wild cherry. The great centers of the manufacture in France are the department of Doubs, Haute-Saône, and Vosges; in Austria and Hungary, Transylvania, Dalmatia, and the Black Forest. Dalmatia produces a kind of kirsch, known as maraschino, which differs from kirsch in the kind of cherry employed. The wild cherry (Cerasus avium) is indigenous in the forests of the Vosges and the Jura. It is cultivated chiefly on the eastern slopes, where the altitude varies from 500 to 800 meters. Young trees are also raised in nurseries. There are many varieties of wild cherries, but they are not all of equal value for the manufacture of kirsch. The cherries are gathered when they are perfectly ripe. This operation is performed by hand, and an able picker can gather about 50 kilogrammes a day. The harvest continues from eight to twelve days. The wild cherries are thrown into vats or into casks without heads, placed in a shed or other dry place. The fermentation begins at the third or fourth day at latest, and continues for about a month. This fermentation ended, the wine is racked off and is not distilled until after fourteen days of rest. During this time the fermentation is finished. The distillation is generally performed in an ordinary still (i.e., with an alembic). The marc and the racked off juice are introduced in the neck of the alembic, which is then heated. This operation should be conducted with care, to prevent accident. The first portion of the distillate should be of a strength equal to 55° to 60°, and is placed in one vessel, and the second portion, which is intended to enrich the marc, by a second distillation in another.

**Marc.**—Marc is prepared from the products of a preceding distillation --a quantity sufficient to raise the marc to 6° B. being used. This material is introduced into a vat or cask of small dimensions, and yeast is added. The fermentation is quickly done and the wine distilled in very simple stills (Fig. 19). The top is larger than the ordi-
PART II.—ARTIFICIAL LIQUORS.

CHAPTER I.

THE PLANT OF THE DISTILLER.

The laboratory of the *liquorsiste* or distiller should be of sufficient size to enable him to carry on his work with facility. The walls should be well built and of sufficient height to prevent the flames from burning the ceiling in case of fire. The laboratory should be well ventilated, lighted from above and paved with brick, stone or gravel. An abundant supply of water should be at hand. The chimney must be large and well constructed and should terminate in a hood, under this are placed the stills (Fig. 21, A, B). The chemist should have a small private laboratory (13) where he can make his experiments. The plant in this small laboratory is very simple: A furnace surmounted by a hood, some gas burners, an alembic, a case of reagents, a good balance, a case for fine instruments, and a work table. In the plan illustrated herewith the store rooms ought to be as far away as possible, on the same floor as the laboratory. They should not be damp and the temperature should be maintained between 12 and 15° (C.). The floor is generally graveled or paved with asphalt.

The cellars must be well ventilated, have a northern exposure and a depth of 5 or 6 meters.

Figs. 22 and 23 represent a large distillery at Saint Denis, for the manufacture of liquors. In Fig. 23 a battery of stills of medium size are shown, the worms having a condensing tank in common. Fig. 22 is a view in another part of the distillery in which the large basins are set up, as well as the stills and the receivers for the raw materials. As the operation of a number of stills has been described, it will not be necessary to describe them again. The operations of the distiller require a large assortment of basins of copper, both tinned and untinned, steam-heated basins and basins...