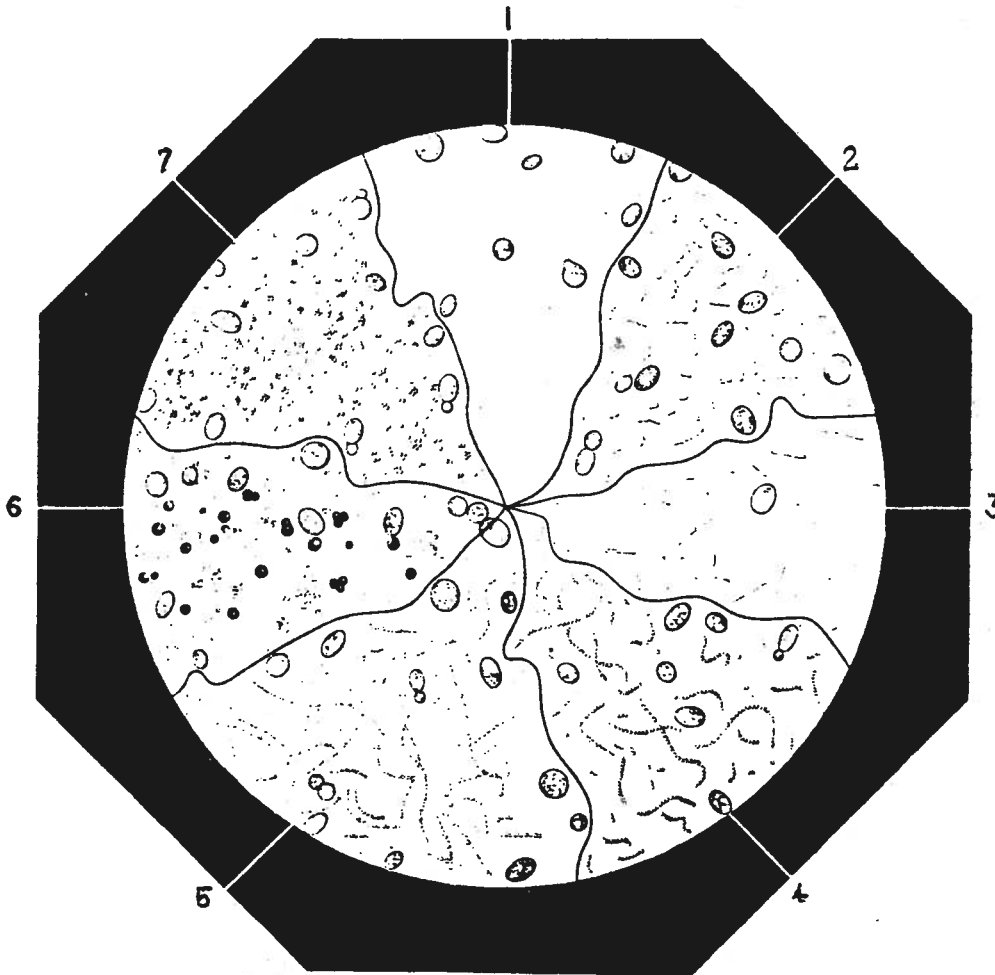


THE ^{#6} Amateur Brewer

FOR THE SERIOUS HOME BREWER



PRINCIPAL DISEASE-FERMENTS MET WITH IN WORT AND BEER.

special YEAST issue

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AMATEUR BREWER

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Talk to Your BEER

Well we didn't quite make our April 30 in-the-mail deadline, but this is April 30, and this is the last unit of the Amateur Brewer before it goes to press tomorrow.

Lee Coe tells me his paper Home Brew on Draft actually sells for \$2.50 and is available from Wine and the People, 907 University Av, Berkeley CA 94710. This is to correct our error in Amateur Brewer No. 5., poor Lee has been getting dollarses in the mail, and the paper costs more than that to zerox. Get your copy from WATP above.

We couldn't find space for Reader Questions, in fact we couldn't even find time to answer the many many questions we have piled up on our desk. If you have a problem with your beer, and need answers why not call me long distance in the morning (Pacific Time), Friday is best, and the telephone isn't that expensive (503) 289-7596. Other times you might get other people answering, and waste your money. I am really v-e-r-y slow answering my mail when people ask time-consuming questions. I really do try to answer all of my mail but it ain't that easy.

WANTED: MORE SUBSCRIBERS

As I explained in my letter to you folks out there, my real problem is time. The circulation is so low that I cannot afford to hire secretarial help, indeed this is the first issue where I've had the book collated and folded, but I still have to staple it. That all takes time, but if the circulation were increased I might even be able to afford farming out the production, which would allow more time for niceties like answering my mail. You might think I am making a mint,
--continued inside back cover.

YEAST

By Fred Eckhardt

"More to him [Pasteur] than to any other man living or dead do we owe much of our present knowledge of that difficult, nay even mysterious process carried on by the agency of living organisms, viz. fermentation."

Walter Sykes 1895, Journal of the Institute (England)

The word YEAST is from the Greek: *Zestos* (boiled), and Sanskrit: *Yasyati* (it seethes). Yeast is an egg-shaped single cell fungus. It contains no chlorophyll, and cannot manufacture its own food supply from carbon dioxide and water as plants do. The production of beer and wine would be impossible without yeast, fortunately there is no problem in this regard since yeast is universally present in all parts of the world including the Antarctic.

Louis Pasteur was the first to establish the scientific role of yeast in the fermentation process by his studies from 1857 to 1868. This information was expanded by Emil Christian Hansen, a Danish Brewer, from the *Carlsberg* Brewery of Copenhagen. By 1890 Hansen had established procedures for isolation and cultivating a pure yeast culture from a single cell, and its use in the production of better beer.

There are basically three types of bacterial fungi that will interest the brewer: mold fungi, budding fungi (yeast), and fission fungi (most bacteria). These are differentiated by their methods of reproduction. Yeast is of the family *Endomycetaceae* genera *Saccharomycoideae*. *Saccharomyces Cerevisiae*, or yeast, reproduce by vegetative budding; that is a bud starts, grows, and separates as shown in figure 1. This process can be seen under a microscope at about 500x magnification. Figure 2 reproduces one of Thausing's drawings. Each cell can reproduce about 30-daughters during its lifetime. Yeast are non-motile, that is they are not able to move about, although under a microscope they often appear to do so.

When conditions of growth are unsatisfactory some cells hibernate within thick walls formed by one or more cells, this is called *sporulation*. These *spores* are very resistant to extremes of temperature and desiccation (lack of moisture), and may remain dormant for long periods.

Alcohol fermentation will take place in either the presence of, or the absence of oxygen, but if the yeast gets plenty of oxygen, it will reproduce itself more quickly, and increase its metabolic activity. Under these *aerobic* (with oxygen) conditions it will not produce much alcohol, since the yeast will be able to oxidise (or convert) more sugar completely to carbon dioxide (CO_2) and water, thereby obtaining much more energy than fermentation alone could provide, thus allowing the yeast colony to grow and multiply rapidly. This growth and reproduction can take place only under *aerobic* conditions. That is why we need oxygen early in the fermentive process to produce an active yeast colony. Later in the ferment the production of carbon dioxide will naturally exclude oxygen, forcing the yeast to obtain its metabolic energy from alcohol fermentation. At this stage life barely turns over. Alcohol production reaches its maximum under these *anaerobic* (without oxygen) conditions, during which the yeast uses twelve times more sugar to grow.

