

Lay Supplement No. 2

THE NATURE OF
ALCOHOLIC BEVERAGES
AND THE EXTENT
OF THEIR USE

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THE NATURE OF ALCOHOLIC BEVERAGES AND THE EXTENT OF THEIR USE

THE term "alcohol" is widely used to mean alcoholic beverages. We speak of the "problems of alcohol" and the "effects of alcohol." In reality, few people drink alcohol. Many, however, drink beverages of which alcohol is an ingredient. The distinction is not without meaning, for the beverages differ widely in their nature, in the materials of which they are made, and particularly in the amounts of alcohol which they contain. The nature of the beverages influences the extent of their use and their effects. Correctly, therefore, the "problem of alcohol" is the problem of the alcoholic beverages. And the student who approaches this problem seriously should familiarize himself with the facts concerning the manufacture and properties of these beverages and the extent to which they are consumed before he makes any generalizations regarding them. This Supplement presents briefly the essential facts.

The most striking difference in the alcoholic beverages is their content of alcohol and this, in turn, is related to the processes of manufacture to be described. The alcohol content of the common alcoholic beverages (and that of two beverages usually not so classed) is shown in Table 1.

ALCOHOL

LONG before recorded history, men in nearly every region of the world made an observation which was fundamental to the preparation of raised bread and of all alcoholic beverages. They found that when fruit juice or any substance which, as we know today, contained sugar was allowed to stand in a warm place, bubbles of gas were formed and the taste of the fluid was altered. The bubbles of gas which "raised" the dough for baking were

TABLE I
Usual Amount of Alcohol in Various Beverages

	Percentage of Alcohol	
	By weight	By volume
<i>Distilled Spirits</i>		
Whiskies	} 32-40	40-50
Gins		
Brandies		
Cordials or Liqueurs		
<i>Mixed Drinks</i>		
Highballs	10-16	12-20
Cocktails	24-28	30-35
<i>Fermented Liquors</i>		
Fortified wines	14-17	18-22
Natural or light wines	6-13	8-16
Beer	3.5	4.5
Ginger beer or root beer (natural carbonation*)	0.3-1.5	0.4-1.9

carbon dioxide;† the change in the flavor of the fluid was due, in part, to the formation of alcohol. Carbon dioxide is the gas dissolved in all so-called "charged" beverages, "soft," as well as "hard." The process by which carbon dioxide gas and alcohol were formed was later given the name "fermentation." The light, porous nature of bread raised by fermentation added greatly to its palatability; the alcohol formed in fermented beverages pleased the taste of many people and gave these beverages their great popularity throughout the ages.

It was not until the nineteenth century, however, that the changes which occurred during fermentation became clearly understood. The essential feature was found to be the growth of the yeast plant. This plant is microscopically small, like a grain of

*A process now used mainly in making these beverages in the home. Commercial root beer is charged with carbon dioxide and contains virtually no alcohol.

†In baking, most of the alcohol formed is driven off by the heat, but a small amount remains and, when there is a hard crust, it may be appreciable. Thus a chemist analyzed English glazed buns and found the content of alcohol to be as high as 0.7 per cent.

pollen; and when dry, like pollen also, it may be picked up and carried in the wind. Thus when early man—and later the housewife—exposed a fluid containing sugar to the air, it was seeded with yeast. Unlike pollen, to which yeast has been compared here, the yeast plant is capable of leading an independent existence. In the nourishment provided by the solution containing sugar it multiplies rapidly so that if only a few plants seed the liquid a great number are soon formed. The yeast plant forms a chemical substance known as zymase. Zymase is one of many so-called enzymes or ferments which have been discovered as responsible for vital chemical reactions in plants and animals. Human digestion, as an example, is carried out by ferments of which pepsin is a familiar one. The ferment, zymase, formed by the yeast plant, changes simple sugars, such as grape sugar, into alcohol and carbon dioxide.

Zymase cannot form alcohol from a complex sugar such as cane sugar. The yeast plant, however, forms another ferment, invertase, which changes this sugar into simple sugars which, in turn, are fermented. Thus in the manufacture of wines from fruit juices, in which all of the carbohydrate is present as sugar, the entire fermentation can be carried out by yeast. Invertase, however, does not act upon starch; consequently the fermentation of cereals, as in the brewed beverages, is more complicated since nearly all the carbohydrate is present as starch. It is necessary first to change the starch to sugar and in brewing this is done by still another ferment, known as diastase, which is formed by malting grain, that is, allowing it to germinate. In the process of germination the diastase normally liberates the sugar from the starches of the seed for the growth of the young plant.

