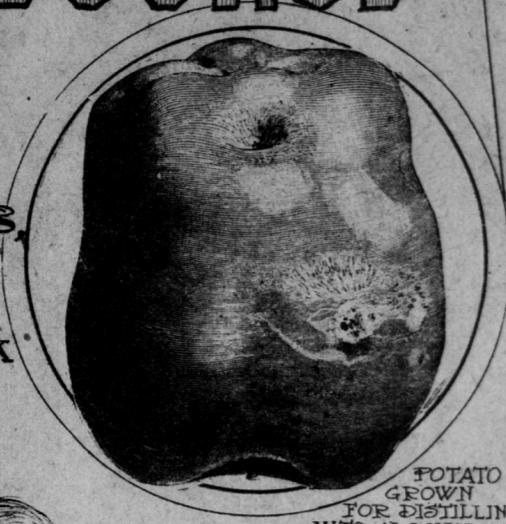


# WHEN DENATURIZED ALCOHOL IS KING

WHAT THE NEW COMMERCIAL PRODUCT IS, HOW IT IS PRODUCED, AND WHY ITS USE, UNDER THE RECENT LAW, IS EXPECTED TO WORK AN INDUSTRIAL REVOLUTION IN THE UNITED STATES



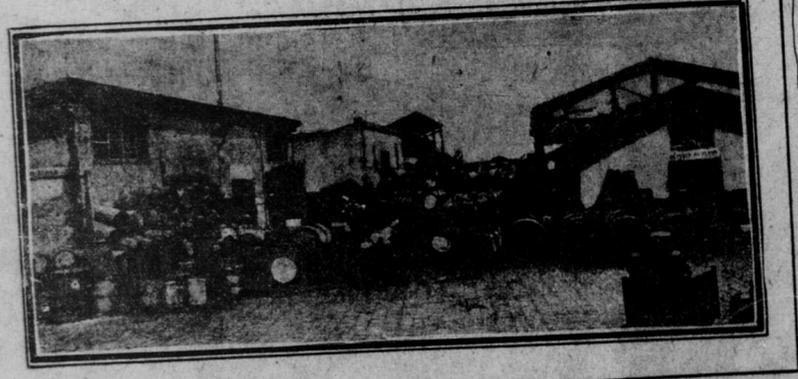
POTATO GROWN FOR DISTILLING INTO ALCOHOL



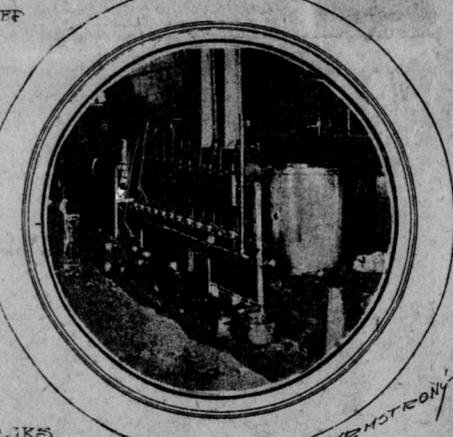
BARLEY OF THE VARIETY ALBERT



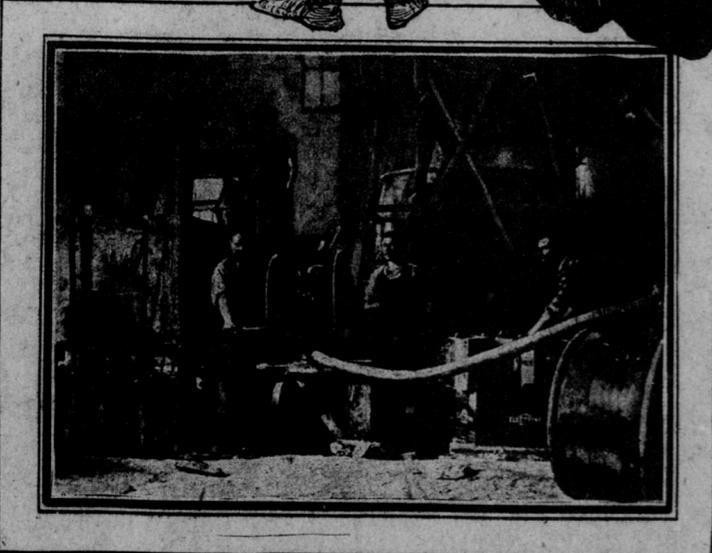
VARIETY OF SUGAR BEET FAISED FOR DISTILLATION



BARRELS OF DENATURIZED ALCOHOL READY FOR SHIPMENT



TANKS AND APPARATUS FOR FILLING THE CANS WITH DENATURIZED ALCOHOL



MIXING TANK. MIXING IS CARRIED OUT IN THE PRESENCE OF GOVERNMENT INSPECTORS



SORGHUM

By Enos Brown

If a discussion should arise as to the relative economic importance of alcohol or cotton it is extremely doubtful if the latter would not be relegated to second place. A French scientist, with the wonderful aptness of phrase which characterizes his nationality, has lately written a profound treatise on alcohol, its distillation and rectification, which he dedicates to his Majesty "King Alcohol" as an acknowledgment of the almost universal employment of the product in the arts and sciences and its relative importance as an indispensable factor in the world's economic development.