The fermentation process is a chain of actions and reactions during which sugar ($\text{C}_6\text{H}_{12}\text{O}_6$) is converted to ethyl alcohol ($2\text{C}_2\text{H}_5\text{OH}$) and carbon dioxide (2CO_2), with a side production of small amounts of glycerol, polysaccharides, fusil oils, and succinic acid, under 6% total (2).* This fermentation continues until the fermentable sugars have been used up, or until stopped by a surplus of alcohol in accordance with the maximum toleration of the particular yeast strain(s) in question.

We are interested in only two yeast strains, two species of *Saccharomyces*: top fermenting *Saccharomyces cerevisiae* and bottom fermenting *Saccharomyces uvarum* (formerly called *S. carlsbergensis*).

* Number in parenthesis refers to books listed in the article SPECIAL REFERENCE REVIEW FOR YEAST STUDY AND GENERAL MICROBIOLOGY.

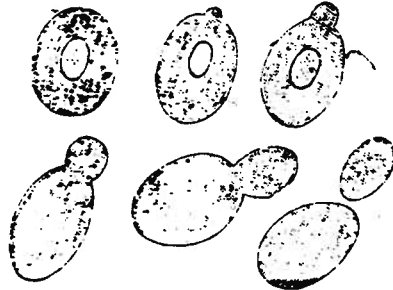


Fig.
Budding Yeast (Sykes).

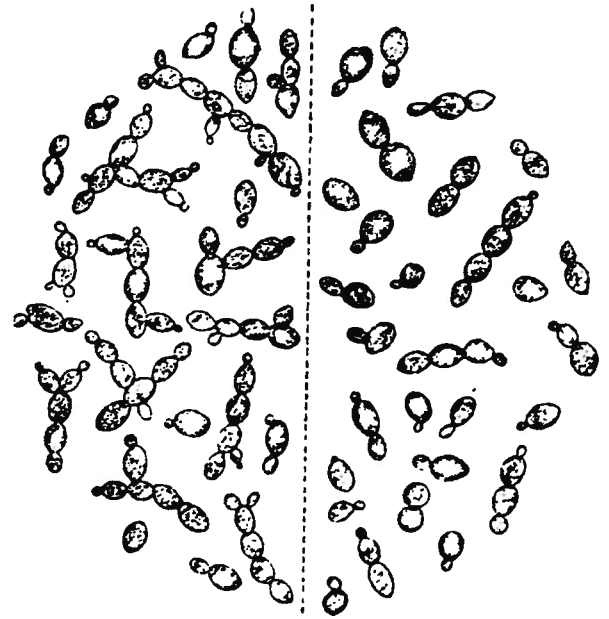


Fig. Budding Yeast (Thausing) 500:1.

TOP FERMENTING OR COMMON BEER YEAST

Top fermenting yeast (*S. cerevisiae*) is the common yeast. It ferments throughout the body of the beer wort, and floats to the top, settling at length on the surface of the beer. Top fermenting yeast will also settle at the bottom of the beer.

The head or *krausen*, (German, pronounced KROY-sen), as it is called, normally assumes a particular cauliflower appearance. Most commonly obtainable yeasts are top fermenting, and most of the World's common beers are (or were in the old days) made with top fermenting yeast. Beer yeast, as we will call it, ferments well at temperatures from 58-104°F (14-40°C). Beer yeast can sporulate (form a cyst of one or two cells that are surrounded by a protective wall (fig. 3) more readily than bottom fermenting or *lager yeast*. For this reason *S. cerevisiae* is unable to function well at temperatures below 58°F (14°C). However such beer yeast will survive much greater ill-treatment and has a higher alcohol tolerance than lager yeast (i.e. can produce beer of higher alcohol content). Beer yeast will usually attenuate (the process of fermentation is called attenuation) faster and to a greater extent than lager yeasts, but does not settle well and is more difficult to clarify than lager yeast. Beer yeast is used in the production of English and Irish stouts, porters, and ales, as well as most German, Belgian, and French common beers.

BOTTOM FERMENTING OR LAGER YEAST

Bottom fermenting or lager yeast (*S. uvarum*) is used in the production of lager beer, steam beer, and some American ales. Lager yeast ferments in the body of the beer, and then settles to the bottom of the fermentor. The *krausen* or head generated by lager yeast assumes a jagged cliffs appearance.

When examined under a microscope, lager yeast has the same physical characteristics as beer yeast, differing only in behavior, and in its ability to ferment the sugar melibiose, which beer yeast cannot ferment. Lager yeast is more fragile, because it does not sporulate easily and has a lower alcohol tolerance. For that reason bottom yeast will ferment in very cold temperatures (39°F--3°C or even lower!). Lager yeast also attenuates slower and to a lesser extent than beer yeast, which gives it a greater ability to form clusters of cells while settling to the bottom of the fermenting vessel. This leaves a greater remnant of sugar in the beer resulting in better clarification and a more full bodied beer with a better palate.

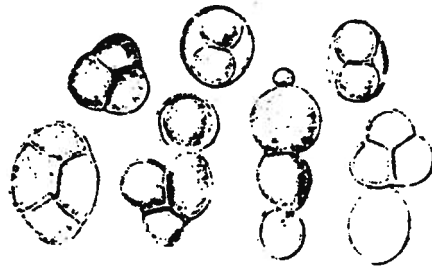
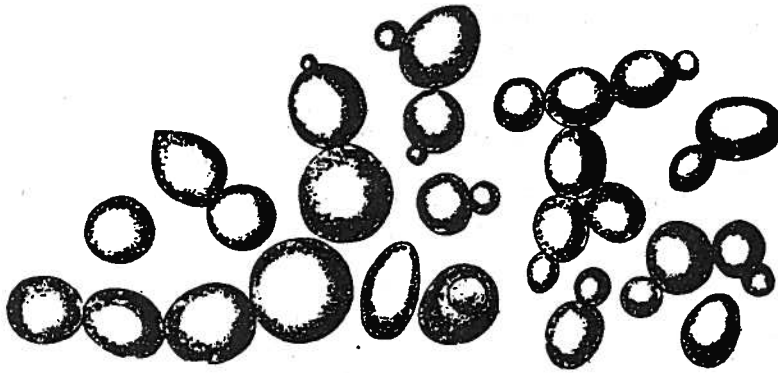


Fig.
Yeast spores (Hansen) 1000:1.



Saccharomyces cerevisiae (Hansen) 1000:1.

BREAD YEAST

No discussion of home beer-making would be complete without a mention of bread yeast which is in fact a strain of top fermenting beer yeast, *S. cerevisiae* var. *meyer*, but cultivated for its ability to generate CO₂ gas to make bread dough rise (16). I would guess that bread yeast is used to make well over 50% of the home brew made in the U.S., even today. Bread yeast is readily available, always at hand and will ferment beer and wine readily.