Even in the presence of abundant carbohydrate, the fermentation with yeast does not go on indefinitely with the production of higher and higher concentrations of alcohol. When the concentration reaches about 14 per cent, and occasionally as high as 16, fermentation stops. Alcoholic beverages containing higher percentages of alcohol are formed only by distillation or, as with some wines, by fortification, that is, the addition of some distilled spirits, usually brandy. The formation of alcohol may cease at concentrations below 14 or 16 per cent if the supply of sugar is

exhausted, or it may be stopped, as it is in brewing by heating, when some desired concentration has been reached.

There are many different strains or varieties of yeast and in the olden days fermentation was carried out with what were known as "wild" yeasts, that is, any strain that seeded the liquid by chance. The particular yeast influenced the flavor and other characteristics of the beverage and so modified its quality. Consequently, the modern manufacturer cultivates his yeast, growing special, pure strains that give desirable and uniform qualities to the beverage.

Likewise in the old-fashioned preparation of alcoholic beverages, the fermenting material was frequently contaminated with bacteria which might cause putrefaction—a process quite different from fermentation—and so spoil the taste of the beverage. To avoid this danger, the modern manufacturer handles his materials and controls his processes under sanitary conditions.

THE PROPERTIES OF ALCOHOL

THERE are many different alcohols known to the chemist since the term "alcohol" indicates only a type of chemical structure. Thus there are methyl, ethyl, butyl, amyl and propyl alcohols. The main alcohol formed by yeast is ethyl, or grain alcohol, and, following common usage, it will be referred to here as alcohol. In the nearly pure state it is a colorless liquid which in full strength causes a burning sensation when taken into the mouth. Even the strongest alcoholic beverages rarely contain more than 50 per cent and some as little as 3 or 4 per cent (see Table 1). A given volume of alcohol weighs only about $79/100$ as much as the same volume of water; alcohol thus has a specific gravity of about 0.79.

Alcohol and water will dissolve in all proportions. However, on mixing the two, a contraction of the volumes occurs. Thus if 52 gallons of pure alcohol are added to 48 gallons of water, not 100 but only 96.3 gallons of the mixture will be obtained.

In beverages with low or moderate amounts of alcohol, the content is expressed as per cent of weight or volume. Thus a certain beer may contain 3.2 per cent of alcohol by weight or 4.05 per cent by volume. The difference in these percentages, as

between weight and volume, is due to the difference in weight of alcohol and water.

In beverages having large amounts of alcohol, the content is usually expressed as degrees of proof. This practice has persisted from the time when there was no ready method of determining any content of alcohol. Today, a hydrometer is used which indicates the specific gravity and hence the proportion of alcohol. Before this instrument came into use, the gunpowder test was used. The powder was moistened with the spirits; if it would light or burn, this fact was "proof" that it contained at least 50.0 per cent alcohol. In the United States today, proof spirits, that is, 100° proof—contain exactly 50.0 per cent alcohol by volume; 90° proof would contain 45.0 per cent; and 80° proof, 40.0 per cent. In the British Isles, 100° proof corresponds to 57.1 per cent of alcohol by volume instead of 50.0 per cent.

CONGENERS

IN the process of fermentation, alcohol and carbon dioxide are the main substances formed, but in addition a large number of other substances is formed in small amounts. These, collectively, have been called "congeners." The nature and amount of congeners are influenced by many factors, such as the materials used for fermentation, the variety of yeast employed and the conditions under which the fermentation is carried out. Some of the congeners have a pleasant odor and these, together with volatile substances from the material which is being fermented, give the flavor or "bouquet" to alcoholic beverages. If the fermentation has been carried out under unsanitary conditions, putrefaction may occur and the volatile substances formed may have an unpleasant odor.

There is one group of congeners in distilled spirits which has attracted much attention; it consists mainly of the higher alcohols, especially amyl, and is often called fusel oil. At times, concern has been expressed about the possible dangers to health from fusel oil. In most distilled spirits, the amount is actually so small as to have little physiological effect.