Any encyclopaedia will afford sufficient information regarding the manufacture of alcohol, but no idea can be expressed of the number of substances into which it enters or the variety of uses to which alcohol may be applied. To sum all, there is nothing in the natural world of greater utility to mankind, and none so deadly. Since fermentations began to appeal to the appetite and the pleasant effects of wine were discovered, alcohol has reigned as a monarch, a benevolent despot to those who accepted his rule wisely, but a hard, destructive and merciless master to those who, yielding themselves to his pleasant advances, abandoned themselves wholly to his seductive and all-embracing sovereignty.

Just now the interest in alcohol is centered in its employment in connection with the utilities. The law just passed by the United States Congress for the use of denaturized alcohol means a wide extension of its benevolent purposes, which this country proposes to encourage by following the example of almost every Government of Europe, in admitting alcohol, under certain discriminating conditions, to be so manipulated that while rendered unsafe or unfit for human consumption, it may be adapted for certain economic uses of the utmost value to the country. Under this benevolent phase alcohol is deprived of its powers to intoxicate or to harm and becomes a servant, like steam or fire, of unlimited possibilities and enormous usefulness.

**Made From Anything.**

Science, with all the distinctions it has realized from many successes, has sometimes failed. Science knows that alcohol is composed of carbon, hydrogen and oxygen and the proportion of each which enters into its composition, but it has failed in making alcohol directly from its prime elements. It can make alcohol from almost everything else, from grapes or fruit, corn, wheat, maize and even sawdust. Potatoes, beets and all other vegetables are fruitful of the spirit. In fact, broadly speaking, alcohol can be made from almost everything except a brickbat. At this attempt science shrinks as it has been obliged to in the attempt to transmute metals or to realize the secret of the origin of life. Any substance possessing susceptibility to the transformation called alcoholic fermentation is capable of producing alcohol.

Fermentation produces the alcohol, which is afterward separated by distillation and rectification. Wine and cider are the products of fermentation, and any farmer may produce them, but the ultimate production of alcohol is the work of the distiller and rectifier. Any substance will yield alcohol which contains sugar or that which is easily convertible into sugar. Out of 100 parts of glucose, for example, fifty-nine parts of pure alcohol and forty-one parts of carbonic acid results when treated after a certain formula.

The manufacture of alcohol was at one period almost monopolized by the French, and at one time it was only distilled from grapes. The ravages of phylloxera so greatly diminished the grape crop that other substances were sought for that might be used as a substitute. It was discovered that potatoes, beets, artichokes, barley, wheat or corn, and an infinite number of other natural productions, could be employed for this purpose, and the former dependence upon grapes as the only

source of a supply was declared off.

Sugar beets are an extremely facile source of alcohol. By the addition of sulphuric acid to the pulp the transformation into sugar is facilitated and yields, after fermentation, a large percentage of spirit. From the potato the Germans have discovered an inexhaustible source of alcohol. Alcohol can be produced in unlimited quantities from wood, sawdust, rags, cotton waste, straw, leaves, turf, etc., etc., by the conversion of these substances into cellulose by the addition of sulphuric acid. Clean rags and paper yield their own weight in sugar after being treated seven times by sulphuric acid and from this saccharine alcohol is subsequently distilled.

The process is one of infinite variety though very complex. The French seem to excel all other nations in the ingenuity with which they attack chemical mysteries and the success with which they subsequently arrive at solutions. Consequently no nation surpasses France in the cheapness with which alcohol is produced or in the mechanical devices requisite for distillation or rectification. Every step is the result of infinitely careful investigation and the fine adaptation of means to produce certain results. There is no universal method by which all substances can be treated; each fruit, vegetable or wood requires a certain method of fermentation, though distillation and rectification are, in essentials, the same process for all. The two last processes are now performed simultaneously, though the means employed are complicated.

The by-products of alcoholic distilleries include spent mash, which furnishes good food for cattle and is an excellent fertilizer; carbonic acid, glycerine and many other substances equally valuable. The foregoing gives a faint idea of the manner in which alcohol is produced and the number of substances in which the fiery spirit is latent, only needing the arts of the chemist to yield a liquid which is as capable of good as it is of harm. Pure whisky, in passing, contains 50 per cent of pure alcohol.

**How Many Materials Yield.**

As a matter of reference, the French manufacturer of alcohol finds he can produce alcohol in the quantities mentioned below from the substances named. From 100 pounds of each the number of blints of alcohol which may be produced is shown:

Potato starch	34 to 40
Rice	35 to 37
Maize	28 to 31
Buckwheat	24 to 27
Soft wheat	27 to 29
Millet	25 to 28
Hard wheat	24 to 26
Rye	24 to 27
Barley	21 to 25
Oats	19 to 22
Potatoes (containing 70 per cent water)	5 to 7
Beets (containing 80 per cent water)	4 to 5
Molasses	23 to 25
Crude sugar	36 to 45
Dry glucose	34 to 41
Cellulose (sawdust)	7 to 10

To France, before any other coun-

try, the world acknowledges its obligations, not only for the discoveries which have cheapened and broadened the sources from which alcohol may be derived, but in the unlimited uses by which it may be employed in the industrial arts.