Bread yeast has several critical faults which make it unsuitable for beer or winemaking. First, it does not ferment well at lower temperatures, being most effective at 80°F (27°C) and above, while the best temperature for using top beer yeast is about 60°F (15.5°C), and that of lager yeast around 50°F (10°C). Second, bread yeast does not settle well, being light and fluffy in sediment, it's use complicates racking procedures, and clarification of the beer. Third, bread yeast ferments faster, to produce a harsher tasting end-product, which is sometimes referred to as "yeast bite". About the only good thing you can say about bread yeast is that it is readily available in even the most backwoods community, and needs no starter culture.

OTHER YEASTS

Wild yeast. There are a very few common beers still being made using wild or natural yeast ferment, the most famous being Belgian *Lambic* beer. Any beer wort left at room temperature or warmer will ferment, but the yeast will most likely be a wild strain of the *Kloeckera apiculata* species. These yeasts are very unsatisfactory for beer-making purposes for many reasons. Most important of these is its low alcohol tolerance. Wild yeasts often introduce off-flavors (16) as well as other bacteria infections, no matter how highly you hop your beer to prevent them, even as high as 2-oz/US gallon (10.5-gm/L), which would certainly give you a well-hopped beer by any standard. Wild yeasts, like bread yeasts, do not settle well.

Wine yeast. Wine textbooks caution against using beer or lager yeasts in wine (11, 16), but I can find no mention in any beer text about using wine yeasts, so I conclude that it's quite unheard of. I am currently experimenting with Champagne yeast (*S.C. bayanus*) with no apparent dire effects.

SELECTING A YEAST

Beer and lager yeasts are readily available in most fermentation supply stores, and the best of these may be liquid cultures imported from England. Yeast is available in several forms:

1. *Agar slant*. A culture in a test tube, usually from a microbiological supply house, not easily obtained or usable by amateurs. Very expensive at \$10 to \$20 per slant. These are the very best, and may be worth the money.

2. *Pressed yeast*. A storage-preservation form used by breweries, and not usually available to amateurs in this form. Occasionally you may have an opportunity to get yeast in this form from a local brewery.

3. *Liquid yeast*. A yeast culture in liquid, and shipped in that manner. English yeast manufacturers supply this type of culture, and they may be the best available (readily) to the amateur. You must always use a starter culture of some type with liquid yeasts.

4. *Dry or granulated yeast*. Usually in a packet of five to seven grams. This is the most commonly available form of yeast culture, and the one most people are familiar with. It is nearly impossible to produce granular yeast in absolutely pure form.

5. *Yeast tablets*. These are a form of dry yeast pressed into tablets. Not too common in beer yeasts.

Any yeast that is labeled "beer" yeast will in all probability be a top fermenting or ale yeast. Even some yeasts labeled "lager" may not be bottom fermenting yeasts. Some of the granular yeasts have not proven to be so, that is they will not ferment the sugar melibiose. Tests conducted at the University of California, Davis leave grave doubts concerning lager yeast in granular form. I called the *Universal Foods Co.*, in Milwaukee, WI. and asked them about this, since their *Red Star Lager Yeast* was one of the yeasts that were found to contain contamination, and which were unable to ferment the sugar Melibiose. I talked to Mr. Gordon Christiansen who told me that they manufactured this particular yeast under license from Schwarz Services International and that it was that nationally known brewery supplier's strain U-125. Bottom fermenting, Pilsner-type *S. Uvarum*. According to Mr. Christiansen this particular strain is indeed used by several world famous lager beer brewers, and the yeast, grown by Red Star, is grown from a pure culture, in and under very sanitary (but industrial) conditions, and that under these conditions absolute purity was impossible, but that the small amounts of contamination possible would not interfere with proper fermentation. Mr. Christiansen's description of the process appears elsewhere.

It is possible that, if you are having problems with your yeast, you should switch to an expensive agar slant yeast from a biological supply house, or to English *Edme* or German *Vierka LIQUID* cultures available from various suppliers. Liquid yeasts must *always* have a starter culture. (See "Starting Your Yeast".

NUTRIENTS

Nutrients are to yeast as fertilizer is to plants — food. Nutrients are necessary to yeast growth and reproduction. Since the yeast converts most of the sugar they use to alcohol, carbon dioxide and by-products it stands to reason they must have nutrition. You cannot make wine or beer from sugar alone. There must be nutrients or food for the yeast.

The nutritional requirements of wine and beer yeasts are almost identical. Now it just so happens that the sugars extracted from malt grains (those that are found in malt extract syrup) are an ideal growth media for yeast and contain all of the nutrients necessary to yeast growth and alcohol ferment. In all all-malt or high malt content beer, yeast nutrients are not required. However in some particular beers where a high degree of attenuation (fermentability) is desired, such as in some ales, it may be desirable to add nutrients of the type and amounts to be described later. Beers made from the traditional home-brew recipe contain a relatively small part of malt sugars and therefore must have nutrients added. We might say then that beers with low malt content (under 50% of the fermentable sugars) must have nutrients added during ferment. Beers in the 50-60% class and some ales might also need nutrients.

HOME MADE BREWING NUTRIENT

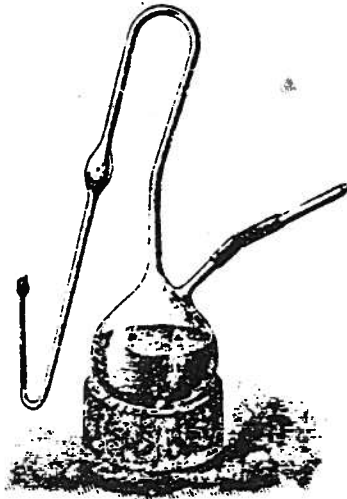
You can improvise a good brewing nutrient for less than the price of the commercial products available. The formula is as follows:

- 2-oz Winemaker's yeast nutrient (57 gm)
(monammonium phosphate)
- 1-oz Brewers yeast extract (available in Health Food stores)
(29-gm — about 4 tablespoons) (US tablespoons not UK)
- 1-100 mg tablet of vitamin B-1 (available in many supermarkets)
This should be crushed.

Be sure to get un-adulterated and un-enriched products, for example don't get ironized yeast or vitan B-1 enriched with minerals. Use only the basic product listed above. The above mix will provide nutrients for about five batches of beer, (25-USgal; 20-UKgal; 100-litre), at a little over half that of imported brewing salts.

If you are making a highly attenuated beer (e.g. an ale), use about 1-tspn per US gallon (2.7-gm: 0.7 gm/litre) to be added when racking to secondary. For the standard home-brew use about twice that much. For diet beers use about 2½ teaspoons per gallon.

* * * * *



Pasteur Flask

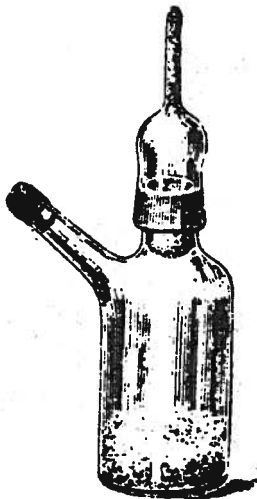


Fig. 295.
Hansen Flask.



Fig. 296.
Freudenreich Flask.



Fig. 297.
Henius Flask.

