FOR THE HOMEBREWER AND BEER LOVER

Zymurgy

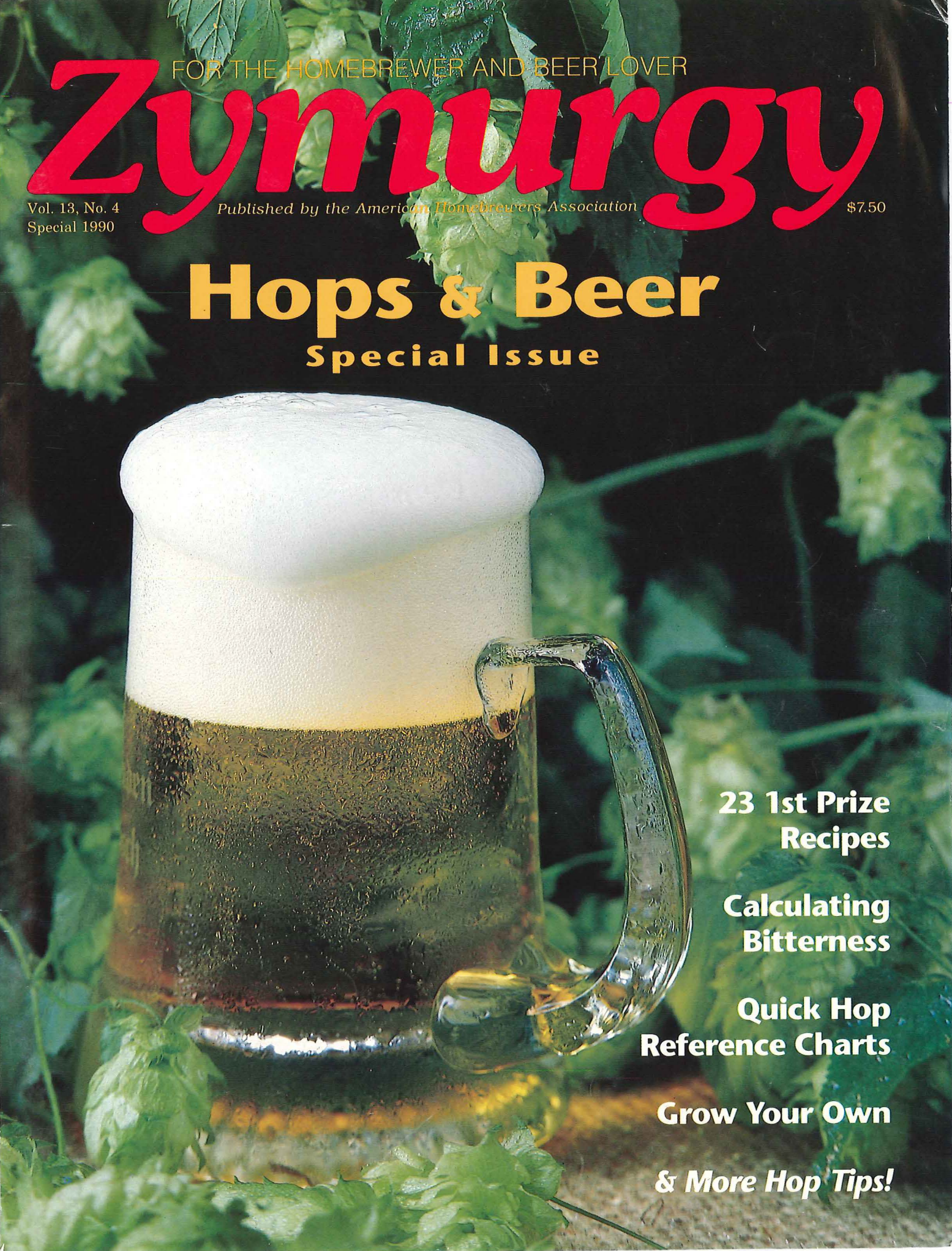
Vol. 13, No. 4
Special 1990

Published by the American Homebrewers Association

$7.50

Hops & Beer

Special Issue



23 1st Prize Recipes

Calculating Bitterness

Quick Hop Reference Charts

Grow Your Own

& More Hop Tips!

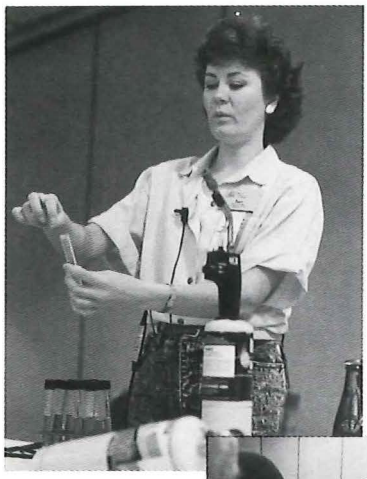
It's summertime, so come on back to school

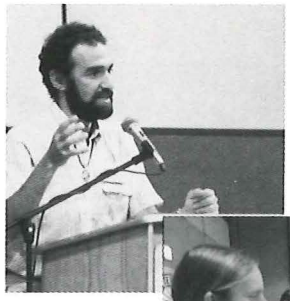
The American Homebrewers Association

presents

The National Homebrew Conference & Competition

June 1991, New England





The finest educational and entertaining experience available for the amateur brewer

Join hundreds of dedicated and fun-loving brewers as they converge on the annual homebrewing symposium, the **National Homebrew Conference & Competition**. Enjoy the dozens of talks, presentations and demonstrations that are an unparrelled educational experience. Gather in the information, tips and ideas that will invigorate your homebrewing. Study the hundreds of homebrew and commercial beers that add to the atmosphere of the Conference. Share with brewers like yourself, events that complete the four days of education and entertainment. It may be summertime, but school's on at the National Homebrew Competition.

The National Homebrew Conference & Competition

For more information about the conference and how you can participate, write or call the American Homebrewers Association, PO Box 287, Boulder, Colo., 80306-0287, (303) 447-0816.

Introducing the "Batch-Latch" . . .

CHAFFEE

A revolutionary breakthrough for the home brewer. The "Batch-Latch" allows you to use new or recyled beer balls as a home kegging system, or secondary fermenter.

The "Batch-Latch" turns a beer ball into a reusable, recapable beer container. So now there is an affordable option to cleaning bottles. A beer ball conveniently holds a full 5 gallon batch of your brew to be inexpensively tapped for a draft style system or used to rack sediment free bottled beer after aging.

Your cost, $19.95, plus shipping. Please allow 4-8 weeks for delivery. We also stock new beer balls, complete draft, tapping, and racking systems. Retailers please give us a call.

Marc C. Fritz, Inc.
18 Main Street
Potsdam, New York 13676

1-800-762-2560

CHAFFEE

Zymurgy

Volume 13, Number 4

SPECIAL ISSUE 1990 CONTENTS

Page 35
A little drop'll do ya

Page 14
High on hops

Page 63
And the winner is ...

zymurgy extends thanks and appreciation to the following who have contributed time and effort in gathering information and artwork for this Special Issue!

Benton County Museum, Philomath, Ore.
Al Haunold, Corvallis, Ore.
Dave Wills, Philomath, Ore.
JoAnn Benson of John I. Haas Inc., Yakima, Wash.
M. Shannon O'Boyle, Corvallis, Ore.

Cover photograph courtesy of John I. Haas Inc.

Zymurgy

The Association of Brewers Inc. is a Colorado non-profit corporation for literary and educational purposes to benefit homebrewers of beer and all those interested in the art of homebrewing. The Association of Brewers is exempt from Federal Income Tax under Section 501(c)(3) of the Internal Revenue Code. All gifts, grants and contributions are tax-deductible.

The American Homebrewers Association is a subsidiary of The Association of Brewers. Membership is open to everyone. ***zymurgy*** is the journal of the American Homebrewers Association, and is published five times a year. Subscription and U.S. memberships are US$21 per year. Foreign: US$26 per year. **Changing your address? Let us know in writing, please.**

zymurgy welcomes letters, opinions, ideas, stories and information in general from its readers. Correspondence and advertising inquiries should be directed to ***zymurgy***, Box 287, Boulder, CO 80306-0287, (303) 447-0816.

ISSN 0196-5921

Printing by EBSCO Media, Birmingham, Alabama. The opinions and views expressed in articles are not necessarily those of the American Homebrewers Association and its magazine, ***zymurgy***.

THE AMERICAN HOMEBREWERS ASSOCIATION MISSION STATEMENT

To help maintain quality in the production and distribution of beer; to promote public awareness and appreciation of the quality and variety of beer through education, research and the collection and dissemination of information; to serve as a forum for the technological and cross-cultural aspects of the art of brewing; and to encourage responsible use of beer as an alcohol-containing beverage.

INTRODUCTION

CHARLIE PAPAZIAN

I'm in Love

When I close my eyes and think of hops I imagine the wonderful aroma of boiling wort and the daily climb of my green hop vines against a deep blue sky. The maturing of the plump, architecturally perfect hop cones in late summer is both an early welcome of the cooler brewing season and a melancholy reminder that summer is nearly gone. Perhaps because hops are flowers, they are so endearing, and as brewers we are a passionate lot.

I'm a romantic when it comes to hops. They add so much to the variety of my beers and offer the most visual and sensual note to the beers I orchestrate.

I love hops. Not because I'm a hop head, liking my beers as bitter and hoppy as I can tolerate. No, I love hops because I can see them, feel them, smell them and distinctly taste them in my beer. I use them with respect. While adding them a handful at a time at different intervals during the brewing process, my mind dances with imagination at how each addition of each variety will help create my beer.

It wasn't too long ago when the quality of hops available to the small homebrewer was pitifully poor. But times have changed. Our knowledge has increased and subsequent demand has resulted in getting the quality every brewer deserves, large or small. It all starts with knowledge and educating ourselves in every aspect of brewing.

With this year's special issue of ***zymurgy*** we focus on furthering the knowledge of hops and how the delicate flower can influence the quality of our beer, our culture and our lifestyles as brewers. The American Homebrewers Association and the staff of ***zymurgy*** are proud to present information that enables all brewers to expand their knowledge and continue to improve the quality of the beers we brew.

We are indebted to the writers who contributed to this Special Hop Issue of ***zymurgy*** (Vol. 13, No. 4). We can't thank them enough, especially in light of the fact that many took time from their very busy professional lives in the hop business to offer valuable recommendations and assistance in presenting the best information to you. And, as always, many amateur brewers shared with us their experiences and insights. Hundreds of thousands of homebrewers owe each and every one of our contributors a hearty thank you. Our beers are better because of everyone's efforts.

Enjoy the pages of this ***zymurgy***, for I am sure you will use it as a reference for years to come.

The Good Wolf

The hop is a mysterious creature. The ancients noted that it grew "wild among willows, like a wolf among sheep."

MICHAEL JACKSON

Everyone knows that wine is made from grapes. Ask any ordinary person what beer is made from, and will the answer be barley, or even malt? It is unlikely. The answer will probably be "hops, of course."

Everyone has heard of hops, and that is surprising when you stop to think about it. After all, apart from beer lovers, brewers and people who live in the areas of cultivation, how many people know what hops are? Ask your ordinary person again, "a plant ... a crop ... something they put in beer." But what?

An herb, a berry, a fruit? The hop is a mysterious creature. The ancients noted that it grew "wild among willows, like a wolf among sheep," and it came to be known as *Humulus lupulus*. Why a wolf, I wonder? Such a fear-inspiring metaphor. On the other hand, a she-wolf did feed Romulus and Remus. The hop is a good wolf. The hop made a drink that protected the Jews against leprosy in Babylon. How? The hop is full of mystery. Even those of us who know it intimately hardly know it at all.

Pliny knew it as a shoot that could be eaten as a salad. I am assured by people in Bohemia and Bavaria that they remember this custom. It is still celebrated in Flanders. I have eaten hop shoots there and felt that I was taking part in some rediscovered communion. In a distant corner of my mind, I could hear Stravinsky's "Rite of Spring," with its evocation of renewal. New life. When the first shoots push through the soil of Flanders, the farmers there used to thin them by hand, nurturing the strong by the removal of the weak. Being farmers, they did not wish to waste anything they had plucked from the ground. Today in Flanders hop shoots are cherished as a delicacy, and are cultivated for that purpose.

Babylon, Bohemia, Bavaria, Flanders, Kent, the Cascade Mountains ... the Good Wolf chooses some poetic places in which to prowl. Bohemia's sweepingly broad vistas of farmland, with scarcely a man or animal in sight, rise to hilltop towns that were once fortresses.

Zatec, founded in 1256, is such a town, but it appears to be guarded by its brewery. Inside the town, the typical Bohemian square of cloistered shops and offices, painted in pastel colors, especially yellow ocher, faces an onion-domed city hall in a surprising pink. Like all Bohemian towns, Zatec looks dusty and a trifle shabby, but it is proud. Just to the side of the city hall is a tiny, ornamental hop garden, spiked with poles and surrounded by park railings—in the middle of the street. Zatec is the capital of the world's most famous hop-growing region, the home of the variety best known by the German name Saaz.

Local buses to Zatec carry on their destination sign a schematic of a hop cone. Beneath the town, the vistas are of a very red-clay earth, hatched with lines of hop poles and winding roads fringed with apple or cherry trees.

In Bavaria, I have often traveled from the city of Munich to the north of the state. As the freeway approaches the exit for Regensburg, small arched hills rise to dramatic crests of hop poles. Silhouetted black against the sun, the strung poles look like crucifixes. From the speed of the road, they seem to rush in ranks into sudden, disturbing vision. Perhaps Calvary also is suggested by the real crucifixes that hang everywhere in the homes of this conservative, deeply Roman Catholic region.

In Flanders, those hop shoots push through the soil where the fields near Ypres are reddened with poppies, where the soil was reddened by so many young lives cut down during World War I. Many of the lost lives were English, of course—Flanders and England have a shared history. In a happy moment, the Flemish introduced the hops to Kent. Yet Flanders and Kent can seem worlds apart.

It may be on the edge of England, but Kent has the feeling of being in the heart of the country. In Kent, the hills are gentle, the roads winding and the images not so much of the hop poles but of the old oast houses, with their characteristic towers and vents turning to the wind. A great many of these distinctive buildings survive, though most have been converted into expensive homes. Kent, with its hops, apples and cherries is the England of Sunday cricket matches that end in an amiable draw just as the pubs open.

There is no more dramatic entrance to hop country than the valley of the Yakima River in Washington but, as the rocky walls of the canyon ease, the first visions are of . . . apples again. The local newspaper of Yakima even uses an apple in its title-piece: To replace the dot of the letter "i" in the name of the town. Surely it should be a hop.

A shoot; a vine or bine; a leaf, cone or flower? The most potent image is the vine. I once visited a hop garden in Bohemia when the vines were being strung. The work was being done by students, most of them young women. There were some very pretty women going about this task in the fresh spring sunshine. I kept falling in love. One of the young women began to sing, in English: "One man went to mow ... went to mow a meadow." Very romantic, the hop vine. Very sexy.

A vine that grows with an astonishing vigor and speed, as potent and priapic as Jack's beanstalk.

Photo courtesy of the Benton County Museum

Is that a clue to the mystery? Is there some deep, inherited memory in all of this, some wonderment at fertility and growth that is seeded by such magical plants? Something that manifested itself so long ago that we have forgotten it except in allusive folklore?

Vines are sexy; cereals are not. This seems to me an inescapable crux in the mythology of wine and beer. It is well known that some magic in the soil and climate of Bordeaux or California will bring forth grapevines of a special quality, that the shape of the slope and its approach to the sun will be critical and that the fruit produced will be plump, rounded, delicate and soft to the touch. We are talking here about the sensuousness of warm climates and musky air. Barley is not at all like that. It is hard to the touch, resistant, the product of cool, rainy places like Scotland and Saskatchewan. It is barley that makes beer, but the hop—the spice—that gives it sex appeal.

Forgive my being so fanciful, if I am. I come into contact with hops in one form or another very frequently. Perhaps they have worked their magic on me. Remember, they are a cousin of cannabis, but do not let that slip to the alcohol-and-drugs brigade.

For generations brewers have made their own attempts to snare our instincts by preferring the ingredients of beer. They have used slogans saying, "It's the water," with illustrations of mountain streams. They have depicted on their labels or logos sheaves of barley and often added a few hops, usually not the vine but the cones.

The consumer vaguely believes claims about the water (after all, it makes obvious sense, doesn't it?); does not distinguish a sheaf of barley from wheat or corn (both of which are, admittedly, used in brewing); and, I suspect, scarcely notices the hop cone on the label or logo. If they are noticed, they remain a puzzle. A vine might just make some sense, but the cone is rarely recognized by our ordinary person.

"What are those things?" I have been asked. "They look like coffee beans. Oh, no, I get it; they are acorns . . . but why? Because the casks are made from oak? No? Pine cones, perhaps? Is it something to do with pine forests and mountain streams . . . ?"