It was once believed that the aging of spirits, as in "bonded whisky," destroyed fusel oil and so purified the whisky. It is now

known that it does not and that actually the amount of fusel oil is increased slightly on aging, largely because of the progressive loss of water and alcohol by evaporation. The fact that crudely prepared distilled spirits made under old-fashioned and unsanitary conditions may lose their offensive odor after several years of aging is not due to the disappearance of fusel oil, but to the slow development of chemical substances whose pleasant odors disguise that of the fusel oil. It was to get rid of the offensive taste which was present in all whiskies of a century ago that the aging process, carried out in oak casks, came into use. This aging, however, imparts no physiological benefit to distilled spirits; it may only alter the taste.

WINES

MYTHOLOGY, as well as the Bible, gives evidence of the great antiquity of wine. Probably the first use of this beverage was in connection with religious ceremonies and only gradually did it become a drink of common use.

Any fruit juice, plant sap, or animal product, such as honey, which contains sugar can be fermented directly to give a wine. Since that made from grapes is by far the commonest sort, it carries the name wine without qualification; all others are designated according to their sources. Of all the alcoholic beverages the wines are, in general process of manufacture, the simplest to produce.

In the preparation of wine the grapes are crushed and the pulp is put into fermenting tubs. There are always sufficient ferments present on the skins of the grapes to induce speedy fermentation but selected strains of yeast are usually added to assure a uniform fermentation. After fermentation is complete, the wine is drawn off. The pulpy mass that is left, the marc, is mixed with water and again allowed to ferment and a wine of lower alcohol content, 4 to 6 per cent, is produced. The last step in the preparation of wine is the storage and care upon which much of its ultimate quality depends.

The nature of a wine depends largely on the variety of grapes used and the climatic conditions under which they were grown. The flavor of wine originates from the so-called bouquet sub-

stances that are contained in small quantities in the fresh grape juice and, to a larger part, develop during fermentation and even more so in the course of aging. The main constituents of wine are water, alcohol in varying amounts and much smaller amounts of glycerin and fruit acids such as tartaric, malic, lactic and succinic. In addition, there are negligible quantities of proteins and minerals and also the bouquet substances and coloring matter.

Dry wines contain very little sugar and fermentation is allowed to continue to completion.

Sweet wines are produced by using grapes of high sugar content and stopping fermentation before the sugar is entirely transformed into alcohol and carbon dioxide. If sweet wines of higher alcohol content are desired, brandy, or for cheaper varieties a distilled spirit, is added. These are called *fortified wines*.

Still wines, which form the majority of the wines consumed, are bottled after fermentation has ceased entirely, while *sparkling wines* are bottled before fermentation is complete and thus retain carbon dioxide. Imitation sparkling wines are produced by charging bottled wines with carbon dioxide.

Wines are classified according to their color as white or red wines, and also according to their geographic origin. Thus the designations Burgundy and Bordeaux mean wines produced in those parts of France. Similar wines produced elsewhere are designated Burgundy or Bordeaux types.

The alcohol content of each of the most important wines is shown in Table 2.

BREWED BEVERAGES

WHETHER the fermented malt drinks, as beer, or the fermented juice of grapes, as wine, is the older beverage is a question that can hardly be decided. In countries where vines were found, wine is perhaps older, and in countries where vines were not native, but grains were grown, beer was apparently made just as long ago. The antiquity of beer is established by archaeological findings in Mesopotamia more than 5,000 years old. Its use in Egypt is mentioned in the *Book of the Dead*; and its use among the ancient Greeks, who were essentially wine drinkers, is mentioned by

TABLE 2

The Approximate Alcohol Content of Well-Known Wines

<i>Type of wine</i>	<i>Percentage of Alcohol by Volume</i>
Claret	10
Rhine	10
Sauterne	11
Champagne	11
Burgundy	12
Sherry (natural)	14-16
Sherry (fortified)	20
Port (natural)	14-16
Port (fortified)	20-22

Archilochos (714 to 676 B.C.). Beer plays a part in the old Icelandic epic, the *Edda*, and in the *Kalevala* of the Finns. It has been traditionally the beverage of the Germanic nations and in England, too, it seems to have enjoyed greater popularity than wine.

In the Middle Ages, beer making was carried on largely by the monks, although much was made in the castle and the home. The ancient process was in general principle the same as that employed in the brewery of today, although the sanitary and technical conditions surrounding the manufacture have changed profoundly.