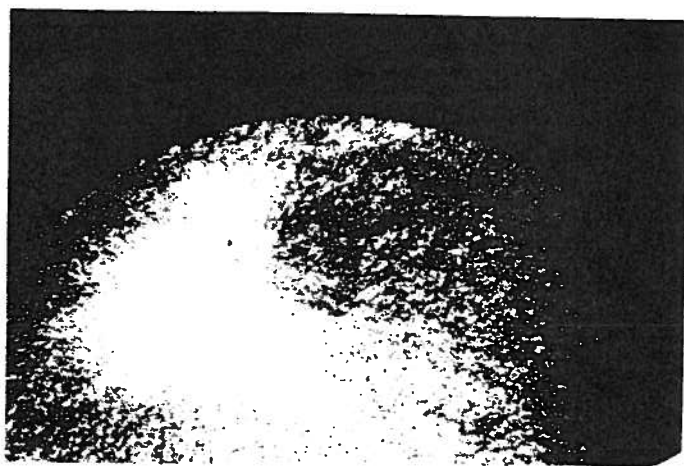
THE PURE YEAST CULTURE

By Fred Eckhardt

"Without theory, practice is but routine born of habit. Theory alone can bring forth and develop the spirit of invention."

Louis Pasteur — Studies on Fermentation (4)

The breweries are very careful about their yeast and the amateur should be, too. A brewery will take great pride in its very carefully maintained yeast culture. In a lager brewery, the yeast is recovered through a manhole near the bottom of the closed primary fermentor. The middle layer of good yeast is retained by pushing away the top layer containing hop resins and debris and leaving the bottom layer containing albumens and dead yeast cells. The yeast crop will usually be about five times the amount used in pitching. This yeast will again be allowed to settle, after which it will be washed in cold sterile water, and then washed again in an acid yeast washing medium such as *aluminum persulfate* to cleanse it of stray bacteria. The yeast may then be added direct to a new batch of beer (see fig. 4) or pressed into cakes for later use. Before being used however, each yeast crop will be inspected for visual purity under a microscope, and by culturing, to grow any bacteria which may be infecting the yeast. Needless to say if any bacteria is found (and sometimes there *are* bacteria in the yeast crop), that particular yeast will be discarded. In most breweries this is no problem, since there will be more than one batch of beer fermenting. However, if all the yeast crops of the current ferment were to go bad, then the reserve of pressed yeast would be used. That is probably as far as it will go, but the brewery will also have in reserve several duplicate cultures growing on agar slants (see later). These may be used to start a new yeast crop if that is necessary. In any case about once a year the brewery will renew its yeast from this mother culture. The brewery will also have its mother culture stored by a yeast laboratory. These yeast labs will keep many such brewery cultures on agar slants under even more sterile conditions than those in a brewery (which you may be sure will be very sterile). A lager brewery will use a yeast culture from only one cell, but



may make its beer from a blend of several batches each using a different yeast strain. The *Pilsner Urquel* brewery in Pilsen, Czechoslovakia, for example, makes its famous beer as a blend of *four* different beers fermented with four different yeasts. If the four yeasts were added to the same batch at the same time, one or another yeast would dominate, thus ruining the effect, hence the four batches.

A British ale brewery may use a special combination of several yeast substrains. An ale brewery might collect its yeast crop by skimming the yeast head from the surface of the open primary, or may rack the beer into closed containers at that point, and catch the yeast crop as it froths out the top of the secondary fermentors. After collecting the yeast crop, it is treated in the same manner as the lager brewery's yeast. The yeast is added to the new brew direct in the primary in an ale brewery, either by mixing with a volume of wort (wet pitching) or adding direct in quantities as high as 1-oz. per gallon (10 ml/litre). In a larger brewery, with closed fermentors, the yeast is usually added by mixing it with the cool wort as it comes from the heat exchanger.

THE YEAST

The commercial brewer takes his yeast seriously, and the amateur would be well advised to do likewise. There are some yeasts that can be added direct to a batch of beer which will satisfactorily ferment the beer. However, this can be a dangerous procedure, because of the length of time it takes the dried yeast to activate itself in beer wort. Every minute your beer wort sits waiting for its yeast to start working, is a dangerous minute, during which many wild yeasts and bacteria can be gaining a foothold in the beer. The safest method of seeding your beer with yeast is to add a volume of already fermenting beer wort. This is absolutely necessary in the case of liquid yeast, and desirable with dry yeast. The only sure way to do this is to prepare (in advance) a *Yeast Starter Culture*.

When you make your very first batch of beer you should brew an extra quart of beer wort. While it is hot off the stove, pour the hot wort into a quart bottle which should be sealed (capped) and stored in the refrigerator until you are ready to make beer again. This quart of beer wort will be your culture media for growing the yeast for your second batch. Each time you brew, remove half a quart of wort, cap and store as above. For your first batch use a packet of dry ale yeast which is the most dependable dry yeast. After that you might be advised to use liquid yeast cultures started as described below.

YEAST STARTER

A few days before you brew, remove the quart of beer wort from the refrigerator, warm to room temperature, remove the cap and decant into a half-gallon bottle (leave any dregs). Mix the liquid (or dry) culture into the starter bottle, and rouse thoroughly to mix plenty of oxygen into the beer wort. Affix a fermentation lock, with water, onto the bottle and stand at room temperature. Swirl vigorously, and repeat every few hours, until a yeast head appears indicating that the ferment has begun. The yeast may be added to the wort at that time, but if the wort is not ready, move the culture to a cooler place (60-70°F; 15.5-21°C). If the ferment in the bottle finishes (after about 48-72 hours) and the liquid clears and settles, store in your refrigerator until ready to use. Do not leave over three weeks in this state.

THE PERMANENT CULTURE

Ideally, you should use a new yeast culture for each brew, but if you find this too expensive, or if you find a really great yeast such as a fresh brewery yeast sample or such, or if you are in a place where yeast is difficult to obtain, then use the following method. You will note that a great many more sterility precautions are taken. These precautions, right though they may seem, are very slipshod, but I believe you may expect about 98% success. Save *two* quarts plus a small bottle (8-11 oz.) of beer wort, one for the culture storage described below, another for your *next* beer batch and the small (8-oz. 250 ml) sample to make wort jelly for your agar slants (see later).

Remove one bottle of starter culture, or beer wort from the refrigerator, open it and siphon the clear liquid from the settlement at the bottom of the bottle. Sterilize the bottle, the siphon hose, the fermentation lock and all utensils with SO₂, NaHCL 5.25% dilute, or alcohol (iso-propyl, methyl, or Ethyl), and rinse carefully using only sterilized (pasteurizing by boiling) distilled water, so as to

remove all trace of the sterilant. Place the beer wort in a half-gallon fermentor that has been carefully sterilized both inside and out and rinsed as directed above. Add to the sterile wort, the yeast to be cultured, at 70-80°F (21-27°F; 13-16°C) place. In either case allow the ferment to recede, and the beer (as it actually has become) to settle. Refrigerate the sample until it becomes clear and the sediment has solidified. This may take a week or so.

The above sample will become your mother yeast, but first let us return to the small bottle of beer wort you saved, which is to become your stored agar cultures.