Advertising artists are not, on the whole, very good at drawing hop cones. Or are they leaf hops? Or flowers? I never know myself which name to use for the part we put in our beer. Yet I know the part intimately. I have held it in my hands countless times, hugged it between my palms until it gives up its resins and oils, then bent to inhale its earthy aromas.

Beside me when I am pursuing this ritual is almost always a brewer doing the same thing. We both know the aroma of hops. I am already familiar with the aroma of the varieties he uses . . . and he definitely is. Yet at the point where my tour of his brewery has led to the hop store, we have gone in to inhale its scents just one more time.

We are on the trail of the Good Wolf—the teasing, irresistible hop.

Hops Through the Years

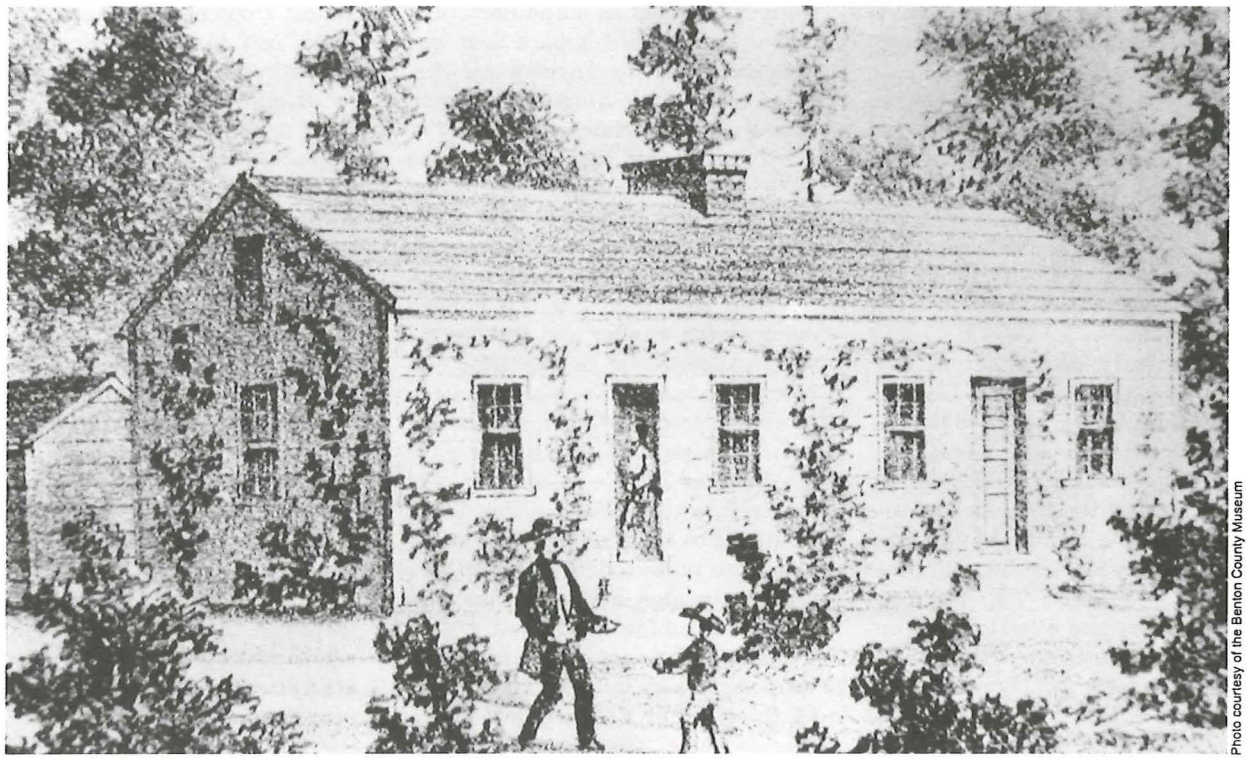


Photo courtesy of the Benton County Museum

It was common for many settler's homes to have a hop vine growing near at hand to supply medicinal, breadmaking and homebrewing needs.

~ *A Brief History* ~

The hop. Without it, where would you be?

Perhaps sipping a beer with "just a kiss of the gruit," an herbal mix popular before the hop's ascendancy. Gruit blended bog myrtle, yarrow, St. John's wort, coriander, rosemary or wormwood was added to malt to make gruit beer. But even a beer so lushly fortified spoiled quickly.

Without the hop's preservative qualities, beer could not keep. Without the hop, there could be no beer stored for the summer when heat and pollen made fermentation unreliable. Even highly alcoholic ales—sweet, thick and sticky—were prone to spoilage, especially if subjected to the motion of travel. They needed to be drunk quickly and close to home.

So without the hop, brewing could not be pursued successfully on a large scale. No legendary brands, no huge breweries, no big advertising bucks, no sports sponsorships, no ESPN, no Women's Pro Beach Volleyball.

As you can see, the hop changed more than flavor; it changed history. It was the addition of hops to beer that enabled brewers to store and ship their beers, to taste their first real commercial success and to relegate the homebrewer and pubbrewer to the status of novelties for several centuries.

KIHM WINSHIP

Among the earliest references to hops are those of the Romans, who brought hops to Britain for use as a vegetable, and the Babylonians, who took a step in the right direction and used hops to brew a strong beverage. People who eventually migrated from Babylonia into Central Europe probably carried the knowledge of hops with them.

The earliest reference to hops in Europe is a mention of a hop garden in the Hallertau district in 736 A.D. The

first European mention of hops being added to beer dates from 1079, but it would be six centuries before the hop was universally accepted.

As Michael Jackson notes in his *New World Guide to Beer*, wherever hopped beer was introduced, it was met with suspicion and hostility from established brewers and those whose livelihood depended upon the cultivation and sale of other plants used in brewing.

So it was in Germany. In Cologne, brewers who wanted to use hops ran afoul of the archbishop who held the monopolistic rights to gruit. But the hop flourished in spite of such roadblocks, and its preservative quality made the brewing, storing and eventual shipping of the German lager style possible.

In Holland in the 1300s, the Dutch developed a taste for hopped German beer from Hamburg, much to the dismay of Dutch brewers of gruit beer. Over the protests, prohibitions and high import duties imposed by the nobility, Dutch drinkers imported hopped beer, then the hops to brew their own.

Once hops had won Holland, England was next. To the detriment of their traditionally unhopped ales, the English developed a taste for hopped Dutch beer while soldiering in the Low Countries in the 14th century. They imported the new beer as early as 1400, and hops were planted in English soil by 1428.

As with all change, there were sufficient English enthusiasts on both sides to keep the debate going for more than a century. Written testimony to the beastly nature of hopped beer and the equal evil of unhopped ale is available in quantity. In 1424 hops were condemned as an adulteration, and as late as 1651 hopped beer was described in John Taylor's *Ale Alevated into the Ale-titude* as "a Dutch boorish liquor. . .a saucy intruder."

By the same token, as early as 1436, Henry VI commended hopped beer as "notable, healthy and temperate." And by 1695, written records show that ale itself was finally hopped.

The advantages of the hopped drink to the quaffer and the brewer were so great that hopped beer was bound to triumph over unhopped ale. Drinkers liked the flavor, and for the brewers, hops clarified the wort, gave the finished beer a good head and helped it to keep. While ale needed to be strong to keep for any time at all, beer was protected by the hop and could be milder, and equal amounts made with half as much malt.

The shift to a greater use of hops was described by historian Peter Mathias in *The Brewing Industry in England* as a "slow change in public taste encouraged by brewers searching for greater efficiency in their product."

Once brewers were convinced of the hop's value, however, they had to learn to live with its whimsical nature. The hop seemed peculiarly defenseless against the attacks of natural enemies, and almost every adversity could prove fatal. As Mathias writes, "a whole series of misfortunes was always possible, developing with an almost tropical luxuriance: the little black 'bob' insect and lice on young plants in the spring, the long-winged fly at midsummer, aphis, grubs and more summer lice which only heavy rain could wash away; 'fire-blast' (intense heat following damp which withered and parched the leaves) and the 'mould', 'fen' or blight—the greatest killer of them all."

Thoroughly capricious, these killers might devastate one crop and leave one on the other side of a tilled field in the full bloom of health. All this served to create huge swings between good and bad harvests, which in turn sent the price of hops falling or soaring. Perversely, the uncertainty created speculation and a booming industry.

Hop growers unashamedly waited for the dream season when misfortune would destroy their fellows' crops and send prices for their own healthy hops up through the clouds.

Conversely, growers dreaded a boom season, when they would have to pay the maximum labor expenses to harvest the crop, which was then practically worthless because of its abundance.

Not surprisingly, it was the brewers with deeper pockets and larger storehouses who were able to weather shortages and high prices, and take advantage of low prices. If consecutive bad seasons created dire shortages, the brewers would be forced to lower the hopping rate. If they still sold every drop they brewed, they were encouraged to leave the hopping rate lower to save money. And so beer became less bitter over the years.

Shortages had the additional effect of encouraging imports from other countries, and as the American hop industry grew in the mid-1800s, it occasionally benefited from a bad year in England.

But for the early American colonists, it was all import. At first, English hops were shipped to North

America, where spruce bark and sassafras root often served as the "gruit" of the day. In 1629, the Massachusetts Bay Co. ordered hop seeds shipped from England. (Talk about a patience-builder.)

The colonists had many uses for hops. Author Sanborn Brown notes in *Wines and Beers of Old New England*, "The hop cones used in the beer brewing were not the only part of the plant that the farmers found useful. It was a common vine in the settler's kitchen garden. The young shoots in the spring were eaten as a special treat in salads. . .a wax extracted from the tendrils was used as a reddish-brown vegetable dye, the fibers were used in textiles as a substitute for flax, the stalks were used for basket and wickerwork, and the leaves and spent hops were an especially excellent food for sheep."

By 1640, observers noted that hops grew "fair and large" in the colonies. But hop growing was still not an industry, and imports would make up the majority of the hops used for many years to come. Even in 1798, when Matthew Vassar began producing his famous ale, he gathered wild hops for the brewing.

Although the first commercial hops were said to be harvested in Massachusetts in 1791, it was New York state that was to be the new country's first major producer. The first hops were planted there in Madison County in 1808.

The first harvests were insignificant compared to English imports, and sold for just 12 cents a pound. But a series of English crop failures increased the demand after 1822, and the new Erie Canal opened up transportation east and west in 1825. Soon brewers in Ohio, Michigan, Indiana and Illinois were demanding and getting New York hops. In 1859, seven-eighths of the nation's hops were harvested in New York state. The area led in new hop technology as well, building the first hop extraction plant in 1871, and moving it to the center of the hop-growing area in 1876.

California began hop production in 1857, when a hop grower from Vermont settled there. Wisconsin began hop cultivation in the 1860s. On the West Coast, Washington's first hop grower was a brewer who harvested a crop in 1866 and Oregon was known on the hop market in 1880.

Photo courtesy of Oregon State College Dept. of Botany

Circa 1928

By then, the American brewing industry was using 30 million pounds of hops each year. The majority were grown domestically, and half of those in New York, still the king of the hop industry and perfectly located for the major eastern ale breweries, which used more hops than the western lager brewers.

But blight and mold sometimes destroyed a crop, and New York began to lose its edge. As in England, hop prices could swing wildly. With the average being 15 cents a pound, the price could drop to a nickel or rise to a dollar.

Gradually, the hops of the western growers, especially those of California and Oregon, gained in popularity. Brewmasters in the eastern breweries heard reports of western growing conditions with an abundance of early rainfall combined with warm summer sun, ideal for curbing the inroads of downy mildew and growing premium hops.

But the shift westward was not sudden. In 1903, New York hops were still noted as the best grown in America, while those of Washington, Oregon and California were cited as very important to brewers in America and England. Internationally, Germany still had the highest production of any nation and its hops were imported extensively into the United States for special brands of beer for which the German hop flavor was desired.

In the years from 1903 to 1914, before the darkness of Prohibition descended, American brewers imported three to 10 million pounds of hops each year, mostly from Germany, and exported 10 to 20 million pounds, mostly to England and Canada.

After Prohibition, the New York hop industry continued to decline, although hops would still be grown and harvested into the 1950s. Today, the United States is second only to Germany in hop production and the growers are centered in Washington state.

Perhaps the most important recent development in hop history is the increasing availability of different hop varieties, in manageable amounts, to homebrewers. It was the hop that pushed the homebrewer off center stage five centuries ago, but now the hop is once again in the hands of those brewers most likely to use it generously, with care, craft and a sense of adventure.

Sources: *A History of Brewing*, H.S. Corran, David and Charles, 1975; *Brewed in America*, Stanley Baron, 8 Press, 1972; *One Hundred Years of Brewing*, Arno Press, 1974 (Reprint of Western Brewer edition of 1903); *The Brewing Industry in England*, 1700-1830, Peter Mathias, Cambridge University Press, 1959; *New World Guide to Beer*, Michael Jackson, Running Press, 1988; *Wines and Beers of Old New England*, Sanborn C. Brown, University Press of New England, 1978.

It's funny what hops into

STEPHEN FOSTER

As a child growing up in a small village in rural Sussex, I took the local hop crop for granted. But now the terms Bullion, Fuggles and East Kent Goldings bring back childhood memories and I know why I enjoy brewing as much as I do. Each rolling boil makes me recall the taste, smells and memories of my youth and the hop-growing cycle. The hops grown in our village were responsible for that wonderful, bitter bite in Guinness Stout enjoyed by beer drinkers around the world.

A New Year - A New Crop

As the earth warms, the perennial hops put up shoots that start the year's crop. Each plant was spaced six feet apart in hills with four plants per hill. At the center of each hill was a wire peg to hold the strings. As spring gave new life, the old plants were trimmed away by hand in a process called dressing down when old pegs were replaced to prepare for the new vines (called bines in Sussex), in preparation for the next task, stringing.

The hop hills were sewn in a glorious web by men furiously working with nine-foot poles to hook strings from the ground peg to the wire framework 12 feet above. The men carried an eight-pound ball of string in a canvas pouch over their shoulders. I remember the speed with which the men worked to place four strings in each hill. The men were paid for each 1,000 hills, which amounted to about 13 miles of string. The four strings were pulled together five feet above the ground by a string band applied typically by the women. Some husband-and-wife teams were famous locally. In Michael Jackson's *World Guide to Beer*, two of my villagers are shown with symbols of recognition for the speed and agility with which they performed these tasks. The children usually came with their parents to play in the woods, fields and streams while their parents toiled. By the time I grew up, Guinness had several thousand acres under hops—you can imagine the miles of string.

As the young hop plants grew skyward, the many young shoots required training, much as peas, to follow the strings and join the wire trellis above. Families spent many long days in the fields training the hops to follow the strings and thinning out weak or overly thick shoots. As a child, I

Photos courtesy of the author

Trained hops by Sussex oast.

followed along, twisting the hop heads around the string in the right direction (the opposite to peas), and was amazed by the line of neatly trimmed hills stretching into the distance in all directions. Hop training was done in three rounds and was very labor intensive. Regular employees were joined by itinerant laborers, often gypsy families who returned year after year for more than a century. Once the training was complete, the hop plants would quietly grow as the days lengthened.

Sleepy Days Under Summer Sun

For much of the growing season, the hops required only tilling for aeration, drainage and to keep out weeds. In 1848 ladybugs were introduced to control aphids; later soft soap, tobacco juice and pesticides were used. Summer was the time for applying these chemicals and to control fungal diseases such as verticillium wilt and downy mildew.

Summer also was the time for enjoying a leisurely picnic in the shade of the hop plants, now a good nine to 12 feet high. June in England is called "flaming June" for its summer heat (that's right, no rain). Irrigation pipes ran between the hop plants, spraying river water on children eager to soak in the cool water under the summer sun.

Autumn and the Harvest Moon

For any brewer, in autumn the mind turns to new brews, and to the hop harvest. It was my favorite time of the year. September brought cool mornings with a fog-filled river valley and the prospect of a warm day. The hop bines, now heavy with fruit, created a dense green maze.

When I was a child, hops were picked by hand, hop by hop, and placed into a large cloth sack stretched between a wooden frame to form a 20-bushel bin. Each family had a bin into which they put their crop. We released the bine by pulling hard to break the string, bringing down a shower of dew in the morning. As the sun rose, the hops would dry and become lighter and easier to pick.

I will never forget lifting the petals of a plump hop and touching my tongue to the bitter resins hidden in its leaf structure. I also will never forget the black hands, thick with resin, of the pickers at the end of each day.

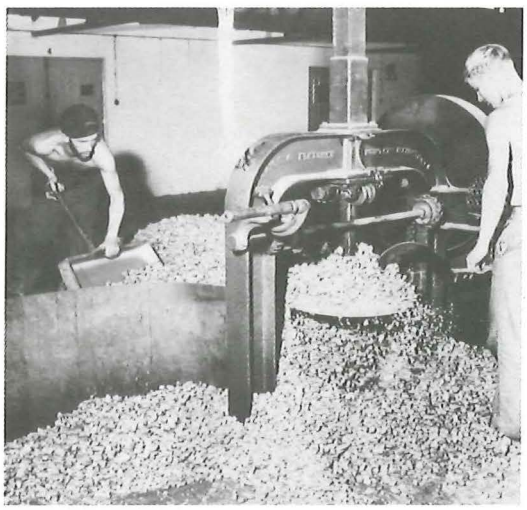
Hops were taken to the oast for drying twice daily. The measurer would come to each family with a bushel basket and measure the hops into an airy sack called a poke. My father often performed this task while my mother tallied the yield and I would follow, watching the bins empty and pokes fill. In olden days each family would be given a hop token, which they could trade for hard cash at the end of the season. We had many tokens for toy money in the days when tokens were replaced by a "bookie" who would tally a family's crop for reimbursement at the end of the week. Once a poke was filled it was transported to the oast for drying and baling before being shipped to the brewery.