In the preparation of brewed beverages, such as beer and ale, porter and stout, an additional step besides that of simple fermentation is required; the carbohydrate is present as starch and must be converted to sugar before fermentation can take place. The basic process of brewing consists of preparing malt to develop the enzyme diastase which converts starch into sugar. The malt is usually made from barley; the grain is steeped in water and allowed to sprout. The sprouting develops the enzyme. The malt is dried and mixed with whatever other cereals, such as wheat, millet, rye and corn, may enter into the brew; the mixture is crushed and water is added to form a mash. The mash is heated and the diastase of the malt converts the starch of the cereals into

sugar which dissolves in the fluid. This fluid, the beer wort, is then boiled to remove most of the protein and "hopped," that is, hops are added to flavor the beverage.

Hops contain resins which give the beer a characteristic taste. It was at one time believed that they caused sleepiness; they were actually used as a medicine for insomnia, sometimes in the form of a "hop pillow." It is recognized today that they have no soporific action; the supposed benefit of the "hop pillow" is an "oldwives tale."

The beer wort is cooled and the fermentation started with yeast. In so-called "bottom" fermentation the fluid is held at a low temperature and fermentation proceeds very slowly; most of the yeast falls to the bottom. In "top" fermentation the temperature is raised; fermentation proceeds rapidly and the yeast rises to the top. After the completion of fermentation the liquid is clarified and aged.

For brewed beverages, fermentation is not allowed to continue to completion, so that considerable amounts of unfermented carbohydrate remain in solution. Some of the soluble vitamins of the cereals are also retained, but most of the vitamin B₁ is removed by the yeast. A portion of the carbon dioxide is also retained to charge the fluid.

The character of the beverage is influenced by the grain and water used, the strain of yeast, the amount of hops added and modifications in the processes of manufacture. In the broadest sense, all brewed malt beverages may be called beer. The name "ale" is often given to the heavier and stronger types. Some centuries ago the distinction between ale and beer was much more definite than at present, since only beer contained hops and ale was made entirely by top fermentation. Beers with more than the usual amount of cereals and extracts, and hence of a darker color, are often classed as porters and stouts.

In the United States, no brewed beverage containing less than 0.5 per cent of alcohol by volume may be classed as beer. The average concentration of alcohol in the beer of this country is 4.5 per cent by volume—3.5 per cent by weight. The typical composition of beer is shown in Table 3.

TABLE 3
Typical Composition of Beer

	<i>Percentage by Weight</i>
Carbohydrates	4.7
Proteins	0.4
Minerals	0.2
Carbon dioxide	0.5
Alcohol	3.5
Water	90.7

DISTILLED SPIRITS

As we have seen, the process of fermentation ceases when the concentration of alcohol in the fermenting liquid approaches 14 per cent. In order to obtain stronger liquors, that is, beverages of higher alcohol content, it is necessary to concentrate the alcohol by distillation.

The term "distillation" is derived from the Latin *destillatio* which means to "trickle down." The general process of distillation consists of heating a liquid and so converting it into vapor, and then cooling the vapor and condensing it again as a liquid. In this manner fresh water can be obtained from sea water; the water distills over and the salt is left behind in the still. To a less exact degree, fluids of different boiling points, that is, different degrees of volatility, can be separated by distillation. Thus when water containing a low percentage of alcohol is heated in a still the alcohol, because it has a lower boiling point than the water, passes over first and in a much higher concentration than in the original fluid. By repeated distillation most of the water can be got rid of and a highly concentrated alcohol obtained.

Distillation is an ancient process, for Aristotle (384 to 322 B.C.) describes the production of pure water by Greek sailors through evaporation of sea water. The application of distillation to obtain concentrated alcoholic beverages came later. Some historians believe that distilled spirits were known in China and India in the pre-Christian era, but there is no clear evidence of this. Some primitive tribes produced distilled spirits and this fact has been taken as an indication of the probable antiquity of spirit distilla-

tion. There is no certain evidence, however, that there was any distillation of spirits in Europe before the sixth century. The art of distillation was probably introduced by the Arabs of Western Europe during the Middle Ages.

Apparently the distillation of spirits from grain preceded that from wine. The former was described by Marcus Graecus in the eleventh century; brandy from wine was produced for the first time in France in the thirteenth century.

In the preparation of distilled spirits any fermentable material can be used. As with the manufacture of beer and wine, the fermentation with yeast is first allowed to take place. Then the product of the natural fermentation is subject to distillation and a highly concentrated solution of alcohol is obtained. Not only alcohol and water pass over in distillation, but also any volatile substance present in the fermented material. The presence of many of these substances is desirable since they serve as flavoring matter and give the characteristic taste to the beverage. Other substances, such as fusel oil which has been described in a previous section, are undesirable and must be removed or neutralized by the further treatment of the spirits.