PREPARING THE AGAR CULTURE

Agar Agar may be purchased in any scientific supply house (call your local high school or college science dept.). I use a product called white *kanten* (*Hime* brand) imported by the Japan Food Corp. of San Francisco, and found in oriental stores, especially Japanese and Korean groceries. *Kanten* is semi-refined *agar* (a seaweed). You need only 5-grams (just over a sixth of an ounce) for the cup of beer wort (8-oz, 250-ml) saved earlier.

1. Place the 5-grams of granular *agar* or shredded *kanten* in a small saucepan, and pour the beer wort over it. Stand for 15-minutes.
2. Bring to a boil, and boil for 15-minutes — watch closely as it boils over easily.
3. Pour the hot wort agar into test tubes resting at a slant, or use sterile 5-dram (18.3-ml) plastic tubes. Cap and cool to 70°F (21°C) which is the temperature *kanten* hardens, although laboratory agar is supposed to harden at 106°F (42°C).

The agar slant has traditionally been a small test tube sterilized by autoclaving in a pressure cooker for 15-minutes at 15-lb/sq. in. These tubes are allowed to cool in the pressure cooker and, when ready, they are inoculated with the yeast (see later).

I have found a simple and satisfactory substitute for the test-tube-in-the-autoclave routine. I use inexpensive 5-dram (18.3-ml) plastic tubes which have small caps to protect them. I sterilize these by dipping them (using tongs) into a isopropyl (or even rubbing) alcohol. They are then drained on a clean paper towell (inverted). Using tongs I hold them in one hand and pour the agar mixture into them while that is hot, to about 3/8-inch in depth (10 mm). The cap is placed on them while the liquid is still very hot. This ensures a fairly high level of sterility. The plastic tubes are available at drug supply houses, or from your wine supply merchant who uses them to package such things as finings, grape tannin, pectic enzyme, and such. If your merchant does not have this item, and you cannot find them elsewhere, you can buy them from *Wine Art Oregon*, 2758 NE Broadway, Portland, OR 97232 for \$.15 each, plus postage. Another possibility is the sterilized *petri* dish packet available at scientific supply houses, 12 (sterile) to a package. The agar tubes are stores in your refrigerator in double wrapped plastic bags until you need them.

INOCULATING THE AGAR TUBE

This is done with a loop on a needle or wire. I use a dissecting needle (available in scientific supply stores or college bookstores). With a pair of needlenose pliers I bent the tip into a hook or circular shape. The inoculation is done when the mother culture is at its height of ferment, as described earlier. Get about six of the agar tubes ready at room temperature. Sterilize the loop by holding it for a minute in the flame of a candle. Dip it into your pasteurized water to cool, then pass the needle through the fermenting wort and, finally, plunge it into the sterile wort agar gelatin in the tube. Place a sterile cotton wad in the open end of the tube. In a day or two the ferment will be apparent as a sort of festering of the center of the tube where you stabbed it. Discard any of the tubes which show a deviance in the style of ferment on the wort jelly surface. Place the re-sterilized cap on the tube, and store that in the refrigerator. These are you "use" cultures.

RE-CULTURING YOUR AGAR TUBES

Every three or four months you must re-culture the yeast tubes by removing them from the refrigerator and adding about a half-inch of sterile beer wort on top of the cultured wort agar.

Place a sterile cotton wad in the top of each tube and stand at room temperature until ferment is evident in the tube. Using this as your culture, inoculate four more agar tubes, and redo the whole process. It isn't really quite the trouble it seems, as it is more difficult to describe than to do.

To make use of any of these cultures, follow the above procedure to start the yeast, and then pour the fermenting liquid into your regular beer starter as you would add yeast. In three or four days the quart of beer wort will be fermenting quite nicely, and may be used to start your beer ferment as usual. About every other year redo the whole thing with new yeast if you can get a good yeast for that purpose.

WASHING YOUR YEAST FOR RE-USE

There are three standard methods of "washing" your yeast. Washing the yeast is the procedure followed by the breweries to rid their yeast crop of bacterial infection (20). If you re-use your yeast you should use one of the following three methods of yeast washing.

The simplest method is to rinse the yeast in cold, sterile, hardened water. Prepare a 750-ml bottle of sterile hardened water by bringing a quart or so of distilled (or very soft) water to a boil, pour into a 750-ml (or fifth) wine or whiskey bottle, add a scant 1/4-teaspoon (US) of epsom salts (Magnesium Sulfate $MgSO_4$) Cap, or seal tightly, and shake the bottle to dissolve the $MgSO_4$. Chill in the refrigerator. This is your yeast-wash water.

Prepare the yeast for washing by allowing the sample to settle in a pint jar, or some such. When the yeast has settled, decant the beer away, leaving the yeast sediment and a small amount of beer. Add an equal amount of your yeast-wash water, cap the jar, and mix the sample by shaking it. Stand and settle it in the refrigerator for an hour or so. Decant the water away as you did the beer at first. Repeat several times. Store the yeast in the sealed jar with the sterile water in the refrigerator until your next use (within three months).

A better method of washing your yeast is to use an acid rinse. Prepare two bottles of sterile water as described above. You do not need the $MgSO_4$. Store one bottle in the refrigerator. In the other bottle, add 3 level teaspoons (US) of winemakers Tartaric acid, (16.44 gm/litre). This will produce an acid yeast-wash medium with a pH of about 2. Use this as described above, after decanting the beer off the yeast, and rinsing it in the distilled water one time. Let the yeast stand in the yeast-wash for at least two hours, and not much longer than that. Decant the acid rinse way and add the yeast direct to your wort starter or to your beer wort. If you wish to store the yeast, it is wise to reculture it as described earlier. This method is probably the most practical for the average home brewer.

Elsewhere in this issue Merlin Elhart of the Los Angeles *Maltose Falcons* describes a more scientific method which is also more complicated. This is the method used by most US breweries and it features Ammonium Persulfate (NH_4)₂S₂O₈ (Sodium Persulfate is also acceptable) as the washing media. Merlin's article is quite humorous and very informative, but you may have trouble getting the Ammonium or Sodium persulfate. At \$10 per lb. it is a little expensive, and according to our chemical dictionary it may be mildly hazardous to store since it is a fire risk in contact with organic materials. You may wish to restrict your efforts to the methods described above.

* * * * *

THE TROUBLE WITH YEAST

By Fred Eckhardt

Last year a California Beer Club, the *Maltose Falcons* of Los Angeles were having problems with their yeast. Merlin Elhardt, Club President at that time, wrote Professor Michael Lewis of the Food Technology Dept., University of California, Davis, who teaches a course on Brewing at that school. Professor Lewis' reply was very interesting. He says:

"I don't think your problem is a very mysterious one. Most home brewers make the assumption that yeast purchased from the home brew store in packet form is a pure culture. Nothing could be further from the truth. These yeasts are produced by a drying process which inevitably introduces some bacterial infection into them which may be greater or smaller depending on the batch and the producer. These bacteria, when the yeast is rehydrated, are also rehydrated and of course begin their own life cycle as the yeast begins its life cycle. Depending then upon the relative population of bacteria and yeast you will either have a successful or unsuccessful product. Theoretically if a starter culture was used this would tend to give the bacteria (which grow faster than the yeast) a bigger start and you could expect that people employing a starter would have worse luck than those not employing a starter.

"The preceding argument is a large part of the reason why I encourage home brewers to maintain their own yeast cultures when I teach my class. The practice is not very difficult to understand and learn but does require discipline and attention to detail.