The hops were spread very carefully in the kilns to a depth of two feet. A fork was used to lift and separate the crop, allowing warm air to percolate through and remove excess moisture. When enough moisture had been removed, the hops were pulled from the kiln by a large sack and allowed to cool before being pressed into bales.

Drying the hops was an art, to reduce moisture from about 80 percent to about 6 percent, without removing too much oil and flavor while maintaining a homogeneous distribution of moisture.

The original Kent and Sussex oasts were designed with a circular kiln and a cowl, or hood, some 15 feet above the slatted drying floor, allowing for good ventilation through the hops. The floor was made of wooden slats covered with a wire mesh. The sacks were used to pull the hops from the kiln.

Hops originally were compacted into round bales using a hand press. The bales were three feet in diameter, 15 feet in length and weighed about 1 1/2 hundred weight (160 pounds).



Filling the bale during pressing.

Man stringing.

your memory

Later they were electronically pressed into square bales, which were practical for storage but less romantic.

The hops from our farm were sent to the Guinness Park Royal Brewery in London or transported to the brewery in Dublin. The men of the hop farms would say that Guinness always tasted sweetest during hop picking. I am sure this was caused by the fact that their nostrils and taste buds were full of the hop resins, giving a sweeter taste to that unique black brew. Guinness was the standard drink in the Guinness hop farm oasts, supplied free to thirsty oast hands.

Once the last of the hops had been picked by late September, the oast would be cleared, swept and prepared for a large harvest festival signaling the transition from autumn to winter.

Preparing for Another Spring

The first winter activity was to cut and burn the hop bines now free of their fruit. Bines were neatly coiled on each hill as they were picked clean during harvesting. The dry bine burned rapidly and the charcoal-like embers and glowing ashes were ideal for toasting bread, and on occasion, the chestnuts that appeared at this time.

When the cruel, damp winter wind drove workers inside, the oasts provided large work areas perfect for repairing bale cloths and for spinning large bales of string into balls the right size for the spring task.

Another winter activity was to construct new hop fields, typically 15 to 25 acres. The wire trellis above the ground was suspended from chestnut poles harvested from local "coppis" woods (Sussex for canopy) that made up much of rural Sussex. The men climbed tall three-legged ladders and put on stilts for working high in the wires. As a child, this was a wonderful sight to see men walking on stilts. It reminded me of circus clowns.

More Hops in Your Wort

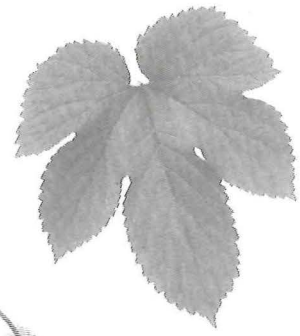
Modern-day hop farming is done with tractors, trailers, hop-picking machines and other fully mechanized operations. Now only the homebrewer picks hops one by one. The romance may have gone, but the taste remains strong and clean with each boiling wort. For a homebrewer, it's worth growing a few bines at home, perhaps along a fence or up the house, not necessarily to produce a vast crop for the brewing year, but to experience the roughness of the bine and leaf, the smell of the petals and the taste of fresh alpha acid on the tip of the tongue. And then there's the homebrewed beer. . . .

Photo courtesy of Oregon State College Dept. of Botany

Training hop vines in Sussex.

Development of Hop Varieties

Nugget



Cluster

Photos courtesy of John I. Haas, Inc.

Humulus lupulus is native to temperate zones of Europe, North America and Asia. The aromatic properties of the plant were known to ancient peoples in Babylon and Egypt. Hop yards and hop usage were first documented in Bavaria, Germany, in 736 A.D. Preservation of beer by the use of hops is probably of German origin. Hop acids retard the growth of gram positive bacteria with little effect on the yeast. Hops were grown in Holland during the 14th century. Flemish weavers probably brought hops and hop culture across the channel to England in the early 1500s.

Hop production was introduced to North America by the Massachusetts Bay Co. in 1629. By 1648 production had spread from New England to Virginia. The state of New York became an important hop-growing area in the middle 1800s when more than 1.5 million pounds were produced annually. After the Civil War, hop production spread into Pennsylvania and Wisconsin. In 1869 more than five million pounds of hops were produced. In 1880 New York was the largest U.S. producer with more than 21 million pounds of hops annually. Powdery mildew appeared in New York hop fields in the early part of the present century. It was controlled around 1920 by sulfur fungicides. At that time, another disease, downy mildew, appeared and devastated the hop industry in the eastern United States.

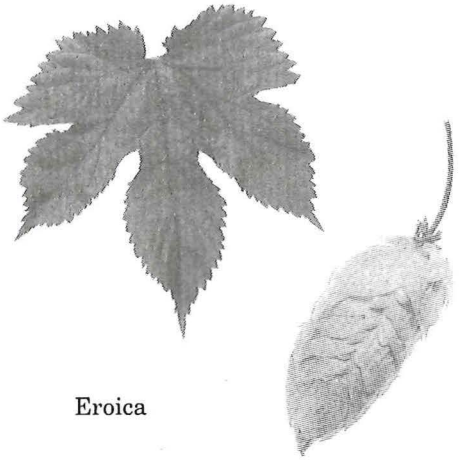
A gradual shift of the hop industry to the western part of the United States started about 1850. By 1900, both Oregon and California produced more hops than New York. Hop production in Idaho began in 1950. The California hop industry began a slow decline in the 1950s, partly because of higher hop yields and competitive price pressures from the Pacific Northwest, primarily Oregon and Washington. The last commercial California hop yard was removed in 1989. All commercial U.S. hops are now grown in Washington, Oregon and Idaho.

ALFRED HAUNOLD

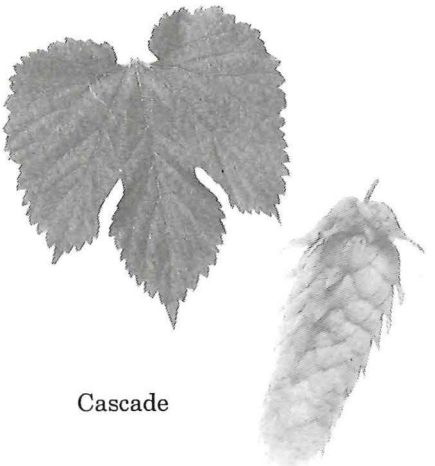
Botany and Taxonomy

Hops belong to the family Cannabinaceae. The genus *Humulus* has two species: the perennial common hop, *Humulus lupulus* and the annual Japanese hop, *Humulus japonicus*. All cultivated hops belong to the perennial species *lupulus*, but there are at least five subspecies. Plants are normally propagated vegetatively from rhizomes (underground stems) or from softwood cuttings. Japanese hop, which is grown from seed, is an annual ornamental with no brewing value.

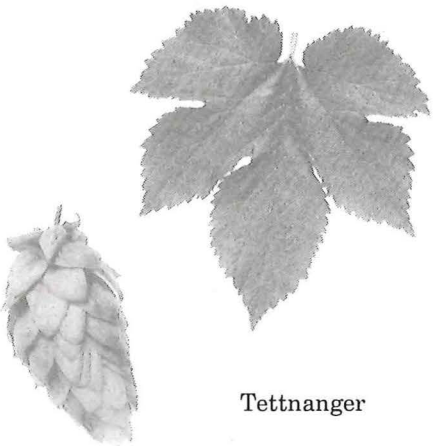
Hop is dioecious, with separate male and female plants. The sex can only be determined when the plant flowers, which occurs only occasionally in the first year when plants are grown from seed. About one-fourth to one-sixth of all seedlings are males; the rest are females. Male plants are useful only for pollinating females to produce higher yields through increased cone size and seed set. They also are valuable for breeding new hybrids and varieties.



Eroica



Cascade



Tettnanger

The hops of commerce (called cones or strobiles) are produced only on female plants. Most commercial hops are diploids with 20 chromosomes (two sets of 10) in their somatic (body) cells. Polyploid plants (having multiples of the basic set of 10 chromosomes) sometimes have both sexes within the same plant and may be self-fertile. Some commercial diploid varieties occasionally produce a few male flowers. The pollen from these flowers, however, is largely nonfunctional and no documented evidence of self-fertile diploid hops is found in the literature.

Development of New Hop Varieties

Hops are native to three continents where it can be found growing wild. Many years ago some enterprising individual probably collected such wild plants, grew them in a home garden and discovered the aromatic properties of the cones produced on female plants. Native wild-growing hops recently have been collected in various countries in order to preserve genetic traits that might be lost if these wild populations should disappear. German, Yugoslavian and American scientists have collected wild hops since the late 1950s and have incorporated them into their breeding program.

Professor E. S. Salmon of Wye College, England, obtained seeds of native North American hops collected near Morden, Manitoba, Canada, in 1916. He germinated the seeds and selected vigorous seedlings that had a much higher brewing value (alpha and beta acids) than European hops grown at that time. Salmon successfully transferred these characteristics to English hops and released the two well-known high-alpha hops, Bullion and Brewers Gold. These hops, and particularly Brewers Gold, were the source of genetic factors for high-alpha acid content in the superalpha hops developed in recent years.

New hop varieties or cultivars can be obtained by three basic methods:

(1) ***Mass Selection*** This is the oldest technique for developing new hop varieties. A superior plant is selected, either in the wild or in an existing hop yard, and increased vegetatively. New plants are genetically identical to the original mother plant, but may have a higher yield potential because of increased uniformity of the planting stock and freedom from diseases. Many older 19th century hop varieties were developed in this manner. Examples of such varieties that are still grown today include Fuggle, Styrian Golding (derived from Fuggle), Early Cluster, Late Cluster, Saaz, Tettnanger, Hersbrucker, Hallertauer mittelfrüh, Strisselspalt and Spalter. All are essentially land races, but some may have resulted from mutations or chance pollination from wild native male hops growing nearby.

(2) ***Hybridization or Cross-Breeding*** Superior male and female plants are selected and crossed. Because hops are wind-pollinated, care must be taken to avoid out crossing. Seeds are pretreated to break the dormancy. Seedlings are started in a greenhouse and transplanted to the field. They may reach sexual maturity that same year, and female plants might even produce cones for chemical analysis. Each seedling is genetically unique, and theoretically each female could give rise to a new hop variety. Seedlings are evaluated for two to three years for agronomic, chemical and aroma characteristics. Superior plants are selected and planted in replicated plots for another two to four years of small-scale evaluation. Final evaluation is in large field plots (one to three acres) that produce commercial quantities of hops for brewing trials. After four to eight years of advanced testing, a new variety may be ready for release. Eight to 12 years are required to develop a new hop variety. Hop breeders must therefore anticipate the demands of growers and brewers at least 10 to 15 years in advance.

New U.S. hop varieties developed by crossbreeding

Cascade: from open-pollinated seed (wind-pollinated, male parent unknown), seed collected in 1956, released in 1972;

Galena: from open-pollinated seed collected on Brewers Gold in 1968, released in 1979;

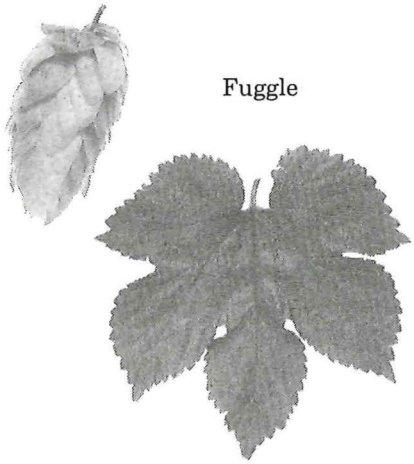
Eroica: from open-pollinated seed collected on Brewers Gold in 1968, released in 1980;

Nugget: from a cross between selected female and male parents made in 1970, released in 1983;

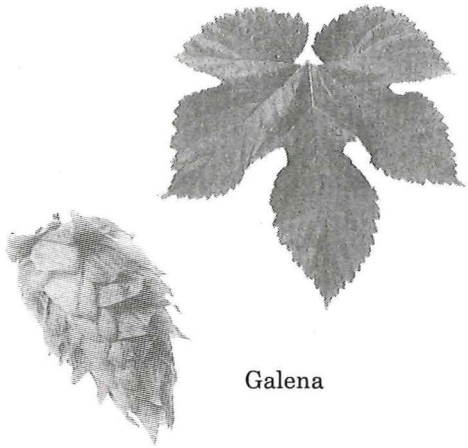
Olympic: from a cross between selected male and female parents made in 1974, released in 1983; and

Chinook: from a cross between selected male and female parents made in 1974, released in 1985.

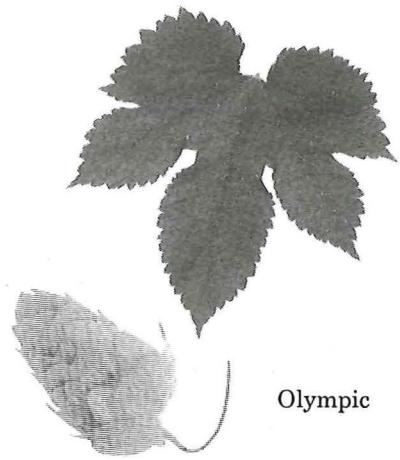
(3) ***Mutation Breeding*** Radiation or chemicals are used to induce genetic variability and/or changes in the chromosome number. Chemical or



Fuggle



Galena



Olympic

radiation techniques thus far have not directly produced any new hop varieties. However, colchicine, an alkaloid useful for doubling the chromosome number in plants, has been used by several hop breeders to develop a hop plant with twice the chromosome number of the original mother plant. The resulting tetraploid has 40 chromosomes or four sets of 10 chromosomes each compared with 20 chromosomes in the diploid. Most hops and most commercial varieties are diploids.

Tetraploid females can be used to cross with diploid males to produce triploids (30 chromosomes). Triploids are nearly sterile and permit production of seedless hops even in the presence of male plants, which are sometimes used as yield stimulators. Most brewers prefer seedless hops and sometimes pay a premium for them. It is also easier to duplicate the quality profile of choice aroma varieties and increase the yield potential by selecting triploid females from crosses of tetraploids and diploids because two-thirds of the genetic potential of a triploid comes from the mother plant. This approach has been particularly successful in developing new aroma hops.

Willamette: This is the first successful commercial triploid hop variety developed by polyploid breeding. Willamette is a Fuggle-type aroma hop. The chromosome number of Fuggle was doubled in 1966, the cross was made in 1967 and Willamette was released in 1976. Today, Willamette is a major U.S. aroma variety grown primarily in Oregon and Washington (Table 1).

Mt. Hood: The chromosome number of Hallertauer mittelfrüh, a well-known German aroma hop, was doubled at Wye College, England, in the 1970s. A tetraploid Hallertauer mittelfrüh (USDA Accession Number 21397) was obtained in 1983 and crossed to selected diploid aroma-type male hops. Some of the resulting seedlings looked so promising that the customary nursery evaluation was bypassed in favor of commercial three-acre tests. Brewing evaluations started in 1986, and Mt. Hood was released for commercial production in 1989. The first crop of about 50 acres of commercial Mt. Hood plantings will be marketed in 1990. An additional 400 acres were planted in 1990, primarily in Oregon and Washington. Mt. Hood thus far has compared favorably with German aroma hops and particularly with Hersbrucker.

Table 1.
U.S. hop varieties and production, 1979-1989.

(Data compiled from U.S. Hop Administration Committee and Hop Growers of America records.)

	1979			1989		
Variety	**Acres**	**Production lbs/acre**	**%**	**Acres**	**Production lbs/acre**	**%**
Clusters[1]	19,114	1,712	60	6,864	2,025	20
English[2]	5,122	1,976	16	0	-	
Fuggle + Willamette[3]	2,276	971	7	7,100	1,367	21
Cascade	4,151	1,847	13	1,297	1,980	4
Galena + Eroica	0	-		7,246	1,782	21
Nugget	0	-		3,519	1,985	10
Chinook	0	-		1,489	1,825	4
Tettnanger	0	-		2,941	1,060	8
Perle	0	-		1,064	1,355	3
Comet	607	1,800	2	0	-	
Others[4]	584	variable	2	3,028	variable	9
Total	**31,854**			**34,548**		

[1]Early and Late Cluster, Talisman. [2]Bullion, Brewers Gold. [3]Mostly Fuggle in 1979, Willamette 1989. [4]Mostly experimentals.

Why Develop New Hop Varieties?