The first stills used in the manufacture of spirits were simple and crude—the so-called “pot still” which has continued in use in the manufacture of some types of spirits. It consists of a metal boiler or pot in which the material to be distilled is placed and heated; from the top of the boiler a coil of pipe carries the steam away; the coil is cooled, the liquid condenses and is collected. Great technological advancement has been made in the process of distillation. In a modern well-equipped distillery highly efficient continuous stills are often used; with them the concentration of alcohol in the distillate can be controlled precisely, and even the amounts of various congeners. With such a still, a highly purified type of alcohol with little odor can be prepared; this alcohol is known as neutral spirits and is extensively employed in blending whiskies and in the preparation of gin.

All distilled spirits are essentially diluted alcohol—usually about 50 per cent—containing small amounts of flavoring and coloring matter. When made from grain, the product is known as whisky; from sugar cane, as rum; and from wines and fruits,

as brandy. Gin is essentially neutral spirits to which flavoring material, always including that of the juniper berry, has been added; and cordials have sugar sirup, besides flavoring, added to the alcohol.

WHISKY

THE name "whisky" (also spelled whiskey) is derived from the Irish word *uisquebaugh*. Whisky is the most commonly used high proof spirits in the United States and the British Isles. There are many varieties of whisky and the main distinction is that of flavor which, in turn, depends upon the material used in preparation and the treatment given to the spirits after distillation. Thus, according to the country in which they are made, there are Scotch and Irish and the American whiskies, rye and bourbon. These may be further distinguished as bonded, straight and blended.

Some Scotch whiskies are made from malted barley only and some with the addition of other cereals, as rye and oats. The characteristic feature is given by the flavor derived from creosote absorbed by the malt from the smoke of the peat fire in which the malt is cured. The malt of Irish whisky is not cured in peat smoke.

Of the American whiskies, bourbon, named after the county in Kentucky where it originated, is made from a mash containing 51 per cent or more of corn. Rye is made from rye with admixtures of other grains.

All whiskies, as sold today, are amber colored but this is not their color as they come from the still. In the early days of the manufacture of whisky in this country some was sold in the nearly uncolored state, "white" whisky. But usually it was colored with caramel, probably to make it resemble the more expensive brandy. In those days, also, whisky was frequently flavored by steeping fruits in it. Later, storage in charred oak barrels was used to give the amber color and also the distinctive taste now associated with whisky. The color and the taste come from material extracted from the charred wood. A small amount of caramel may also be added to whisky to give it a deeper color.

With the old-fashioned still and with the unsanitary ways of preparing the grain for distillation common to whisky of the

past, the distillate had an unpleasant odor and taste. Redistillation and leaching through charcoal were used to remove these unpleasant characteristics; it was later found that storage for several years in charred oak barrels served the same purpose.

The aging process necessary to mellow the raw whisky from the old-time distillery process led to the principle of bonding. The Government collected a tax on whisky; but it permitted the distiller to store the whisky under Government supervision and to pay the tax on withdrawal from bond.

The Federal Alcohol Administration at present requires that whisky shall contain 40 to 55 per cent of alcohol by volume. Aside from water and alcohol, there is very little else in whisky, as is seen in Table 4.

TABLE 4

*Composition of Neutral Spirits and Typical Whiskies.
Ingredients (Other Than Water) in Per cent by Weight.
Values Given at 100° Proof*

	Alcohol	Solids	Acids	Esters	Aldehydes	Furfural	Fusel Oil
Bonded, 4 yr. old	39.700	0.166	0.062	0.027	0.012	0.002	0.125
Neutral spirits	39.700	0.000	0.001	0.0005	0.0001	0.000	0.004
Spirit blend	39.700	0.049	0.017	0.018	0.005	0.002	0.051

GIN

THE name "gin," or geneva, is derived from *geneivre*, which is the French word for juniper. Gin is essentially diluted alcohol—usually about 86° proof—containing oil of juniper berries and frequently other flavoring ingredients, such as the extract from coriander seeds, orange and lemon peels, etc. Unlike whisky, it is not stored in oak barrels to give it color but is "white." In Holland gin, the juniper berries are added to the fermented mash before distillation. Other gins are made by percolating the flavoring materials with the alcohol and then distilling.