Every great nation of the world which levies internal revenue taxes relies upon alcohol and alcoholic beverages for a large proportion of the tax. As luxuries which may be dispensed with, and with positive benefit to the people, alcohol, in the form commonly absorbed, is compelled to pay a huge proportion of the internal taxation, and, as the temptation to evade the payment of the tax is great, the Government surrounds the distiller with every precaution possible in order to prevent fraud. The tax levied by the United States upon alcohol is \$1.10 a gallon, which, added to the first cost of distillation, makes the price to the consumer so great that only where the use of alcohol is absolutely necessary is it employed at all. But there is an infinite variety of harmless purposes in which alcohol might be of the greatest service, provided its price could be reduced to reasonable figures. To France again the world is indebted for the demonstration of the unlimited number of purposes in which alcohol is useful in the industrial world. Hundreds of manufacturing processes are dependent upon alcohol for successful results. Lighting, heating and locomotion may be cheapened and perfected by the employment of low-priced alcohol, and from this requirement has finally risen the term industrial or "denaturized" alcohol, to indicate the change or addition made to its character of a nature to prevent consumption by human beings, and limiting its employment to purposes purely industrial.

**Government Foregoes Tax.**

On denaturized alcohol the Government consents to forego the tax of \$1.10 a gallon provided it can be protected against fraud and be assured

the liquor is to be used for industrial purposes only. A good denaturant ought to possess the following essentials: It should, first of all, render the alcohol unfit for drinking and should not hinder its use for lighting or heating purposes. No acid should be given off and it should not stain. For power purposes the alcohol should not give off offensive odors or deposit soot. The proportion of the denaturant should be low and not high and not of a poisonous nature. Its presence in alcohol should be easily detected in order to prevent fraud, and a most essential point is the impossibility of separating the denaturant from the alcohol even by the most refined means. Among other denaturants offered are pyridic bases, oils of acetone, ethers, formaldehyde and methylene. Near-benzine used is a distillation of coal tar. Alcohol admitted for denaturation must have at least a strength of 90

combustion. Moreover, they can be eliminated by distillation. Formaldehyde is poisonous. The best denaturant used in France is methyl spirit, prepared by the Government itself. It cannot be separated from alcohol by any chemical means and imparts a nauseous taste, neither is the odor offensive. In Germany and Austria the official denaturant is used in the proportion of 2 1/2 per cent. England uses 11 per cent proportion, and Holland 15 per cent. Denaturized alcohol is colorless. In France the official denaturant is composed of 1 part of methyl spirit and 0.5 part standard benzine, to be added to 100 parts of alcohol. The methyl spirit is to be 90 per cent strong and must contain 25 per cent of acetone and 5 per cent of pyrogenic matter. The benzine used is a distillation of coal tar. Alcohol admitted for denaturation must have at least a strength of 90

per cent. Another form of standard denaturized alcohol is the carburetted, extensively used in motors. It has been proved that the calorific power of alcohol is low. Compared with gasoline, alcohol shows a power of but 4850 calories as of 2860 calories for the former. By making a 50 per cent benzine mixture 7850 calories is produced. The French standard of natural is 10.5 per cent. Denaturing alcohol is a simple process and requires no heating or apparatus. All that is needed is a mixing plant and a series of tanks to hold the denaturized alcohol. From the tanks the mixture is run off into cans or metal casks for shipment. All the process is under the supervision of Government inspectors who examine and gauge all of the products which are used. Thus far no denaturant discovered is free from objections and the French Government, in order to stimulate dis-

covery, has offered valuable prizes. The first prize of \$4000 will be given for a denaturant superior to the present one and offering guarantees against fraud. The second prize of \$1000 is offered for the discovery of a system of utilizing alcohol for lighting under the same conditions as petroleum.

**Things Yet to Learn.**

The United States Government has the advantage of knowing all the processes and methods of denaturizing alcohol and of the experiments of foreign authorities which have been made to overcome the objections met with, but will be compelled to acquire more knowledge, inasmuch as the process known is free from radical objections. It has been found that methyl-alcohol is extremely injurious and causes of loss of sight, well authenticated, have resulted from inhalation of vapors of wood alcohol, as well as in its use as a liniment. Painters are peculiarly subject to the dangerous effects of the poison as the denaturized alcohol is extensively employed in varnishes. The Government, through the Department of Agriculture, will on January 1 publish a bulletin placing before the public a collection of the best obtainable data on the use of alcohol in small engines. All persons interested in patents or inventions or experimenters are requested to communicate with the department. The operation of the law will be watched with decided interest. The use of denaturized alcohol is expected to become universal, almost, and to open up a new line of research and discovery from which the country will derive great benefit. In Germany the cost of potato spirits is reported to be from 32 to 35 cents a gallon. Commercially pure alcohol is quoted at \$2.75 a gallon.