From a worldwide agricultural perspective, hops are definitely a minority crop. The fermented malt-beverage industry is, however, a major economic factor in many countries. About 30 countries grow hops on a commercial scale. Few of these countries, however, can afford the expenses of systematic hop research. The private sector generally has avoided hop breeding because it is very difficult to patent a new variety and to protect the associated investment. A new hop variety can easily be propagated vegetatively for commercial production in a relatively short time.

The U.S. Department of Agriculture has supported hop research for many years. A hop research center, established at Oregon State University, has supported the U.S. hop-growing industry since 1930. Substantial additional support has come from industry sources—primarily grower organizations—and brewers.

The state of Washington also supports hop research at the Irrigated Agriculture Research and Extension Center, Prosser. Research intensified after Washington became the predominant U.S. hop producer in the 1950s. Idaho has supported hop research since the 1950s at the Parma Research Station near Boise.

Other hop research centers are located in the United Kingdom (Wye College, University of London, England); West Germany (Hop Research Center Huell, near Wolnzach, Bavaria); Soviet Union (Hop Research Center Zhitomir, Ukraine); Yugoslavia (Hop Research Center Žalec, Slovenia; and Hop Research Center Backi Petrovac, Serbia, near Novi Sad); Czechoslovakia (Hop Research Center Žatec); New Zealand (Riwaka Research Station near Nelson), and Australia (Hop Research Station Ringwood near Melbourne, closed about 1980).

Private efforts to develop new hop varieties in recent years have been successful in South Africa and Japan.

The research centers mentioned above have generally been leaders in developing new hop varieties. Such varieties frequently appeared in other hop-producing countries that often did not contribute to their development. In some cases, such varieties could be successfully adapted in new environments, but in other cases there were disappointments.

Choosing a Hop Variety

Grower Considerations

Hop growers, like other businessmen, must remain fiscally competitive. Higher yield per acre with comparable or reduced labor and material input is an important motivator for planting new or improved varieties. Early maturity is another important factor for the grower's planning. Most hop varieties in the United States mature between Aug. 25 and Sept. 15. A few, mostly low-yielding varieties such as Fuggle and Tettnanger, mature about one week earlier than most other hops grown in the United States. A variety that matures one week earlier permits the grower to utilize expensive machinery one additional week while it would otherwise sit idle. Harvesting machinery and equipment for an average U.S. hop farm typically costs up to $1 million or more, and one additional week of harvest can spread this cost over a larger production base.

Brewery Considerations

Brewers are more concerned about hop quality than yield per acre. There are basically two distinct quality factors in hops: bittering compounds (primarily alpha and beta acids) and aroma components (essential oils).

Most traditional European aroma

hops are relatively low in bittering compounds. Mass selection within such hops has not significantly increased the content of bittering compounds. A dramatic breakthrough occurred when Professor Salmon introduced genetic factors for high alpha acids from wild North American hops. His first selections, Bullion and Brewers Gold, contained nearly twice the alpha acid content of traditional European hops. The new superalpha hops, Galena, Eroica, Nugget, Olympic and Chinook, represent an additional increase of nearly 50 percent in relative brewing value compared with Salmon's earlier high-alpha hops.

Research Restrictions

Developing higher-yielding aroma hops similar to the old established lower-yielding European hops (Fuggle, Tettnanger, Saaz, Spalt, Hersbrucker, etc.) has been more difficult than raising the alpha-acid content. Until recently, no reliable laboratory methods were available for routine screening of large seedling populations for aroma potential. Organoleptic evaluations and particularly the "rub and sniff" test were too unreliable and subjective to guide hop breeders in developing new aroma hops.

Willamette and to a limited extent, Perle represented the first breakthrough in developing new aroma varieties with increased yield potential. Mt. Hood, the recently released triploid aroma hop, appears to be similar to the German Hersbrucker, a major noble aroma hop valued in international hop trade.

Additional research is being conducted by the U.S. Department of Agriculture in cooperation with the Washington and Idaho Agricultural Experiment Stations to find higher-yielding Tettnanger and Saaz types that can be grown successfully in the United States. The associated field and laboratory work, however, is very expensive and time consuming.

Additional Considerations

(1) ***Disease Resistance*** Downy mildew (*Pseudoperonospera humuli*) is an obligate parasite that devastated the hop industry in the eastern United States in the early part of this century. Although still damaging, it is now largely controlled by combining the natural resistance of new varieties with limited use of new systemic fungicides such as Ridomil and Aliette. New U.S. hop varieties generally are more resistant to this disease than older varieties and especially Clusters. Verticillium wilt (*V. albo-atrum* or *V. dahliae*) is not a major problem in most U.S. hop-growing areas. It is a major disease, especially in Germany, where it caused the precipitous decline of the aroma variety Hallertauer mittelfrüh in recent years.

(2) ***Insect Resistance*** Hop aphids and spider mites are major insect pests in most hop-growing areas of the world. These two pests are difficult to control because they often develop resistance to pesticides. Effective insecticides sometimes have been withdrawn for environmental or safety reasons. Because hop is a specialty crop with very limited acreage worldwide, there is little incentive for industry to develop or register pesticides for hops because of limited user potential. Thus, growers even today must rely mostly on management and

limited chemical control measures to control insect pests.

U.S. Hop Production Current Status

Table 1 illustrates changes that occurred in the U.S. hop industry in the past decade. While total hop acreage has increased slightly, a dramatic shift in varieties has occurred. In 1979, Clusters (Early and Late Clusters including the Cluster selection Talisman) accounted for approximately 60 percent of total hop acreage. Cluster acreage has now shrunk to about 20 percent, and the Cluster-related Talisman has completely disappeared.

English hops (Bullion and Brewers Gold), which made up over 16 percent of total U.S. hop acreage in 1979, are no longer grown. They were replaced by the new superalpha hops. These hops (mainly Eroica, Galena and Nugget, with an average alpha-acid content between 13 and 15 percent) were not grown commercially in 1979. They now account for 31 percent of total U.S. hop acreage and nearly 50 percent of total U.S. hop production.

Willamette, an aroma hop

Table 2.
Agronomic and quality characteristics of major hop varieties grown in the United States in 1989.

Variety	Yield lbs/acre	Maturity	Disease Problems	Alpha %	Beta %	Cohum-ulone%	Brewery Use
Early Cluster	1,700-2,200	Early	Downy mildew	5-8	4-6	35	general kettle hop
Late Cluster	1,700-2,200	Late	Downy mildew	5-8	4-6	35	general kettle hop
Fuggle	1,200	Early	Verticillium wilt (mild)	4-6	2-3	26	aroma
Willamette	1,700	Med. late	Verticillium wilt (mild)	5-7	4	26-28	aroma
Cascade	1,800-2,100	Med. late		4-7	4-6	30	aroma
Galena	1,600-2,000	Med. late		12-15	7-9	30-33	bittering, extract
Eroica	2,000-2,200	Late		10-14	5	40	bittering, extract
Nugget	1,900-2,200	Med. late		13-16	4-5	26	bittering, extract
Chinook	2,000	Med. late		13-14	4	31	aroma, bittering
Perle	1,200-1,800	Early		8-11	5	28	aroma, bittering
Tettnanger	1,200-1,400	Early		3-5	4-5	20-22	aroma

released in 1976, was then included with Fuggle. Together they represented a total of 2,276 acres (mostly Fuggle) or just over 7 percent of total U.S. hop acreage. Ten years later, Willamette had increased dramatically while Fuggle had decreased, and their total 1989 acreage was nearly 21 percent of all U.S. hop acreage.

Cascade showed a substantial decrease between 1979 and 1989, partly as a result of Willamette's expansion.

Tettnanger, an old established, lower-yielding German aroma hop, was not grown in significant quantities in 1979, but had expanded to nearly 3,000 acres 10 years later, primarily because of price incentives by certain U.S. breweries.

These changes in acreage and production were not sought by hop growers because average production per acre of both Clusters and English hops (Bullion and Brewers Gold) was among the highest in the U.S. hop industry (Table 1). Brewers, however, had learned to appreciate the added benefits of increased quality (bittering or aroma compounds) in new varieties, and therefore urged growers to switch, often with added incentives such as premium prices for superalpha varieties or multiyear production contracts for new aroma hops or both.

Additional changes will occur as new varieties, primarily aroma varieties similar to the German Hallertauer mittelfrüh, Hersbrucker or Tettnanger, are developed. The first release from these efforts, Mt. Hood is now grown on approximately 500 acres. Other experimental noble aroma hops have now been tested commercially for four years, and one or more may be released in the near future.

Differences Among Major U.S.-grown Hop Varieties

Important agronomic and quality characteristics of major hop varieties currently grown in the United States are summarized in Table 2.

Early and Late Clusters produce excellent yields. Except for maturity, they are essentially identical in quality and brewing performance. Their alpha-acid content ranges from 5 to 8 percent, and the cohumulone content (one of the alpha-acid fractions) is

relatively high. All Cluster hops are susceptible to downy mildew and, therefore, they are grown primarily in Washington and Idaho where this disease is rarely a major threat. They are used primarily as general kettle hops, (occasionally for production of hop extracts), and for exports because of excellent storage stability of the soft resins (alpha and beta acids).

Fuggle, an early-maturing, relatively low-yielding aroma hop, is resistant to downy mildew but somewhat susceptible to verticillium wilt. It has a moderately low alpha-acid content (4 to 6 percent), and the ratio between alpha and beta acids is approximately two. The cohumulone content also is low, similar to European aroma hops. Its early maturity allows growers to extend their harvest season.

Willamette, genetically two-thirds Fuggle, produces substantially higher yields, has a verticillium wilt reaction similar to Fuggle, and a somewhat higher alpha- and beta-acid content. It is a triploid with 30 chromosomes and produces few seeds even when male hops are present. It is used exclusively as an aroma hop and is generally substituted for Fuggle in brewery blends.

Cascade, a medium- to late-maturing aroma hop, produces excellent yields. The alpha-acid content ranges from 4 to 7 percent, and the ratio between alpha and beta acid is near one, similar to European aroma hops. The cohumulone content, however, is somewhat higher than that of traditional European aroma hops. Cascade use has declined in recent years as newer aroma hops became available in increasing quantities.

Galena, Eroica and Nugget, three superalpha hops released in the late 1970s and early 1980s, generally produce excellent yields and have a very high alpha-acid content (13 to 16 percent). Galena is remarkable because of its relatively high beta-acid content, while Nugget has a relatively low cohumulone content, similar to that of European aroma hops such as Fuggle. All three have good to excellent storage stability of their soft resins, and they are primarily used as bittering hops and for production of extracts. The acreage of Eroica has declined in recent years because of late maturity that may cause weather-related problems at harvest.

Chinook, a high-yielding, medium- to late-maturing hop has both high alpha-acid content (12 to 14 percent) and is valued for its aroma components.

Tettnanger, a German noble aroma hop, matures early but has relatively low yields. Its alpha-acid content ranges from 3 to 5 percent and the beta is similar. The cohumulone content is very low (20 to 22 percent). It is priced for its aroma.

Perle, a seedling of Northern Brewer, reportedly combines higher alpha-acid content and noble aroma characteristics. United States-grown Perle, however, has about 3 percent more alpha than Perle grown in Germany. Aroma hop users in the United States and abroad have not been completely satisfied with Perle's performance as a substitute for other aroma hops.

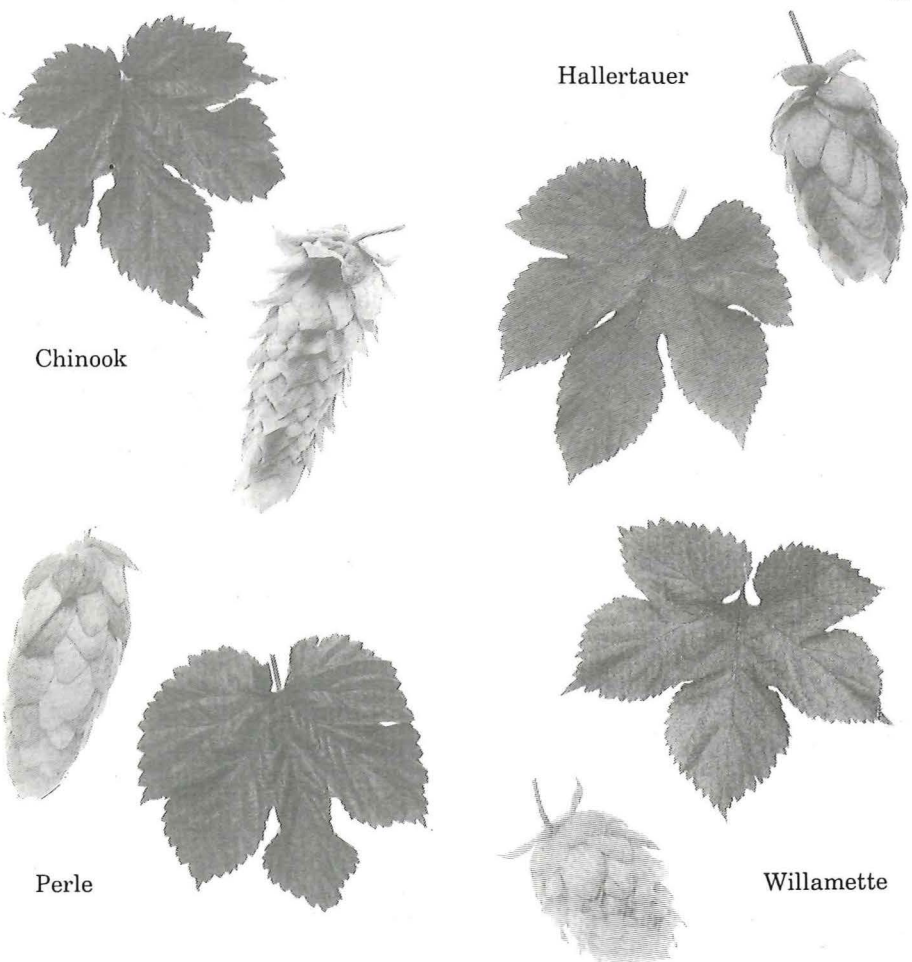
The U.S. Department of Agriculture in cooperation with the Agricultural Experiment Stations of Washington and Idaho currently emphasizes development of new aroma hops similar to Tettnanger, Saaz, Hallertauer mittelfrüh or Hersbrucker. The recently released Mt. Hood appears to be similar to the German Hersbrucker (4 to 6 percent alpha acids, 5 to 7 percent beta acids, cohumulone approximately 24 percent). Other experimental aroma hops currently in large off-station trials in the three hop-producing states of the Pacific Northwest may soon offer additional choices to hop growers and brewers.

Future Outlook

The United States ranks second in worldwide hop production after West Germany. These two countries together account for more than 50 percent of all hops moving in international commerce. Typically more than half of U.S.-produced hops are exported each year. These exports are either kettle hops such as Clusters or high-alpha bittering hops. Aroma hops, except for Cascade in certain years, have rarely been exported from the United States insignificant quantities.

Some major U.S. hop varieties have been grown successfully in some foreign countries. Reportedly, Cascade is somewhat popular in Argentina. It also has been planted in limited quantities in several East European countries. Nugget is currently being evaluated in West Germany and may soon be grown there on substantial acreage. This may enhance the West German position in the high-alpha segment of world hop markets. Conversely, German hops and primarily aroma hops such as Tettnanger and Perle have been introduced into the United States on a limited basis.

The United States still imports significant quantities of aroma hops each year, primarily from West Germany and Czechoslovakia. As additional domestic aroma hop varieties are developed and released, U.S. imports will probably decline.



Hop Varieties and Qualities

In 1990 the most popular bittering hops in the United States are Cluster, Galena, Nugget and Chinook. Most widely used aroma hops are Cascade, Hersbrucker, Willamette, Hallertauer and Mt. Hood.

Popularity and availability of some of the traditional varieties are declining, in some cases rapidly. Brewers Gold and Bullion, for instance, which were a major factor in the Oregon market up to 10 years ago have now all but disappeared. Several new "starts" on the hop variety scene a few years ago also have faded away (Comet, Columbia and Olympic). While imported traditional aroma types such as Hallertauer and Mittelfrüh are sometimes available in very small amounts, the growing trend in the major breweries and microbreweries is to use the newer U.S. varieties, which in most cases produce beers of equal or superior quality.

Saaz

Traditional fine aroma hops from Czechoslovakia. High price, low yield, but one of the world standards for noble hop aroma in a lager beer.

Chinook

U.S. Department of Agriculture cross from Petham Golding released in 1985. Good yields and high alpha-acid content make this an economic bittering hop. Mild, spicy aroma with a positive, lingering bitterness.

Galena

Developed in Idaho from Brewer's Gold by open pollination. Released in 1978 and now rivals Cluster as the most popular U.S. bittering hop. Good yield and very high alpha content makes this an excellent economic value. Aroma neutral if used early in the kettle boil. Excellent as early kettle addition when combined with Cascade or Willamette for late "aroma" addition.