"I am very pleased that you recognize the need for a strict program of sanitation in home brewing. This is absolutely crucial to success. A fermentation lock, even one filled with sulfite solution, is a very small part of a total sanitation program, and indeed may be of marginal importance. In conclusion, I should say that your club members should be encouraged to keep very good records of their brewing experiences so that they can avoid buying supplies from manufacturers who are careless, OR FROM SHOP OWNERS WHO ARE INSENSITIVE TO THE NEEDS OF THE AMATEUR AND STOCK SECOND RATE MATERIAL."

In May I had an opportunity to visit UCD, but Prof. Lewis was out of town, and I didn't have the opportunity of discussing the matter with him directly. I did talk to one of his students doing research on yeasts available to the Home brewer. One of the major differences between top fermenting *S. cerevisiae*, and bottom fermenting *S. uvarum* is the ability of the latter to ferment the sugar melibiose, while top yeast will not ferment that sugar. According to the student doing this research, none of the dried yeasts were *S. uvarum*, since none of them fermented melibiose. These included *Universal Foods*, *Vierka*, *Edme*, and *Kitzinger*. At that time he had not experimented with the *Specialty Products International* dried yeast, so we have no information on that (Leigh Beadle's) product. At any rate he found no bottom yeasts by the above definition, and all were contaminated to some extent. Of the contamination, *Universal Foods* (Red Star) was the cleanest yeast. No tests were conducted on the English liquid yeasts in this experiment, dried yeasts were the only ones used.

With this in mind I called *Universal Foods* whose *Red Star* bread yeast, and wine yeasts *Montrachet* (UCD #522), *Champagne* yeast and *Ale* yeasts are all mainstays of Home Winemaking Merchants. Most of us have one or another of these yeasts. I talked to Mr. Gordon Christiansen, of the marketing division, who is responsible for the production of this yeast.

The yeast is a strain from *Schwarz Services International* of Mt. Vernon, NY, a major supplier to the Brewing Industry. The yeast is bottom-fermenting, Pilsener-type, *Saccharomyces uvarum*, strain U-125. *Schwarz* supplies brewing cultures for breweries all over the world. *Universal Foods* processes, and mass produces, the yeast for *Schwarz Services*; under license. The yeast supplied to the home brewer is the same yeast as that produced for *Schwarz*, and *UF* pays a royalty on every envelope. Mr. Christianson assured me that the yeast is, to the best of his (and the Red Star people's) knowledge, a true "Lager" Yeast, and the company is doing its very best to produce the finest product possible. The yeast itself is certified by *Schwarz*, and *UF* makes no pretense at being experts in brewing (OR wine) yeasts. Rather, they cultivate the strains that the industry offers them, and make no claims beyond that.

When I read him Dr. Lewis' letter (above) he told me that some contamination was indeed unavoidable, (although the basic strain might be completely pure). By the time the yeast has been

mass produced, some contamination is inevitable. I would also like to point out that, according to Piesly and Lom (20), *S. uvarum* is indeed a difficult yeast to mass produce. Lager yeast does not respond well to dessication (drying) because of its inability to sporulate (to protect itself from such extremes), the yeast is therefore very delicate. Thus the contamination. It would seem that the liquid yeast produced by *Edme* (England) or *Vierka* (Germany) might be the only rational bottom yeasts available. It is certainly a vexing problem, perhaps you should even buy a good culture from *Turtog* or some other bacterial supply house, even if the cost is rather high. The use of such yeasts would require that you culture your own agar slants, and work from them. If you are fussy, that might be your answer.

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THE PRODUCTION OF ACTIVE DRY YEAST

By Gordon Christianson, Universal Foods Corporation

As told to Fred Eckhardt

The pure culture is first fermented in big vats — stainless steel tanks using a Cane-Beet molasses wort. This process does not produce alcohol as much as it produces yeast cells. At the finish of ferment the yeast is washed three times, with clear water, through centrifuges, resulting in a slurry which has the appearance and texture of pure cream.

The slurry is then filtered and pressed into a cake, leaving 70% moisture locked into the cells. The cake is firm, will stand rather solid, and can be broken up if desired. This cake is next pressed through dies resulting in little noodles, which are cut off, and distributed on a perforated stainless steel belt carrying them through drying tunnels of different temperatures and humidities. The result is a product with only 7% moisture. This yeast is in a dormant state and, when packaged in small envelopes under nitrogen, will remain active (at room temperature) for about a year and a half. Heat is very destructive to stored yeast. The cartons of yeast packets are dated, and if stored refrigerated, will last "almost indefinitely."

Lager yeast is a very difficult yeast to dry and the process of manufacture on an industrial scale inevitably results in some contamination in spite of our very carefully controlled conditions. We have found, however, that the survival of the yeast is greater than the survival of the contaminating organism, over a long period of time.

The yeast is prepared, for use, by pouring the contents (7-grams) of the packet into about 6- to 8-ounces (200-ml) of water or wort at 75 - 95F (24-35C), with 86F (30C) as optimum. Allow this slurry to stand for 10-minutes to rehydrate the yeast and obtain maximum active cell survival. Stir before inoculating into the bulk of wort. Use a yeasting rate of 2½-3 grams per USgal (0.7-0.8 gm/litre). This means two envelopes for the 5-gallon batch of wort, at a temperature of 50-60F (10-15C).

EDITOR'S NOTE: The recommended use of two packets of lager yeast for a 5-gallon batch is twice the rate suggested by most dealers, and perhaps this might help to ensure a good, contamination free, ferment. Alternately, you should use a wort starter as described elsewhere. Prof. Lewis is quoted earlier as advising against the use of "yeast Starters", and we agree, because most yeast starters are not hopped beer wort. Our suggestion is to use a hopped beer wort culture to prepare the yeast for ferment.

* * * * *

CULTURING AND DECONTAMINATING YEAST

By Merlin Elhardt

The problem of producing (or not producing) contaminated beer crops up from time to time and may cause considerable anguish and much pulling of hair. The purpose of this paper is to (1) assuage our tempers (2) calm our fluttering hearts and (3) put us back on the road to making the stuff we were used to drinking before we were unceremoniously yanked by the scruff of the neck into the hostile bad lands of rotten beer and things that go bump in the night.

This dissertation in no way constitutes a complete treatise. The mechanics of culturing your own yeast are more easily demonstrated than written about.

In sheer desperation I put in a call to Professor Lewis of U.C. Davis and presented our problem. He was gracious enough to lend a sympathetic ear and send four yeast cultures down by special courier. A week after my call I discovered one of his students standing on my door step with a smile on his face and four slants in his hot little hand.

A slant is an agar medium that has been put into a test tube with a plug of cotton in it, and sterilized in a pressure cooker for ten minutes. In the event that agar is not available, a medium of wort and gelatin can be substituted.

While the agar is in a liquid state the test tube is propped up on its side so when the medium solidifies, it does so slantwise and exposes a greater surface for inoculating. See fig. 117-32a.

Yeast grows only on the surface. The slant is then inoculated with the use of a loop, which is nothing more than a fine, stainless steel wire that has been stuck into a cork, and has had a small loop fashioned into the other end. This is first sterilized over a flame and a bit of the yeast sample is rubbed across the surface of the medium.