Gin was originally regarded as a medicine and sold as such, mainly for the treatment of kidney diseases. It became a popular drink, however, and by 1727 production in the United Kingdom had risen to 3,600,000 gallons.

In the United States, much less gin is sold than whisky; it is, however, widely used in the preparation of mixed drinks, such as cocktails. During Prohibition, Americans learned that gin was an easy liquor to produce in the home. The home preparation and the poor quality are commemorated in the term coined during that period, "bathtub gin."

RUM

RUM was formerly one of the most popular distilled spirits. It was traditionally the favorite drink of sailors. Its popularity in the past, especially with heavy drinkers, led to its being identified, by some people, with any hard liquor as a term to express their disapproval—i.e., "demon rum."

Rum is distilled from fermented cane juice and molasses. It is manufactured extensively in the West Indies, particularly Jamaica, and in British Guiana; the product of the latter is commonly known as *Demerara*. An American variety is designated "New England Rum."

BRANDY

BRANDY is the most important distilled spirit on the European continent but it is not extensively drunk in the United States. Brandy is distilled from fermented fruit juice and, unless designated by the name of the fruit, as peach brandy, is understood to be made from grape wine. Apple brandy, or applejack, was a popular drink in America in Colonial days. The quality of the brandy depends largely upon the character of the wine used for distillation. "Cognac" is a term applied to French brandy from the region of that name.

CORDIALS AND LIQUEURS

CORDIALS and liqueurs are alcoholic beverages obtained by mixing or redistilling neutral spirits, brandy or other distilled

spirits with various aromatic substances from herbs, spices, flowers, fruits and seeds. They differ from gin not only in the usual absence of juniper berries but primarily in the fact that considerable quantities of sugar are added to them. They are sweet, sirupy beverages. The alcohol content of most liqueurs is as high as whisky. They are, however, consumed only in comparatively small quantities, especially in the United States.

COCKTAILS

COCKTAILS are mixtures of different distilled spirits to which flavoring agents and water, in the form of ice, are added. The main ingredient of the cocktail is usually gin, brandy, rum, or whisky to which liqueurs or wine in small quantities, as well as bitters, sirups, fruit juices or egg whites, are added. Cocktails are designated under picturesque names which ordinarily do not indicate the ingredients. The average alcohol content of a cocktail is slightly less than 1 fluid ounce of alcohol.

CONSUMPTION OF ALCOHOLIC BEVERAGES IN THE UNITED STATES

THE amount of alcoholic beverages consumed by an individual, a group, a state, or a nation, may be of interest to many people. For some, it is only a matter of curiosity, but others draw far-reaching conclusions from the statistics available on this question. In presenting figures for the consumption of different alcoholic beverages for the States of the Union (Table 5) we wish first to stress the important limitations attaching to these statistics and the errors that may occur in deductions from them.

The quantity of alcoholic beverages produced legally in any one year is well known. But consumption, particularly of distilled spirits, does not necessarily equal production. A large part of that produced in a given year may be stored for aging and some may be exported. Exactly how much is actually consumed is not known. It is assumed, however, that those alcoholic beverages on which the tax has been paid are in the hands of retailers and will probably be consumed within the year in which

TABLE 5

Apparent Consumption of Alcoholic Beverages, Per Capita of the Population 15 Years and Over, United States by States, 1945