Nugget

New high-alpha variety, based on Brewer's Gold and released in 1982. Good aroma profile and storage stability. Interesting aroma character—heavily spiced and herbal. Good bitterness quality. Increasing production and demand.

Tettnanger

Traditional German variety from the Tettnang area. True noble aroma variety recently planted extensively in the United States. Low yields keep the costs high but Tettnang remains one of the finest hops in the world for aroma.

Mount Hood

This is a triploid seedling of Hallertauer with improved agronomic characteristics. Released in 1988 but acreage increasing rapidly because of acceptance as Hallertauer equivalent by major brewers.

Perle

Developed in Germany from English Northern Brewer. Moderate bittering potential (about 8 percent alpha) and some good aroma characteristics. Recently introduced into U.S. growing areas.

Hallertauer (Hersbrucker)

Traditional German variety selected in the Hallertauer area. More properly called Hallertauer mittelfrüh, as many other hops are also called Hallertau. Very good aroma hop, until recently the standard for lager beers. Declining production because of sensitivity to verticillium wilt and low yields. Recently largely replaced by Hersbrucker, another German "area" hop, not as highly regarded but much more readily available.

Cascade

Aroma hop developed in Oregon by open pollination of a Fuggle seedling. Released commercially in 1972. Rapid acceptance followed by rejection by major brewers and recently renewed interest. Still a major variety, well liked for its distinctive aroma derived in part from the relatively high content of linalool and geraniol in the oil fraction. Pleasant bitterness even at high bitterness unit levels.

BERT GRANT

Variety	% Alpha Acids (fresh)	Freshness Stability	Ounces per 5 gallons for average bitterness	Origin	Comments
Aquila	7.0	Fair	1.5	U.S.	New, aroma
Banner	10.0	Fair	1.0	U.S.	New, bitter
Brewers Gold	9.0	Poor	1.1	U.S./U.K.	Declining use
Bullion	9.0	Poor	1.1	U.S./U.K.	Declining use
Cascade	5.5	Poor	2.0	U.S.	Good aroma
Chinook	12.0	Very good	0.9	U.S.	Recent, bitter
Cluster	7.0	Excellent	1.5	U.S.	Standard
Columbia	10.0	Fair	1.0	U.S.	Obsolete
Comet	10.0	Fair	1.0	U.S.	Obsolete
Eroica	10.0	Fair	1.0	U.S.	Bittering
Fuggles	4.0	Fair	2.2	U.S./U.K.	Rapidly declining use
Galena	12.0	Very good	0.9	U.S.	Most popular bittering hop
Goldings	5.0	Fair	2.0	U.S./Canada	Declining use
Kent Goldings	5.0	Fair	2.0	U.K.	Declining use
Hallertauer	5.0	Poor	2.0	U.S./Germany	Declining, premium aroma
Hersbrucker	5.0	Poor	2.0	U.S./Germany	Aroma
Mt. Hood	5.0	Fair	2.0	U.S.	Good aroma
Northern Brewer	8.0	Fair	1.4	U.S./Germany	Bittering
Nugget	12.0	Good	0.9	U.S.	Bittering, aroma
Olympic	10.0	Good	1.0	U.S.	Obsolete
Perle	8.0	Good	0.9	U.S.	Bittering, aroma
Pride of Ringwood	8.0	Good	1.4	Australia	Bitter
Saaz	5.0	Fair	2.0	Czechoslovakia	Premium aroma
Spalt	7.0	Poor	1.5	Germany	Aroma
Styrian Goldings	6.0	Fair	1.8	U.S./Yugoslavia	Aroma
Talisman	8.0	Good	1.4	U.S.	Declining use
Tettnanger	5.0	Poor	2.0	U.S./Germany	Aroma
Willamette	5.0	Fair	2.0	U.S.	Aroma, popularity rapidly increasing
Wye Target	10.0	Fair	1.0	U.K.	Bitter

Photo by Dave Willis

Cluster

The standard bittering hop in the United States and much of the world since the turn of the century. Parentage is lost in antiquity but it is likely a cross between an English import and a wild American hop. Best aroma and bitterness stability of any variety. Good yields, vigorous plants, susceptible to mildew in rainy areas but reasonably resistant to other problems. Use declining in favor of much higher alpha-value types such as Galena.

Fuggle and Willamette

Fuggle is an English variety selected in 1875. Widely used in the United States and England until the 1980s. Largely supplanted in United States by the recently developed triploid progeny—Willamette.

Fuggle use declined in England because the Wye varieties were developed as replacements. Fuggle still is widely used as dry hops, but even here Willamette is an adequate replacement.

1989 acreage figures give an estimate of the major varieties in commercial production.

Variety	Acreage
Cluster	6,862
Galena	6,451
Willamette	6,299
Nugget	3,519
Tettnanger	2,941
Chinook	1,560
Cascade	1,297
Perle	1,064

Some varieties already are nearly obsolete, not having survived competition from newer arrivals, or losing to disease and pests. These are Brewers Gold, Bullion, Columbia, Comet, Olympic and Talisman.

A few new varieties, Mt. Hood, Aquila, Banner, are increasing in acreage, but still are considered experimental.

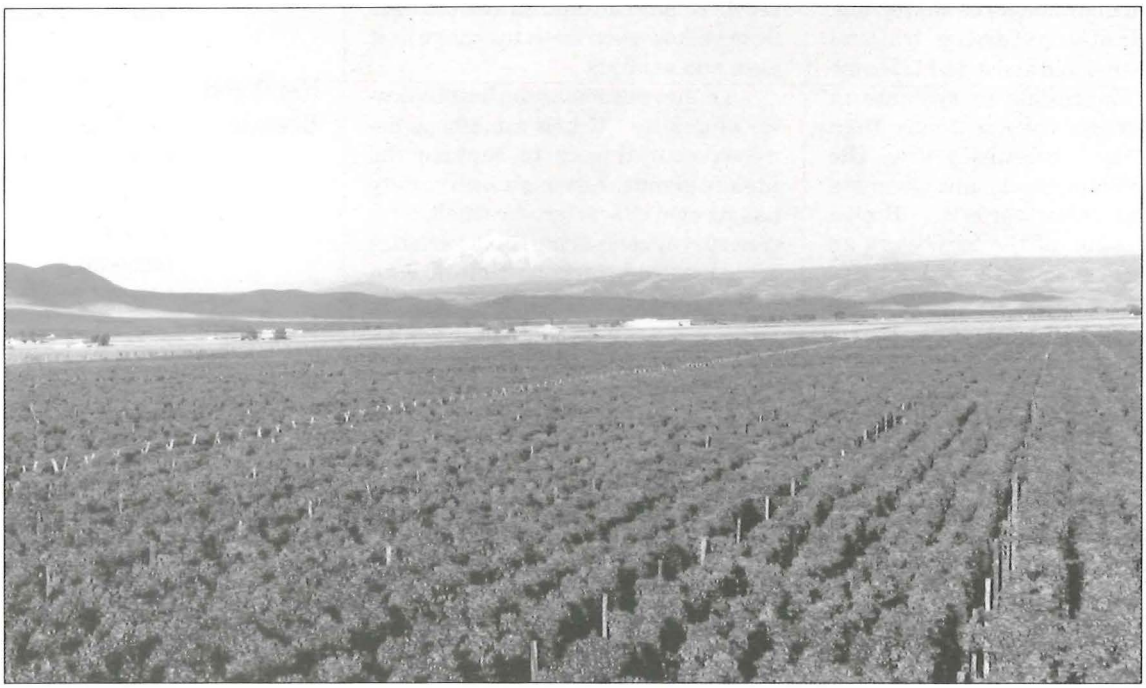


Photo courtesy of John I. Haas, Inc.

Assessing Hop Quality

What is a good hop? Selecting a good variety does not necessarily mean you are selecting a good hop. Quality is first determined in the field, where the hops must be kept free from pests and disease, and be harvested at optimum ripeness in clear weather. Drying also affects quality. Using too high and prolonged temperatures will cause deterioration of the aroma compounds and shattering of the hop cone. Once in the bale, a quality hop is maintained through dry cold storage.

In assessing hop quality you must combine a number of factors to determine if a hop is suitable for your purposes, including whether to use whole flowers or pellets, the hops' color, aroma, age and perhaps flavor.

Color and visual quality are always your first impression, and because most hops are packaged in a plastic bag, they are often the only way to assess quality before purchasing. Although color usually is not as important as aroma, it becomes very important when your nose is restricted by a plastic bag. Whole hops are easier to evaluate than pellets

DAVE WILLS

Photo courtesy of the Benton County Museum

Old-time hop kilning: After 18 hours of slow drying, the kilns are emptied by pushing the dried hops into bins with a large scoop.

because such problems as shattering, which indicates overdrying, leaf and stem content, mold and individual cone color are impossible to evaluate in pellets. Proper color will vary from vibrant green to greenish yellow. The variety Willamette is always more yellow than other varieties. Brown tips on the end of the bracts are an indicator of ripeness and are not necessarily bad. Old hops have a very dull brown color. The lupulin also changes from yellow when fresh to orange as it ages and oxidizes.

I believe aroma is the best indicator of quality. Crush some hops between your fingers to rupture the lupulin glands. Although each variety has its own characteristic smell, a recent survey comparing three varieties of old hops to fresh hops came up with these descriptions.

	Old	Fresh
Northern Brewer	barnlike musty earthy orange pungent	grassy citrus pitch flowery
Cascade	mild cheesy straw woody dead vegetative wimpy dank tea phenolic	spicy resiny fresh floral kick Santa Claus floral/white pine pitch
Willamette	stale cardboardy sour dirty T-shirt bland	herbal grassy oily-spicy sharp lemon rind spicy floral fruity citrus

Age, to a certain extent, is not that important; if they have been kept in cold storage, hops should have a decent aroma. Research is finding that the noble hops such as Hallertauer, Tettnanger and Hersbrucker actually improve with the proper amount of oxidation. The variety Cascade and most other hops do not improve with age, and therefore should be used within a year after harvest.

If your supplier makes an effort to keep hops in cold storage and provides the alpha-acid content to you, there is a good chance that the hops will be fine. If your supplier keeps hops on the shelf with malt extract, you should find a new source of hops.

When in doubt, chew up a few hops and you will soon sense if there is any zip left in them.

Processing Hops into Bales and Pellets

A question usually asked by a new microbrewer or homebrewer is, "What is the difference between baled raw hops and pellets, and which is better in brewing?" To explain the difference simply, a pellet is raw hop cones that have been ground and compressed into pellet form; baled hops are compressed but not ground. From my experience,

RALPH OLSON

neither process is better—it is a matter of personal preference considering the equipment the brewer intends to use. To look closely at the differences between raw hops and pellets, we need to start at the grower's ranch.

Before the hops arrive at a brokerage firm, they must be picked, cleaned, dried and baled by the grower. Typically hops grow on trellises 18 to 20 feet high. Work is being done with low trellises of about 10 feet. Paper string and/or Coiryarn is anchored to the ground and tied to the trellis above for the hops to grow on. At harvest, the string is cut and the vines loaded onto a specially designed truck for delivery to a picking machine. There the vines are unloaded, hung upside down and sent through a hop picker where the cones are mechanically plucked from the rest of the plant.

The cones then go through a series of cleaners while the vine is chopped up and deposited on a mulch pile located outside. The cleaners help separate the cones from the smaller bits of vine and leaves that the

Photo courtesy of the Benton County Museum

Many hop yard workers returned year after year, brought their families and personal belongings, and stayed the whole season.

picker tears off. The cleaned cones, meanwhile, are now ready to be dried from about 80 percent moisture when picked to around 8 percent when pressed into a bale. The kiln rooms use either propane or diesel furnaces. After the desired dryness is attained, the heat is turned off to let the hops cool.

The next step is the baling process. The loose cones are pressed almost like flowers in a book into a hop bale then covered with burlap or plastic. At this point, the raw hops are ready to be trucked to a warehouse. They will be sold to brewers who use raw hops in this same form.

When hops are pelletized, several bales are mixed together. At our facility, we like to mix around 10 bales per batch. This process of mixing hops that may be different in alpha-acid concentration gives a homogeneous end product. To pelletize, the compressed hop bales are broken up by machine. A vacuum system sucks up the lighter hop cones leaving heavier objects such as pieces of hop-picking machinery, rocks or vines. While U.S. hops are the cleanest in the world, such things do make their way into a bale occasionally. Using pellets eliminates the potential problem of any of this material getting into the brew kettle.

Next, the hops go through a hammer mill to grind them into a powder and a mixer to blend the bales. The mixed powder goes through a pellet die, a perforated circular drum which forms the pellets. The small loss in alpha concentration during the pelletizing process is partly because the pellet die creates some heat from the friction of pushing the hop powder through. We normally see about a two-tenths to three-tenths loss of alpha acids in the entire pelletizing process. After going through the die, the pellets go into a hopper that feeds them into cardboard cartons containing polyfoil bags. The typical weight of a carton is 44 pounds or 20 kilograms.

An additional advantage of pellets is that on a pound-for-pound basis they take up less cubic space. During the pelletizing process, the lupulin glands are broken up, causing some alpha-acid deterioration that some people feel gives harshness to the beer. Having a good filtration system is essential when using pellets, because the residue is much finer than raw hops.

When both bales and pellets are stored, they are refrigerated in the warehouse to prevent heat and oxidation from breaking down the alpha acids. Pellets packaged in polyfoil bags that eliminate oxygen are much more stable during storage than are raw compressed baled hops.

In conclusion, with either raw hops or hop pellets you can make a great beer.

Hop Products in 1990

Prior to late 1930 only one form of hops was used in brewing in North America—the standard American bale. Wrapped in burlap, the bale weighs slightly under 200 pounds and has a density of about 11 pounds per cubic foot.

Now, about 50 years later, brewers can choose from about 25 different products. A brief discussion of their characteristics and use follows.

Baled Hops

Despite the proliferation of hop products, more than 50 percent of the beer brewed in the United States is made with regular compressed hops. In fact, in North America all hops, even if eventually processed into pellets or extract, leave the hop farm as standard bales. This is a legal requirement, because hops cannot move in U.S. commerce before they have been baled. Largely because of reasons of transport and storage, various forms of recompressed bales came into limited use in the late 1930s. In one case, two normal bales are compressed to double density. Sometimes these are double wrapped in burlap with a layer of plastic between. This double bale, weighing about 400 pounds, is then encased in a wooden box. Because ocean freight is based on cubage, this cuts freight costs almost in half, and the package offers good protection from the elements.

Another form having similar advantages is the packing of a recompressed bale into a steel drum. Recompression damages hop quality because it breaks many more of the lupulin glands, exposing them to oxygen. The heavy double-compressed bales are awkward to handle, a problem that is aggravated if some of the bands break and the bale fans out at one end. These rock-hard bales are difficult to handle in the brewery.

The advent of pellets and extracts has largely displaced the recompressed bales, because they give even greater reduction in shipping costs and have other advantages as well.

Processed Products

The switch to processed products by many brewers was caused by a variety of reasons, including: improved storage life, uniformity of brewing value, improved utilization, decreased storage and transport costs and convenience.

The processing of hops into extracts actually preceded the commercial processing into pellets, but pellets represent less of a technical change. Significant use of hop extract dates back to about 1960 and pellets were introduced about 10 years later.

LLOYD RIGBY, PH.D.

Hop Pellets

In the simplest process, pelletizing involves breaking up the bales, separating a minor amount of extraneous material, grinding in a hammer mill, passing the powder through a pellet mill and packaging the pellets either under vacuum or with an inert gas atmosphere.

Type 90 is the most common type of pellet used, although use of Type 45 is quite substantial. These numbers distinguish between regular pellets and concentrated pellets and do not necessarily mean the processing yield. The numbers originated in Germany where the hops were given additional drying before processing, with consequent weight loss. The weight delivered from American hops is usually in the range of 95 to 97 percent. For concentrated pellets, the delivered yield is related to the alpha-acid content of the original hops and the customer's specification for delivery. The original concept of the Type 45 pellet was to enrich the hops by removing the fibrous portion of the cone and produce pellets with double the alpha acid and half the original weight. Some of the high-alpha hops available today will make a regular pellet higher in alpha content than a concentrated pellet from an aroma variety. It is not advisable to exceed 20 percent alpha acid in the pellets because at this point they are usually sticky and clump together.

Two other types on the market are the stabilized pellet and the isomerized pellet. In the first, the alpha acids combine with divalent metal ions, such as calcium and magnesium. This appears to stabilize the alpha acid molecule and improve keeping quality. If the amount of divalent ion, such as magnesium, is in the right molar ratio to alpha acid, and if the mixture is heated, isomerization of the alpha acids takes place. In this process the pellets are held at about 122 degrees F (50 degrees C) for one to two weeks to bring about isomerization. The resulting product gives significantly higher yield of hop bitters in the brewhouse and does not require the prolonged boil otherwise necessary to bring about isomerization.

A variation of the above process has received considerable attention in Britain, and is referred to as extrusion cooking. The hops are milled and the milled powder mixed with magnesium oxide. The mix enters a twin-screw extrusion device which is heated to accomplish the isomerization. The material is extruded through an orifice plate in the form of pellets. In the extrusion process the temperature reaches about 302 degrees F (150 degrees C), which is a rather drastic treatment. The extrusion process is reported to be more expensive.