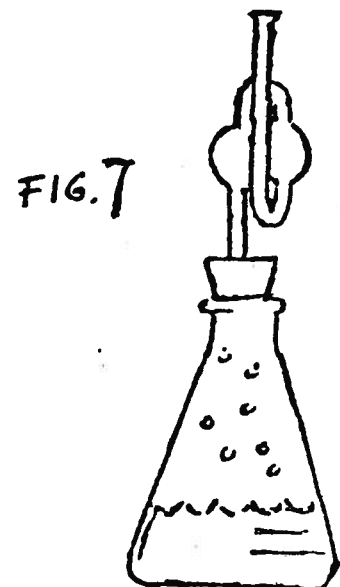
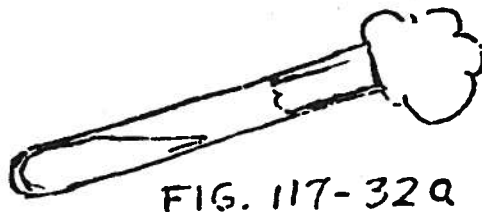
This is a convenient method of transporting a culture from one place to another or vice versa.

The yeast and bacteria develop into colonies and at this point it is a simple matter to detect the presence of a contaminated culture. Yeast colonies are white and somewhat dull, while bacteria colonies are yellow, shiny, and look like snot. Pardon the analogy, but this is the term I was offered and, in the interests of accuracy, I am compelled to quote verbatim.

In a couple of days the yeast will have grown to the point where it is ready to transfer to the second stage.

One hundred ml of wort, (3.4 fl. oz.) at about 10°B, (1.040) is sterilized in a small-necked vessel that will hold about twice that amount. Again, this second medium is inoculated and allowed to grow at room temperature for two more days.

If a cotton plug leaves you feeling uneasy, then a fermentation lock with a sulfite solution in it should make you feel better. See fig. 7.



A liter of wort, at 10°B (1.040), is then sterilized by boiling, and poured into a half gallon bottle. When it was cooled, the culture is poured into it and it is fitted with a lock as before. When this has finished working it is ready to pitch into your beer.

Secondary sediment can then be used to pitch the next batch of beer. If this is done a number of times, you may find that the yeast has picked up a little bacteria with each use and has begun to develop off-flavors, or on-flavors, if you like that sort of thing. You will then decide to either, (a) quit making beer and start a pickle farm in Whiskey Flat, (b) move south of the equator and swat killer bees, or (c) decontaminate your yeast.

In the event that you have selected (c) then you will discover that the use of acidified ammonium persulphate $(\text{NH}_4)_2\text{S}_2\text{O}_8$ produces remarkable results. The solution is prepared in a quart of distilled water by adding one teaspoon of *tartaric acid* and two teaspoons *ammonium persulfate*. The yeast is washed just prior to being used. Add the acidified ammonium persulfate solution in equal volume to the yeast dregs, mixing thoroughly, and allowing the yeast to settle out for about 2 hours. The washing solution is decanted away, and the yeast pitched direct into your beer wort.

This procedure, however, has no effect on wild yeasts, so if enough foreign yeasts do get into your beer, which doesn't seem too likely, then it is no problem to buy more yeast and decontaminate it before using.

The problem of contaminating your beer through the use of unsterilized tap water has been considered, but I was told that it doesn't contain the type of bacteria that will spoil a beer and besides, it exists in too small a quantity.

All this information was made available through the cooperation and assistance of Professor Michael Lewis.

* * * * *

MERLIN ELHARDT

Merlin Elhardt has been corresponding with your editor for about five years now. He is a Los Angeles utility company lineman who developed a taste for good beer, and a disdain for American beer while stationed with the army in Germany. Merlin, along with John Daume, owner of the Home Winemaking Shop in Woodland Hills, has been the guiding force behind organizing the Maltose Falcons, the largest Amateur Brewing Club in America. These days Merlin no longer has to do all of the pedaling to hold the Falcons together, so he has more time for brewing his Continental style all-grain pilsner lager, which would bring smiles to any brewery's Braumeister. During the course of the club's recent yeast problems Merlin wrote the above article in the Falcon's newsletter, so naturally we had to steal it and let you profit from Merlin's wisdom. We will try to get more articles from Merlin in future Amateur Brewers.

BEER CLUB NEWS

We are now on the mailing lists of two beer clubs, the Redwood Lagers of San Rafael, and of course, the venerable Maltose Falcons of Woodland Hills (LA). If you are a member of a beer club, put us on your club's mailing list, and give us an address to send to as well. (It took us 3-months to get an address for the new editor (John Fitzgerald) of the Maltose Falcons newsletter.) We have special rates for beer club members, plus we like to know what you are doing. The Redwood Lagers are planning a Homebrew tasting at the Marin County Fair in June, and the Falcons just held another of their numerous tastings, although one couldn't really call their bashes tastings any more than you could call them "silver teas". Those people hold beer guzzlings!

Down in Oakland they are forming a new club thru the Wine Factory in San Leandro. Club name is the Draught Board.

Let us know what your club is doing. Now that we are out of the closet things can be really great!

BOOK REVIEW

SPECIAL REFERENCE REVIEW FOR YEAST STUDY AND GENERAL MICROBIOLOGY

This special book review section is included to give a brief mention of some of the various texts introducing one to the science of microbiology. If this field interests you, you should pick up a used college text in a bookstore. A modern text book is not necessary, any that you find which interests you, will do. We have included two below, Pelczar (5) and Umbreit (9) at less than \$3 used.

1. American Society of Brewing Chemists, Methods of Analysis, sixth revised edition, 1958, Glenview, IL 60025, 1201 Waukegan Rd.

The chapter on yeast analysis is valuable, although very technical. The book is an interesting survey on the subject of beer analysis, and I have used many of their methods: after first revising them to be usable in the average home with very little equipment.

2. Ames, Ruth, "Louis Pasteur and the Science of Fermentation", Wallerstein Laboratory Communications, vol IX:27, Aug 1946, p85.

This is an interesting article on the work of Louis Pasteur, worth reading if you can find it in your library.

3. Nowack, Carl A., Modern Brewing, 1934, St. Louis, Mo., privately published. p289-306.

This fascinating book was the first to be published on the brewing science after prohibition was repealed. The book is the simplest of all the brewing texts, and I believe that with only a little effort and study you will find it understandable. The above pages are a short review of microbiology presented in simple terms. Nowack was Executive Secretary of US Brewers Assn during prohibition.

4. Pasteur, Louis, Studies on Fermentation--The Diseases of Beer, Their Causes and the Means of Preventing Them, Transl., Faulkner, F., & Robb, D.C., 1879 London: Macmillan Co.,: 1945 New York: American Library Service., Currently in print by Kraus Reprint Co., Millwood, N.Y.

Originally published by the author, in French, in 1876 -- translated into English in the above edition, and now again being published! This was one of the most fascinating books I reviewed in my research. I had assumed it would be archaic and unreadable, but that was not so at all. I found instead, that the book and its author have a unique charm of their own. The book deals with the kind of problems you and I have with our beer, and the author explains his procedures carefully, in simple language, (archaic but simple), that most people will understand easily. The brewers of that era were simple folk, even as you and I. Their problems and methods were remarkably similar to yours and mine. I urge you to read this book if the subject of fermentation is of any interest to you.