	IN WINE GALLONS			Total Absolute Alcohol from All Beverages
	Distilled Spirits	Wine	Beer	
Alabama	1.01	0.35	6.65	0.78
Arizona	1.95	1.03	20.39	1.88
Arkansas	1.32	0.22	7.01	0.91
California	3.10	2.52	22.74	2.74
Colorado	2.32	1.22	19.13	2.02
Connecticut	2.64	0.94	28.91	2.51
Delaware	2.86	0.64	26.52	2.46
District of Columbia	5.39	0.93	24.27	3.56
Florida	2.73	0.80	18.73	2.12
Georgia	1.65	0.47	8.59	1.16
Idaho	1.38	0.53	20.05	1.51
Illinois	2.20	0.98	30.02	2.36
Indiana	1.36	0.45	23.16	1.62
Iowa	0.91	0.28	20.96	1.30
Kansas	Dry	Dry	10.20	0.41
Kentucky	1.74	0.22	18.30	1.55
Louisiana	1.90	0.91	18.88	1.77
Maine	1.95	0.46	23.89	1.92
Maryland	2.46	0.66	31.58	2.48
Massachusetts	2.14	0.88	28.47	2.25
Michigan	1.74	0.75	35.11	2.31
Minnesota	2.31	0.44	25.33	2.12
Mississippi	Dry	Dry	8.59	0.34
Missouri	2.33	0.75	23.60	2.12
Montana	2.28	0.67	26.20	2.19
Nebraska	2.46	0.49	22.87	2.10
Nevada	4.81	1.89	29.07	3.64
New Hampshire	2.27	0.44	27.32	2.18
New Jersey	2.39	1.26	33.37	2.62
New Mexico	1.11	1.51	15.21	1.37
New York	1.82	1.46	34.40	2.45
North Carolina	0.48	0.61	10.20	0.73
North Dakota	1.56	0.64	18.05	1.53
Ohio	1.53	1.06	30.40	2.09
Oklahoma	Dry	Dry	19.57	0.79
Oregon	1.23	0.85	24.74	1.68
Pennsylvania	1.77	0.65	38.25	2.44
Rhode Island	1.25	1.03	33.26	2.07
South Carolina	0.95	0.25	9.13	0.84
South Dakota	1.45	0.33	16.62	1.37
Tennessee	0.81	0.11	12.38	0.88

TABLE 5 (Continued)

	<i>Distilled Spirits</i>	<i>Wine</i>	<i>Beer</i>	<i>Total Absolute Alcohol from All Beverages</i>
Texas	0.86	0.43	16.64	1.13
Utah	1.14	1.06	19.64	1.48
Vermont	1.33	0.52	12.52	1.19
Virginia	1.33	1.30	17.49	1.52
Washington	1.12	1.97	24.27	1.80
West Virginia	1.62	0.79	21.56	1.72
Wisconsin	1.67	1.01	37.95	2.44
Wyoming	1.67	0.58	17.29	1.54
UNITED STATES	1.95	1.13	25.97	2.09

the tax has been paid. Thus the tax-paid withdrawals are used as the basis for estimating consumption.

As far as wine and beer are concerned, the error of this estimate is probably slight. For distilled spirits, however, the actual consumption may be considerably higher than the quantity indicated by tax-paid withdrawals, since distilled spirits are even now produced in appreciable quantities by the so-called bootleg trade. Estimates of the amount of bootleg spirits run from 20 to 50 per cent of all distilled spirits consumed. It is impossible to obtain reliable estimates, but some idea of the extent of bootleg liquor production can be gained from the fact that, in 1940, Federal authorities confiscated more than 10,000 illicit stills. The production of bootleg liquor varies greatly from state to state; in some it is negligible, and in others it is large. The production of illicit spirits, taking the confiscation of illicit stills as an indication, is especially large in those states in which a high percentage of the communities exercise their option of local prohibition, and also in those states in which the average income of the population is low. Thus considerable error may occur in comparisons of alcohol consumption as between states when the figures are based on tax-paid withdrawals or payment of state taxes.*

Since the number of inhabitants varies to a large extent from state to state and city to city, it is customary to compare the

*During the war years there was a sharp reduction in bootlegging, so that data on legal consumption in 1945 may more nearly approximate actual consumption than did older data.

consumption of alcoholic beverages in terms of per capita consumption, that is, the number of gallons consumed in an area is divided by the number of inhabitants. It is quite common to find per capita consumption figures quoted as evidence or as an indicator of the "alcoholism" in any given locality or at any given time. The use of per capita consumption figures for such purposes, however, may be entirely misleading, since it is customary to distribute the total gallonage consumed over the total population of the state. Actually, however, one should consider as consumers of alcohol, mainly that portion of the population over 15 years of age; the largest consumers fall into the age range of 30 to 50 years. The age distribution of the populations of the states varies to a larger extent than one might expect. Thus in California, 80.2 per cent of the population were according to the 1940 census, aged 15 years and over, while in New Mexico only 65.5 per cent of the population were in that age range. Thus there were more potential users of alcohol indicated by the total population figures in California than in New Mexico.

Furthermore, in one state, according to custom probably determined by race, there may be much greater general use of alcoholic beverages than in another state of the same population and thus a larger per capita figure in the former state would not indicate that the people there are heavier drinkers but merely that there are more moderate users of alcoholic beverages. Consequently per capita consumption figures cannot be taken at face value or as indications of any particular conditions unless a careful analysis is made of the composition of the population concerned. Conclusions should be drawn from the figures given in Table 5 only with these qualifications in mind.

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