Pellet Packs

Pellets can be packaged in evacuated pouches called hard packs, or evacuated and back-filled with inert gas, called soft packs. The hard packs need more protection from abuse or damage, so they are separately protected by a specially designed carton. Soft packs do not need so much protection and several may be placed like pillows in a large carton. The pouch in both cases is a multilayer laminate that is an excellent oxygen barrier. If the hard-pack pouch is damaged the pouch becomes soft, so a leaking pouch is easily recognized. On the other hand, the soft pack is less easily damaged, but a leaking pouch is not easily recognized.

Non-isomerized Extracts

The production of hop extracts in the United States began in the early 1960s. The solvents now in use are methylene chloride, hexane and carbon dioxide. In Europe ethyl alcohol also is used. All of these solvents make quite acceptable products for brewing, but some significant changes are taking place. Methylene chloride is rapidly being displaced because of fears about using a chlorinated solvent in food processing. Hexane extracts still are widely accepted. Nevertheless,

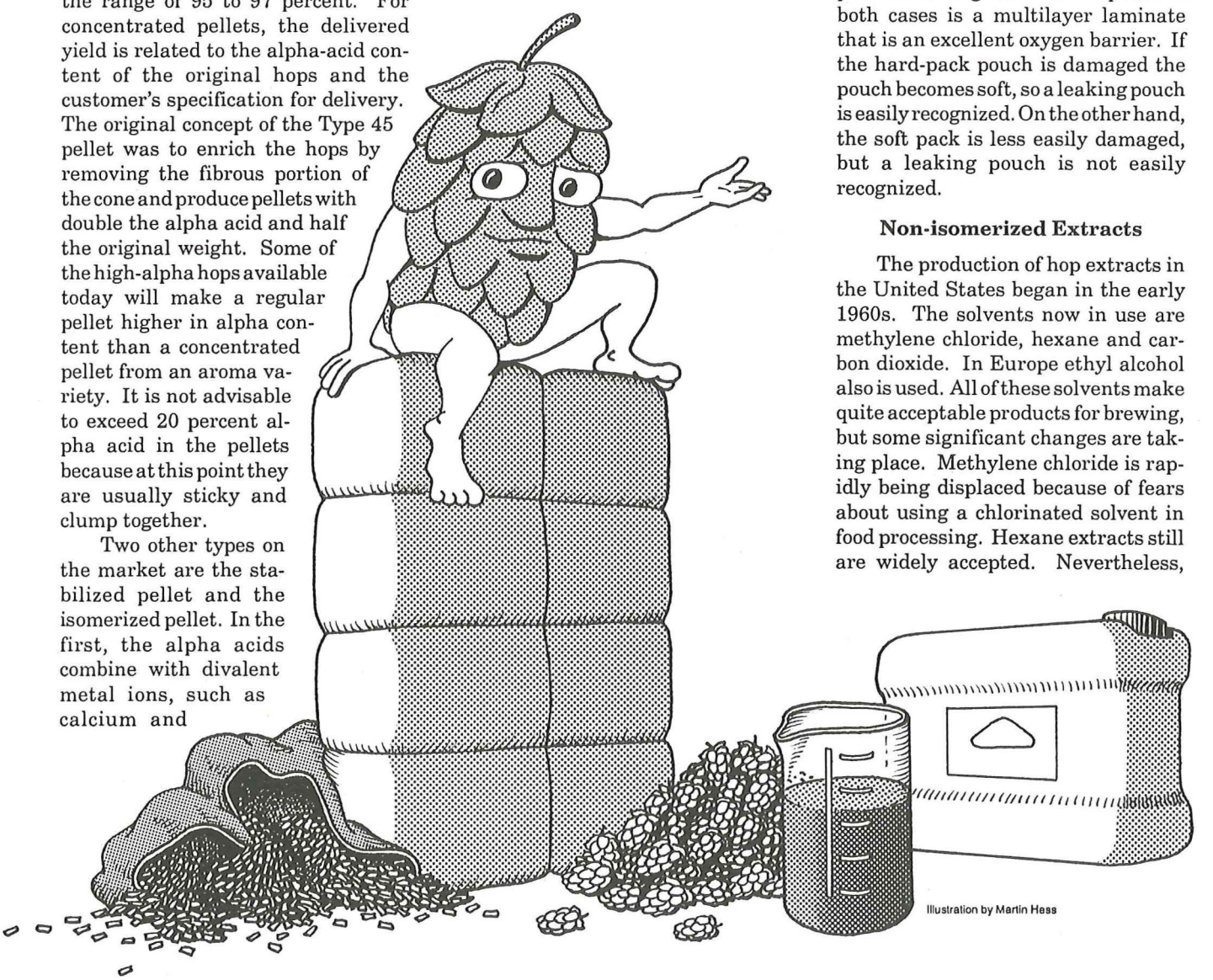


Illustration by Martin Hess

the brewing industry is sensitive to any connotation of chemical processing and, therefore, attention has turned to ethyl alcohol and to carbon dioxide. The use of ethyl alcohol as an extractant in the United States or Canada presents serious problems because of government restrictions. Furthermore, ethyl alcohol, being somewhat waterlike, extracts a substantial amount of non-resinous substances that some brewers do not want. Some isomerization of the alpha acids may occur during removal of the solvent, causing variable utilization. In addition, alcohol extracts are poor starting materials for subsequent processing into postfermentation isomerized extracts.

Hexane extracts will probably be accepted in the export market for many years to come, because there is really no technical advantage in carbon dioxide extracts, which are more expensive, at least until the initial high investment in a processing plant has been recovered. But demand for CO_2 extracts inevitably will increase.

Carbon dioxide may be used as an extracting solvent in either of two forms, technically referred to as subcritical and supercritical. Brewers are familiar with gaseous and liquid CO_2, and perhaps this is why it is acceptable to many brewers as an extractant for hops.

The main differences between the subcritical and supercritical processes and products are that the subcritical extraction is performed in the liquid state at pressures in the range of 300 to 700 PSI whereas the supercritical extraction is performed in the fluid gas state at temperatures above critical and pressure in the range of 3,000 to 4,000 pounds per square inch. The maximum solubility of alpha acid is about 0.8 percent at 50 degrees F (10 degrees C), in liquid CO_2 but in supercritical CO_2 the solubility of alpha acid is about 3 percent. Consequently the supercritical process gives a higher yield in a shorter time. By comparison, alpha acid is infinitely soluble in conventional solvents.

Liquid CO_2 does not extract chlorophyll and other pigments, whereas supercritical does. Thus the liquid CO_2 product is golden yellow and the supercritical product is green. This has no consequence in brewing. The capital cost of a supercritical plant is much higher because of the extremely high operating pressure.

Resin Extract and Dispersible Extract

Hop resins may be marketed as the undiluted resin with an alpha content anywhere from 30 to 50 percent, depending on the hops of origin, or they may be diluted to any lower alpha-acid content. If the brewer wishes to have the hop tannins, the dilution is made with a syrup obtained by extracting the resin-free hop residue with hot water. Corn syrup is used if the tannins are not wanted. So-called "dispersible" extracts can be made by appropriate formulation of resin and diluent, provided the alpha-acid content does not exceed about 20 percent. These extracts form a creamy yellow emulsion with hot water and are suitable for use in some types of dosage equipment.

Kettle Extract Packages

Kettle extracts come in a variety of package sizes, ranging from 0.5 to 200 kg. Custom packaging of partially filled cans also is done, and recently there has been a trend toward packaging a specific weight of alpha acids per can.

Isomerized Hop Extracts for Kettle Addition

Isomerized kettle extracts have appeared only recently. They are usually made by subjecting the entire mixture of resins and oils to the isomerization reaction. They give good utilization, about double that of non-isomerized extracts. They are cheaper to make and easier to use than postfermentation extracts. This is because the brew kettle is a great purifier, and anything not soluble in beer is removed by adsorption on kettle trub, yeast or filter aids. They do not offer the flexibility of the postfermentation type, which can be used to make flavor adjustments in the cellar.

Isomerized Extracts for Postfermentation Addition

These are made by isomerizing the alpha acids under controlled conditions, usually after first

separating them from the other hop constituents. They are usually marketed as a 20 or 30 percent solution of the potassium salts in water and are added to the beer in the cellar.

Another type of isomerized extract, called reduced isomerized extract, has been developed to minimize the so-called sun-struck effect, or skunky aroma, that develops when beer is exposed to sunlight. This flavor results from the splitting off of a side chain in the alpha-acid materials and combination of this side chain with a sulfur compound in the beer, catalyzed by sunlight, to form a mercaptan. If the carbonyl group in this side chain is reduced to an alcohol, the molecule is stabilized and the side chain does not split off. This reduction is accomplished using sodium borohydride in alkaline solution. The product is called dihydro isoalpha acid or rho isoalpha acid.

The isoalpha acid molecule has two isopentenyl side chains and in each of these there is a double bond. These double bonds can be reduced using hydrogen and a palladium catalyst. The resulting product is tetrahydro alpha acid. The tetrahydro form is noteworthy for the pronounced foam cling it produces, but some sun-struck protection also is provided. If these double bonds *and also* the carbonyl group are reduced, the product is hexahydro isoalpha acid.

Both dihydro (rho) and tetrahydro are currently being used in commercial brewing, but the hexahydro is not being used to a significant extent at this time. The relative bitterness of these iso forms, compared to normal isoalpha acids are:

Dihydro	80%
Tetrahydro	200%
Hexahydro	100%

Nearly all isomerized extracts are pourable liquids, usually the potassium salt in water, with or without stabilizers, and they are added postfermentation, preferably before final filtration.

Aromatic Oils

One of the questions most often asked by brewers is "How can I get more hop aroma in the beer?"

Hop aroma in beer means different things to different brewers. In the United Kingdom it is not uncommon to dry hop the beer, or even to add the steam-distilled whole hop oil to beer. But this produces a flavor and aroma that many North American brewers do not like, and the term "kettle hop aroma" is used to identify the desirable aroma. The problem lies in the fact that kettle boiling and fermentation have a selective action on the hop oils. Many components are eliminated and some are modified, so addition of whole hop oil can not produce the kettle hop aroma.

Products called "Late Hop Essence" are being offered in the market. Presumably these are fractionated hop oils in which an attempt has been made to simulate the selective effect of the brewing process. The extent to which this is achieved will govern the acceptability of these products. Certainly a suitable product would meet a great need in the industry.

The most widely used method of attempting to obtain kettle hop aroma is late hop addition. This is intended to ensure the survival of more of the hop oil components, and yet allow some of the selection and modification to take place in the remainder of the brewing process. The disadvantage of late hop addition is that most of the bittering power is lost because there is insufficient time for the alpha acids to be isomerized. This is avoided by using an isomerized hop pellet or isomerized kettle extract, which can be added near the end of the kettle boil with no sacrifice in bittering power. At this time it has not been adequately confirmed in commercial brewing that the isomerization processes used to make isomerized kettle products have no detrimental effect on the oil composition.

Liquid CO_2 extraction provides another possibility of obtaining an oil-rich product for late kettle addition. The hop oils are more readily soluble in liquid CO_2 than are the alpha acids, and the first washes of a charge of hops in the extractor are relatively rich in oils. The selectivity is not perfect, and some alpha and beta acids are also present in this fraction. But the process can provide a late hop oil addition with much lower sacrifice of the bittering components.

Hop Oil Equals Aroma and Flavor

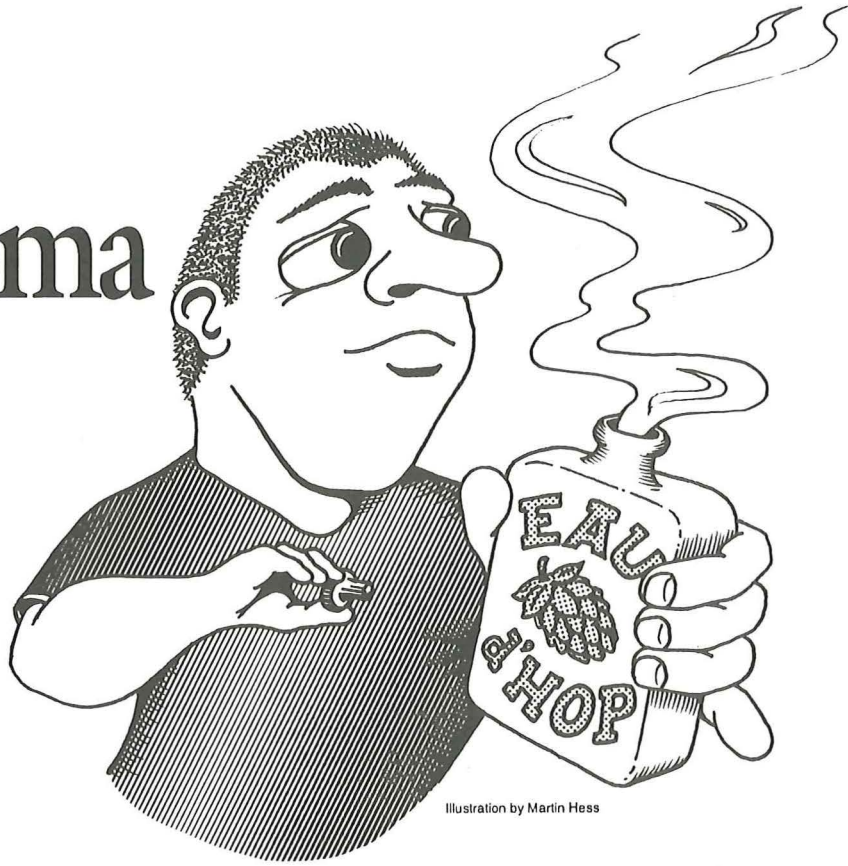


Illustration by Martin Hess

Brewing is chemistry. The chemicals in hops impart much of the aroma and flavor so important to beer. The legal definition requires the use of barley malt, yeast and hops in order to call the beverage beer.

The chemistry of hop aroma in beer is not well understood, despite the effort that has been expended on the study of hops, and the large number of reports that have been published in the technical literature. In fact, it is difficult to agree on what is a hoppy aroma. The aroma of a dry-hopped English ale has little in common with a Pilsener made with aroma hops added late in the kettle boil.

Various hop compounds have been reported to contribute to a hoppy aroma when added to beer. It is generally accepted that aroma is the result of many different volatile compounds interacting; this complex of sensory impressions is the hoppy aroma.

In homebrewing, hop aroma is achieved by adding hops near the end of the wort boil. If the addition is early in the boil, most of the volatile compounds will be lost with steam. For this reason the hops used for bittering are usually different from those used for aroma. It takes significant boiling time to get the alpha acids dissolved in the wort isomerized for bitterness. Hops added only near the beginning of the boil will contribute to aroma at a barely detectable level.

This has been demonstrated at breweries making typical American-style lagers. Most American lagers have a hop aroma that is light and delicate to match the style of the beer. It is possible to add bitter hop acids that have been separated from all the volatile aroma compounds. A taste comparison shows that there is "something missing" in the beer made without hop oils, although no specific characteristic can be described.

The essential oils of hops, the volatile components, produce the hoppy aroma and flavor in beer. They are not the hoppy aroma in themselves. These components can be isolated from ground hops by steam distillation and are commercially available. However, when they are added to beer the aroma is rather unpleasant; it is the wrong aroma. This naive approach to producing hop aroma assumes that the brewing process has no effect on the mixture of volatiles derived from the hops. The hop aroma of beer is nothing like that of hops. Even rather cheesy smelling hops can sometimes be used to give a pleasant aroma to a homebrew.

In the brewing process, the hop components undergo a series of changes. The most obvious change is the loss of very volatile compounds by evaporation in boiling. The chemical processes of oxidation, hydration and rearrangement modify the compounds extracted from the hops. To make things even more complex, yeasts also transform these compounds. Hop aroma is the perceived aroma due to a large number of different chemicals that are produced in brewing.

To make some sense out of the complex chemistry of hop aroma, I am going to divide this article into discussions of the chemicals in hop oils, detecting hop chemicals in beer and other useful information.

GUS GUZINSKI

Chemicals in Hop Oil

Cultivated varieties of Humulus lupulus produce hop cones that contain 0.5 to 2.0 percent essential oil. There is a great range of values for the amount of essential oil within a given variety, depending on growing location, climate, year and especially age of the hops. Hop oil deteriorates very rapidly during storage of whole hops.

For brewing purposes, hops usually are divided into bittering hops that are high in alpha acids and added near the beginning of the wort boil, and aroma hops, which are lower in alpha acids and added near the end of the boil.

Aroma hops need not be higher in essential oil content but they need to contain the right compounds. Unfortunately, no one has been able to determine accurately what these compounds should be. A hop variety is categorized as an aroma hop because test brews have shown that it gives the aroma the brewmaster wanted. This is a very practical approach.