5. Pelczar and Reid, Microbiology, 1958 New York: McGraw-Hill pp50-84, 148-156, 496-9, 539-42.
This is a college text, but with a little effort you will have no difficulty understanding the listed segments relative to culturing yeast.
6. Shimwell, J.L., "Brewing Bacteriology", part IX, Laboratory Methods, Wallerstein Laboratory Communications, Vol XII:39,p349.
Good summary of brewery laboratory methods.
7. Tanner, F.W. The Microbiology of Foods, 1944 Champaigne, Ill., Girard Press, pp1102+.
Recipes and methods of preparing culture media.
8. Taylor, & Vine, Home Winemaker's Handbook, 1968 New York: Harper Row, P238.
Information in culturing yeasts for winemakers--applicable to home brewers.
9. Umbreit, Wayne, Modern Microbiology, 1962 San Francisco, W.H. Freeman & Co. p.5-56.
Another college text with easily understood information.
10. Wahl & Henius, The American Handy Book of the Brewing and Malting Trades 2 vols., Third Ed., 1908 Chicago Ill: Wahl:henius Institute. Vol 1, p593-646.
Information on laboratory methods at the turn of the century. I have found these two volumes quite valuable in many ways. The above information is especially valuable because it is presented simply, again because brewers of that day were not as scientific as they are now.

SUPPLEMENTARY

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BEER KIT REVIEW

It isn't often we have an opportunity to review a "kit-beer". Most of the so-called kits are just another way to sell a few extras: mashing liquid, brewing salts, citric acid, bad yeast and such as well as tons of corn sugar. It was quite a surprise then, to find a beer kit that not only eschewed most of the above additives, but which also produced a good beer. We had three kits to experiment with, and we farmed them out to a friend who produces good beer on his own, and who, unlike myself, can follow directions. The beer was great in each case: the Dortmunder Gold, for example, had an OG of 1.061, just what the directions said it should have. The yeast is Leigh Beadle's Superbrau yeast, from Denmark.

These Lager Maaker kits have good, easy-to-follow directions and, when produced according to the directions, they have a fine smooth taste without the "bite" common to many home made beers. These are obviously high-malt content beers with dextrans added for buffering to reduce tartness levels. I found the hop content lower than my taste buds like, but Jack, the beermaker, found the hop balance well to his liking. If you like a hoppier beer you might add extra hopping to your own taste requirements.

We found the cost high, but the quality good. The twenty-one 5-gallon kits range in price from 40¢ to 90¢ per quart at retail. The OG's range up to 75 (Einbocker), and TG's as high as 15 (Irish Stout). Most of the beers are German style, but there are also six English/Irish/Scotch style beers. Your dealer can order the kits from Gene and Ellie Schneider at the Homemaker's Wine Supply Co., 2414 San Mateo Pl NE, Albuquerque NM 87110.

MAGAZINE REVIEWS

Two new magazines have appeared on the beer lovers market place, Zymurgy, the self-styled "Journal of the American Homebrewers Association." We found this a disappointment. Most of the articles have little substance, but if you just want to jive-on about homebrew and homebrewing, you will surely enjoy this magazine. Editor Charlie Papazian offers his magazine as a "vehicle for getting homebrew lore into print." We all have a few such stories to tell, and that's great fun, but what really bothers us here at the Amateur Brewer is the blatant attempt to commercialize on the homebrewing movement with the so-called American Homebrewers Association (T.M.), and for this they want money: \$10, \$25, \$50 or \$100 for one or three years of lifetime memberships. We are not worried about competition. Zymurgy appears to aim itself at a different slot than the one we are in. Rather, we are reluctant to support a publication whose main interest seems to be in forming a self-dominated organization aimed at commercially exploiting American Home Brewers. The business-like approach this magazine takes towards money probably means they will publish on schedule and most of you will appreciate that in a home brew publication. Subscription is \$4.00 for one year (4 issues), from Zymurgy, Box 287, Boulder CO 80306, single issues are \$1.50.

The other, a newspaper, All About Beer, is also a membership publication, for Beer Drinkers International. For some reason we don't find offense in the attempt to organize beer drinkers that we found above. In this case the paper is published bi-monthly, and the subscription price of \$10 brings you a gunnysack full of goodies, as well as 6-issues of the paper. The paper itself is quite good, with segments for every beer-lover's interest: Can collecting, Home Brewing, cooking recipes, and many other goodies. The editor, Sam Hicks, a wide ranging journalist of distinction, says "We plan to have something for everyone who likes beer, whether they prefer it from a can, a cow's horn, a glass or enjoy savoring it from a gourmet dish hot from the oven...to fill a long overdue void in the fields of public information and good entertainment." Membership and subscription \$10 from Beer Drinkers Intl. Inc. PO Box 372, Calabasas, CA 91302.

BREWERY NEWS

WASHINGTON D.C. -- Beer and Ale consumption tops all other alcohol beverages, or at least did in 1978, according to the U.S. Brewers Assn. Nevada and New Hampshire top the list drinking 56.7 and 59.9 gallons per person, while California, leads in total volume (520,800,000 gals) followed by New York and Texas. Naturally they don't include Home Brew in those figures.

PORTLAND OR -- The Pabst Brewing Co of Milwaukee announced that it was acquiring the Blitz-Weinhart Co, and eventually would close its Los Angeles plant.

PORTLAND OR -- The country's (very) small brewery will produce it's first brew in June, according to Brewmaster Charles Coury, of the Oregon's new Cartwright Brewing Co. The Cartwright Brewery is a family venture of Charles and Shirley Coury. Coury formerly owned a major share of Coury Vinyards, an Oregon winery noted for its high quality Pinot Noir wines. The new brewery (named after Mrs. Coury's family) will produce 30-50,000 gallons of "flavorful, foreign-type beer". His first brew, Portland Beer will be an ale. Coury told us, "we'll try to make an old-fashioned classical all-malt beer." He said he thinks that there is always room for a very small brewery, while a large brewery might fail with this approach.

MILWAUKEE, WI -- The Miller Brewing Co., a subsidiary of the Phillip Morris Tobacco Co., and second ranked US and World Brewer declared War on No. 1 Brewer Anheuser-Busch (Budweiser) recently by marketing a new Beer called Gussie. "Gussie" is the nickname of August A. Busch, Jr., head of the Anheuser-Busch Brewery (St. Louis, MO), which is just furious about that, and to add insult to injury Miller has filed a complaint with the Federal Trade Commission asking the FTC to take action against A-B's promotion of its beers as natural products, while adding such stuff as hydrolyzable gallotannins, chemically treated lumber, sulfuric acid and calcium sulphate. The complaint lists amounts and quantities which Anheuser-Busch is alleged to use.

ST. LOUIS, MO -- Anheuser Busch issued a statement "The complaint (above)...is a publicity ploy without substance and is deliberately misleading regarding our brewing process. All (our) beers are brewed naturally and contain only natural ingredients....Miller cannot (say this on their labels) because its products (are not natural) and apparently has resorted to this type of ploy as a "sour grapes" tactic. This complaint gives (us) the opportunity to again stress