Analysis of the chemicals present in hop oils should be predictive of the hop aroma. Flavor research is not so simple. Three compounds—myrcene, caryophyllene and humulene—make up approximately 80 to 90 percent of all hop oils. No combination of these three compounds, when added to beer, will produce an aroma that could be described as hoppy. Myrcene gives a sharp aroma like turpentine. Myrcene is part of dry hop aroma. In the range of 10 to 50 parts per billion, it imparts a sharpness to the aroma and improves the "nose" of beer. It can repeat on you, causing "myrcene belch."

Caryophyllene and humulene impart resinous, woody flavors. These three compounds give most of the aroma that would be produced if a typical steam-distilled hop oil were added at bottling.

The three major compounds have been used as markers in breeding of new aroma hops. Most aroma hops have relatively high amounts of humulene compared to the other two compounds; Hallertauer mittelfrüh and Tettnanger are examples. Eroica hops used to be considered as aroma hops even though they are extremely low in humulene; their flavor contribution is rather weak and floral.

Because a high level of humulene is present in traditional aroma hops, this has been used to select for hybrids that are more likely to be aroma hops. This reduces the number of test brews that must be made from the hundreds or thousands of seedlings which are grown. Only the seedlings having a high humulene content are worth testing. Initial reports from the large breweries have been very positive about the aromas produced using newer hybrids developed by recent breeding work.

The three major chemicals do produce many pleasing scented compounds upon oxidation. These oxidation products are often much stronger flavors; that is, they have a flavor impact when present at much lower concentrations. This oxidation can occur under controlled aging of hops and also in the wort kettle.

A few hundred minor compounds have been identified in hops. The most important conclusion from this research has been that hop aroma is the result of the interaction of several different compounds.

A few of the classes of compounds are worth examining. There are many floral scented chemicals in hops. Linalool (which smells like carnations) and geraniol (roses) are good examples of oxygenated terpenes. A floral component in the total aroma profile can increase the apparent hoppiness if not overdone. Cascade hops are unusually high in geraniol and related compounds; this is the source of the perfume aroma produced by the high addition of this variety.

Other terpenes give pinelike aromas as in Chinook hops and citrus aromas as in Cluster hops. As with most aromas, the freshness of the hops makes a big difference.

Many esters are present in hops. In general they have fruity aromas. Some are very characteristic of certain fruits such as apple or banana or pineapple. Others tend to give a stale aroma.

Fatty acids give the sweaty, cheesy aroma of old hops. Some conversion to esters occurs in fermentation but many survive in the final beer. Besides damaging the aroma of beer they also can ruin the foam. Larger fatty acids also go rancid, producing aldehydes that cause wet paper or cardboard aromas—oxidized aromas.

Sulfur compounds are present in very low quantities in hops; however, some have flavor thresholds of a few parts per trillion. The grapefruit aroma produced by late hopping with bittering hops may be caused by these compounds. Incidentally, skunkiness is formed when the bitter hop acids (isohumulones) are exposed to light and then react with sulfur-containing proteins. Skunkiness is not caused by hop oil.

Detecting Hop Compounds

Beer is a very complex mixture to analyze. Individual hop-derived compounds are present on the order of one to one hundred parts per billion. With modern analytical instruments, this level of chemicals can be detected very easily. In water, part-per-trillion levels often are reported. Beer has fermentation by-products such as fusel alcohols and esters that are present in the part-per-million level and obscure the hop compounds. It is difficult to find trace hop compounds when large amounts of other compounds are present.

The common approach is to compare unhopped beers to beers made with different hops. Some set of the chemicals unique to the hopped beer must cause the hop aroma.

The main instrument used to separate and detect the hop aroma compounds is the gas chromatograph. This separates compounds by their volatility. Note that a compound must be volatile to have an aroma; the compound has to reach the chemically sensitive receptors in the nasal passages before you can smell it. Once a compound has been separated and identified, it can be synthesized or isolated from hops. In this way each chemical can be added to an unhopped beer to determine its aroma in beer. It is certain that none of the detected hop compounds are responsible for hop aroma, although some do contribute to it.

The literature about the detection of hop oil in beer is somewhat contradictory. The results depend somewhat on the method used to separate and concentrate the hop components from beer before injection on the gas chromatograph. Two approaches

Photo courtesy of the Benton County Museum

Weighing-in. The weight of each bag of pickings was recorded in the log book.

are most common. In one case, a water-insoluble solvent is used to extract the compounds from the beer. In the second case, a stream of nitrogen gas is used to wash the volatile compounds out of the beer and onto an absorbant.

Other Useful Information

Controlled aging of hops can improve aroma hops. This is not a recommendation for the use of old hops. If you are buying hops in less than bale quantities, they are sure to be aged enough. They should be kept in the freezer with no exposure to air to maintain quality. Aging of hops may be a good idea if your hops are home grown. After harvesting, hops should be dried to remove enough moisture so that they will store without molding. The slightly dried hops should be sealed in freezer-type plastic bags with as much air as possible removed. Aging in the dark at room temperature or below will cause oxidation and improve the aroma. The trick is to get a small amount of slow oxidation. If the hops develop a cheesy aroma, you have gone too far. After aging, the hops should be stored in a freezer in airtight containers. Of course, bittering hops won't improve much in aroma by aging and they will lose alpha acids.

The homebrewer should purchase the freshest hops available. Unfortunately, this is difficult in some parts of the country. I still see bags of hops sitting on open shelves in homebrew stores. These hops have usually deteriorated beyond cheesy, beyond rancid, to aromaless. There is nothing to be gained by adding such hops for aroma.

It would be pointless for a homebrewer to make hop oil. Steam distillation is fairly easy to do but has no advantage over the addition of the whole hops to the kettle.

Hop oils are commercially available, although rather difficult for the homebrewer to use. The maximum amount of hop oil that is palatable in a bottle of beer is about two parts per million. In a 355 milliliter bottle (12 ounces), this is 0.0007 grams or 0.000025 ounces. This amount can only be added in a dilute solution. ***zymurgy*** carries ads for such products. Even five gallons of homebrew will take less than 0.04 grams of hop oil if added after fermentation.

If hop oil is going to be added after fermentation or just before bottling, it is important to realize that not all hop components are desirable. The flavor will not be modified by the brewing process and can be raw and harsh. A good hop oil to use in this case is one that has been redistilled and blended for a selected flavor profile.

With wort addition, the choice of hop oil is less critical because brewing modifies the aroma and will remove many off-flavors present in lower grades of hop oils. However, it is important to get the hop oil dissolved in the brew. All hop oils are insoluble in wort and in beer. Direct addition of the oil to boiling wort would form an oil slick on the surface and not incorporate the oil into the brew. Hop oil may be dissolved in an edible solvent like ethanol before addition to the wort. It is not possible to predict the amount that will be lost in boiling and fermentation or the actual flavor produced from the hop components added. Brewing remains an art.

Hop aroma of beers changes with time. This is true if live yeast is present or if the beer has been filtered and pasteurized. In general, the hop aroma decreases with time. Homebrewers can tone down hoppiness by storage at 60 to 65 degrees F (15.56 to 18.33 C). When the desired level is achieved, beer can be stored near freezing to slow aging. The beer should be allowed to warm slightly before opening, because very little aroma can be detected in a very cold beer.

Hop aroma is a complex interaction of many chemicals derived from hops. It is the complexity of the sensory impressions that make a good beer so enjoyable. There are many types of hop aromas, just as there are many styles of beers. For this reason, it is better to refer to an aroma as dry hop, floral hop, herbal hop, spicy hop, etc. I have often heard the phrase "noble hop aroma." I am not certain what it means but I like the sound. What could be more noble than the aroma of homebrewed beer?

Growing Hops at Home

Ten years ago I was introduced to homebrewing and the magic of hops. At that time two kinds of hops were being sold. One was for bittering and the other for finishing. They did not even have names. Needless to say that after being on the shelf who knows how long, their only use was for bittering. Later, I found out different varieties of hops grew in faraway places. I imported some and was hooked. Hops were grown near Montreal before and during World War II, but the farms gradually faded away. One fall while driving down a country road I noticed what looked like hop cones dangling from the limb of a tree. A quick stop showed they were hops, although dried and stale.

I had become interested in plants and gardening and was taking courses at the Montreal Botanical Garden. The following spring I was given a small hop cutting and quickly put it to work in my garden in the mountainous area north of Montreal. I trained it around a tree and by the middle of July the small cones were growing. I could just imagine them in the brew kettle. By the time they had a dry, papery feel, which means they have attained maturity, we had a hot, humid spell and they were covered with aphids. I quickly gathered and dried them, making a hop tea to sample their flavor, but there was none. At best it tasted and smelled like dried hay. Of course this was an unknown variety, but at least I knew they could be grown.

The following year I acquired rhizomes of the following varieties: Tettnanger, Willamette, Cascade, Perle, Hallertauer, Hersbrucker and Bullion. I had prepared a special spot the previous year by weeding and feeding with generous amounts of compost and manure. Because the garden is in an open area, I decided the best way to train them would be on a post. I had some angle iron welded to steel rebar rods, drove them into the ground and bolted a two-by-four to them. I did not expect a crop the first year, so I made lots of cuttings and by fall had more that 50 small plants

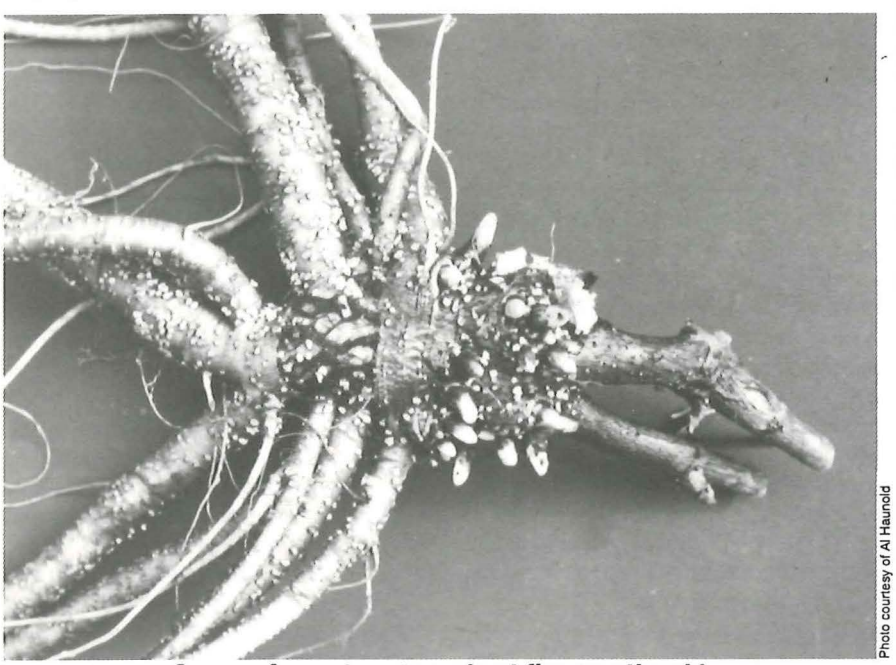


Photo courtesy of Al Haunold

Crown of a root system about five months old. Note buds for next year's growth.

PIERRE RAJOTTE

Photo by Charlie Papazian

Hop shoots springing forth.

ready to add the following season. The best plants grew to as high as 14 feet and produced a few cones.

To prepare ground for the new plants, I used a method that was successful in the vegetable garden—covering the ground with flattened cardboard boxes in the fall. Soon most of the vegetation disappeared and the ground was ready without tilling or weeding. By springtime everything was ready. I just dug holes through the decomposing cardboard and put the plant in the ground. Every year I add more cardboard to keep my hop field permanently weed free and maintain moisture during dry spells. The decomposing cardboard is just organic matter anyway. Of course if you do this on your front lawn your neighbors might not appreciate the looks.

I was looking for spring eagerly. A week after the snow was gone, I was in for the first treat of the hop grower—fresh hop shoots. Each plant produces about 20 shoots. When they are about three to four inches long, before the leaves start to open, you cut off all but the two best shoots. The biggest one will be about the size of a pencil. If you want them longer, just make a small mound of soil over the hill the previous fall and they will grow underneath. When the first one sticks out of the ground, remove the mound carefully and cut off the white shoots. Clean them, put in a pan and bring the water to a boil. As soon as it boils, dump the water and add fresh, boil again, simmering for a few minutes until tender. Serve with butter, fresh chives and voilá, a fresh springtime treat.

With all these new plants, I decided that it would be better to string them on wires like in the big hop fields. Not having the equipment to drive big posts into the ground, I ran some steel wire from trees instead. This worked OK—they would move in the wind with no harm. I have used this system for three years but gradually am switching back to posts because when tied to wires the wind unwinds the vines and they break. They seem to have a better grip on poles than on wires. My system of overhead wire was about 14 feet off the ground but would sag to 10 feet in places. The plants on poles grow to almost 20 feet and produce a bigger crop. When it was hop gathering time it was quite a job to untangle the vines from the wire.

Now I drive a 6 to 8 foot steel bar into the ground. It can be anything—old pipe, angle iron or rod. When it is firmly in place I twist tie to it a 15 to 20 foot post using old electrical wire. For posts I use trees I cut in the fall from the nearby forest where they grow

lean and tall. When I cut off the limbs I leave four-inch stubs on the main trunk to support the hops, especially when they are loaded with cones and it rains. I sharpen the posts and drive them just a few inches into the ground. When attached to the steel rod they stay firmly in place. When gathering the crop untie the electrical wire, cut the hop vines and take the whole post to the crew of pluckers.

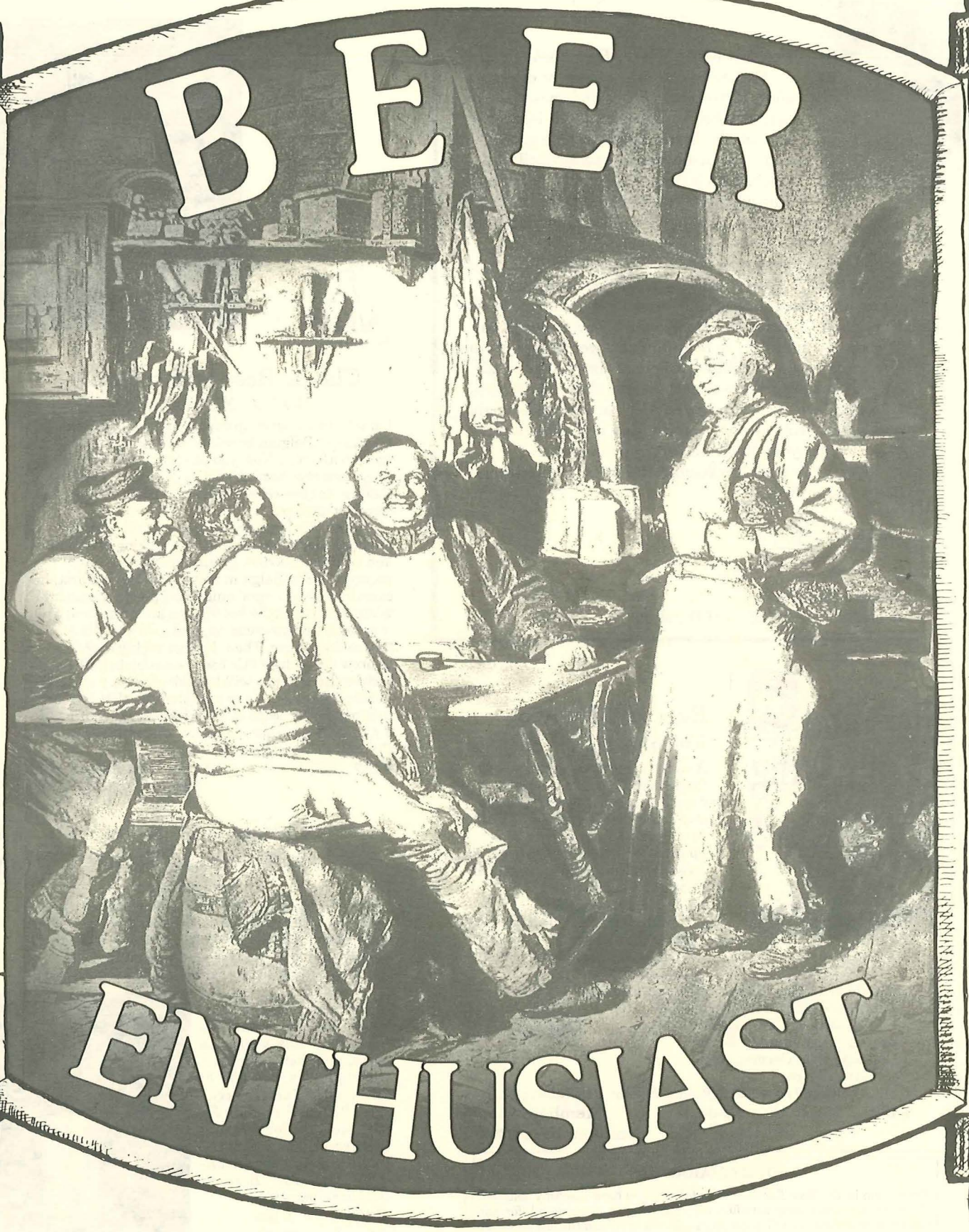
The earliest varieties are the European ones—Tettnanger, Hersbrucker and Hallertauer, all ready around Aug. 20. A week later the Perle, Willamette and Fuggles are ready, followed by Cascade and the high-alpha varieties, Nugget and Eroica. Except for my first year with an unknown plant, I have not encountered serious disease or insect problems. The European varieties have been totally aphid free. I have only found aphids on Cascade but not every year and only when the cones were drying. The average summer temperature is on the cool side. Days can get as warm as 95 degrees F but nights are always below 70 and usually below 60. Apart from aphids, I have encountered caterpillars that sometimes chew a few leaves, and an unknown insect that sometimes chews part of the ripe cones. I do not use any spray on my plants and I only feed them with compost or manure applied once a year.

Now that I have grown and used hops for a few years, I can draw some conclusions. My favorite varieties are the European ones. They give the best crop, have been disease and insect free and have the best aroma. I use Perle as a bittering hop almost exclusively now. It gives a nice crisp taste without annoying side flavors. Cascade produces the biggest crop, more than two pounds per plant dried, but it has too much of what the Europeans call the American taste. It is more pronounced than in the Cascade grown on the West Coast, so I use it sparingly as a bittering hop only. Willamette, which is supposed to be a good cropper, has produced very low yields although the quality has been good. For aroma Hersbrucker is a real winner. I always run out of it and every year I have to add new plants. Hallertauer is very similar to Hersbrucker. Tettnanger yields less, but the aroma is very delightful.

I have tried other varieties but the quantity has not been sufficient to evaluate properly. To dry the hops, I lay them on flat screens in a room out of the sunlight. After four days of air drying, they are ready for storage. I compress them in plastic bags, put them in airtight metal containers and freeze them. The first year I used them, I was in for quite a surprise. I expected the bittering value to be low, but to the contrary they were much more bitter than those I had purchased. So much so that I reduced the amount to not more than 4 ounces of Perle for bitterness in 25 gallons.

Although on occasion I use commercial hop varieties, I prefer them in pellet form. I believe pellets are better than whole hops, which are best when fresh, but lose their value very quickly if not kept cold or frozen. With home grown, you know how fresh they are.

BEER ENTHUSIAST



Vol. 1
No. 3
1990

Winter Catalogue $1

Welcome to the Winter *Beer Enthusiast*!

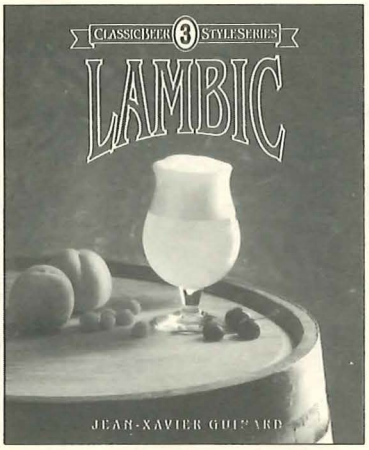
Fall and Winter is a time for celebrations, festivities, parties and seasonal specialty beers. For brewers, it is often an occasion for breaking open some special beers that were stashed away until they reached their proper maturity. It is also a time when we take advantage of the colder days and brew up the beers for the following spring and summer. It is indeed a festival season.

We're bringing you the Fall-Winter *Beer Enthusiast* with the same festive feeling. We have several new items that will enhance your brewing experience. A new video from Canada, *The Homebrew Video*, is one of the best productions for the beginning brewer to see. We are also quite proud to debut a couple of books which will enrich your experience of some world class beer styles. Of course, we're continuing to offer our many items and books that bring you the information and entertainment you want for your beer and brewing pleasure.

Enjoy our *Beer Enthusiast* and enjoy your winter beers and brewing.

Fermentingly,

Charlie Papazian
President, Association of Brewers



NEW

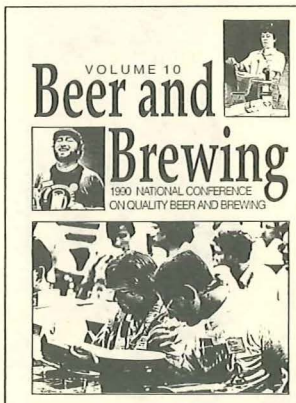
Classic Beer Styles: Lambic

by Jean-Xavier Guinard

Lambic: this beer conjures up images of the exotic, of traditional Belgian brewing, of the rich flavor of beer made with fruit. Now you can learn how to successfully brew this beer at home—or in your small commercial brewery—with these practical step-by-step instructions.

Jean-Xavier, a research associate with Dr. Michael Lewis, has studied the making of lambic—and its cousins kriek, gueuze, framboise, and peche—both in Belgium and at UC-Davis. First, he examines these beers' unique origins in a country where spiders in the brewhouse are protected, fruit is a must for fermentation, and wild yeast is a national treasure. Then, he thoroughly explains how to brew these dramatic beers—complete with recipes. Beer lovers will love his directory of Belgian lambic breweries. An incredible book that is bound to broaden the scope of American brewing. *5 1/2 x 8 1/2, 180 pp., illus., softcover. Available Dec.1. Brewers Publications, 1990.*

#437 10 oz. Members $9.95
Nonmembers $11.95



Beer and Brewing Volume 10 (1990)

A whole conference at your fingertips! That's one way to describe this transcription of the conference held in Oakland, Calif. In this valuable reference book, an array of brewing experts speak directly to your need for practical information on brewing techniques. Topics include:

- New Brewers and Their Products
- Yeast Culturing
- Quality Assessment for Homebrewers
- Going Pro in Your First Commercial Brewery
- Instructions for Infusion Mashing
- Secrets of Beer Carbonation
- Brewing High-Quality Beers
- Learning from German Beers
- and Much More.

NEW

5 1/2 x 8 1/2, 260 pp., illus., softcover. Brewers Publications, 1990.

#432 12 oz. Members $18.95
Nonmembers $20.95

Classic Beer Styles: Continental Pilsener

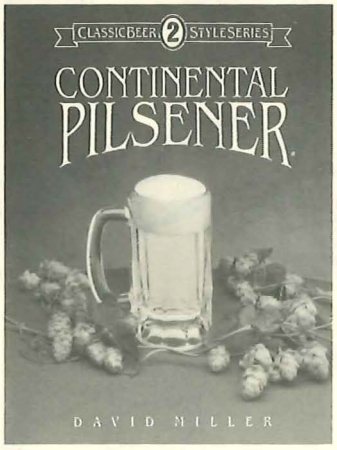
NEW

by David Miller

This revolutionary beer style changed the course of brewing when its brewers in Plzen, Czechoslovakia, introduced it to the world. It's a clean, refreshing style you know, you love, and you can brew to perfection **as it ought to be made** with this guide.

Award-winning homebrewer and author, David Miller examines the history of this venerable style, and then guides you through the process of brewing it. Includes recipes. Required reading for the bottom-fermenting brewer. *5 1/2 x 8 1/2, 120 pp., illus., softcover. Available Nov. 15. Brewers Publications, 1990.*

#434 9 oz.
Members $9.95
Nonmembers $11.95



OUR GUARANTEE

Every item in the *Beer Enthusiast Catalogue* has been carefully selected. If you are not completely satisfied with the product you ordered, for any reason, at any time, we will promptly replace it or refund the full purchase price.

Association of Brewers • PO Box 287 • Boulder CO 80306-0287 USA
(303) 447-0816 • FAX (303) 447-2825 • Office hours: M-F, 9-5 MST

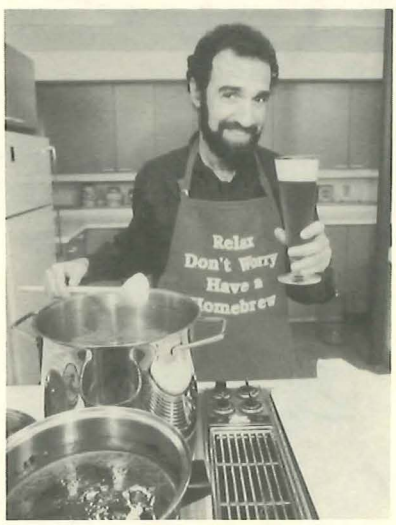
Homebrew Video NEW

Brew with the masters!

There's nothing like hands-on training for learning an art, and in this three-part, 90-minute, home studies course, acclaimed homebrewer Charlie Papazian, author of *The Complete Joy of Homebrewing* and publisher of ***zymurgy*** magazine, demonstrates the complete process of brewing for you. Is there a clearer, more comprehensive way of learning to brew? We don't think so!

Charlie shows the required equipment, ingredients and techniques for brewing, then several other homebrewers tell you their brewing secrets. Finally, two brewmasters share their tips with you, one of whom takes you behind-the-scenes at his brewpub in Toronto.

 # 325 10 oz. $29.95



Old Nick

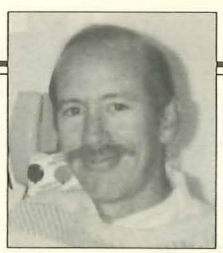
"A Devilishly Good T-Shirt"

You won't have to sell your soul to get this bold, colorful T-shirt commemorating Old Nick, "a devilish brew." For the first time ever, Young & Co. Brewery in London has allowed us to bring you this outstanding T-shirt. The sponsor of the Barley Wine Category in the National Homebrew Competition, Young's own brew is internationally renowned. Bound to become your favorite, this shirt is black with a brilliant five-color logo on front. Sizes M, L, XL

NEW

#929 8 oz. $12.95

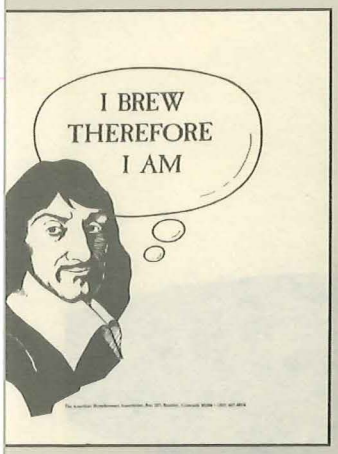
Association of Brewers



Charlie Matzen
co-founder and member of the Board of Directors of the Association of Brewers

I took a beermaking class from Charlie Papazian. I had always liked beer, and the course sounded interesting. Charlie and I were both teachers at the time and became good friends. We traveled to Hawaii together, and while sitting on a beach drinking some homebrew, we decided to create a brewing magazine. That was the first issue of ***zymurgy***. I had always enjoyed writing and cooking, so the magazine came together naturally. We had very little idea of what we were doing—it was just whatever we thought a magazine should look like. Charlie and I did everything those first few years from paste up to photography and layout to distribution. There were pages of ***zymurgy*** totally covering Charlie's floor as we did paste up. There were many late nights, typing, addressing and sorting by zip code. We created it as a hobby not even thinking it would become full time. Very quickly, other people got involved and took over the mechanics of the publication. From the first issue of ***zymurgy*** came the American Homebrewers Association. As the Association grew, it became apparent that one of us would have to quit his job. Charlie did, and I continued teaching. At some point, I shifted from production to being a board member. Many of the original articles were done tongue-in-cheek—mostly we were writing for a local audience of people who had taken Charlie's class and knew him directly. It was quite a bit different then. Now, ***zymurgy*** articles are much more informational and provide greater variety.

Wear the Colors



I Brew Therefore I Am Tee

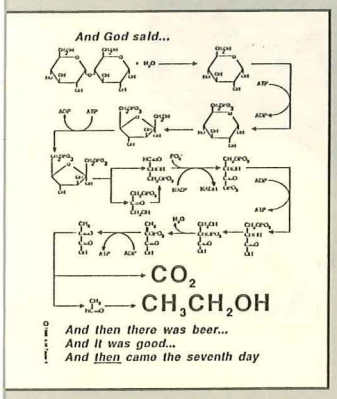
Wear this variation on a classic theme and no one will dispute it—especially while its author, the great French philosopher René Descartes, stares boldly back. 100% cotton T-shirt is mint green or white with black letters. Sizes: S, M, L, XL.

Mint green #117 8 oz. $10.95
White #118 8 oz. $10.95

Beer Formula T-shirt

See what He did before He relaxed—The chemical composition of the Earth's most divine creation is vividly displayed on this 100% cotton shirt. And it was good. Black on white. Sizes: S, M, L, XL.

#113 8 oz. $11.95



Wild Boar Special Amber

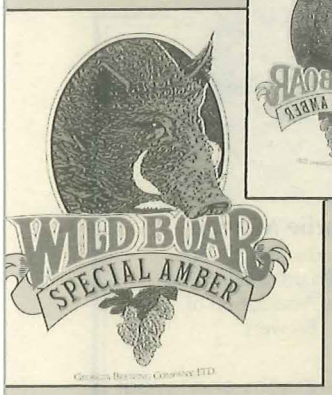
The Georgia Brewing Co., Atlanta, Georgia. Be caught alive in one of the wildest, most unique beer T-shirts we've ever seen. The front boasts the head of a wild boar and the Georgia Brewing Co. emblem. The back? The backside of the boar, of course! Four-color design on white. Comfortable, easy-care, 50/50 cotton blend. Sizes: M, L, XL.

#926 8 oz. $13.95

Great Turkey T-shirt

BREWER'S KEEPSAKE—This great design made the AHA famous. Wear the high-quality cotton shirt with its colorful logo, and you'll join the legendary legion of American homebrewers. Tan with four-color logo. Sizes: S, M, L, XL.

#103 8 oz. $12.95



Pecan Street Lager

Distinctive two-color design on a top-quality, white, 100% cotton T-shirt. Front: "Hand Crafted Pecan St. Lager, Austin's First Since 1878. The Old City Brewing Company." On the back in bold letters: "BEER... If You Can't Taste It, Why Bother?" One of the most popular T-shirts at the 1989 Great American Beer Festival. Sizes: M, L, XL.

#927 8 oz. $12.95

Beer ... If You Can't Taste It, Why Bother?

Relax Sweatshirt

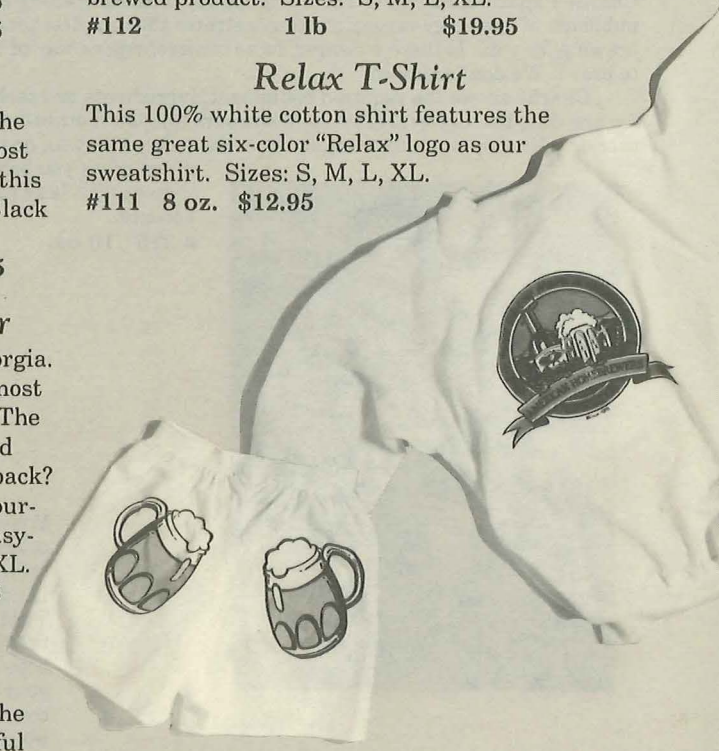
Made of easy-care poly-cotton, this heavy-duty sweat shirt is perfect for relaxing on those cooler days. Emblazoned with six-color "Relax. Don't Worry, Have a Homebrew!" logo, featuring a scenic vista, hops, grains, and the final home-brewed product. Sizes: S, M, L, XL.

#112 1 lb $19.95

Relax T-Shirt

This 100% white cotton shirt features the same great six-color "Relax" logo as our sweatshirt. Sizes: S, M, L, XL.

#111 8 oz. $12.95



Homebrewer Boxer Shorts

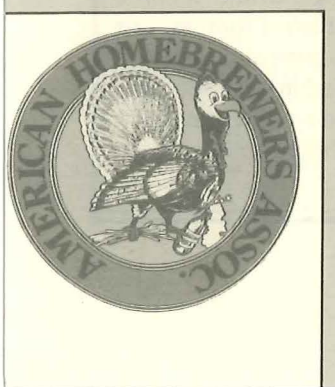
Drop your pants with pride — Get into these comfortable, 100% cotton, His and Hers designer boxer shorts. The two-color design shows two mugs toasting each other, one on each cheek, with the "Relax" motto on the left thigh. Baby your buns with the best, and don't forget a matching pair for your main squeeze. Sizes: S, M, L, XL.

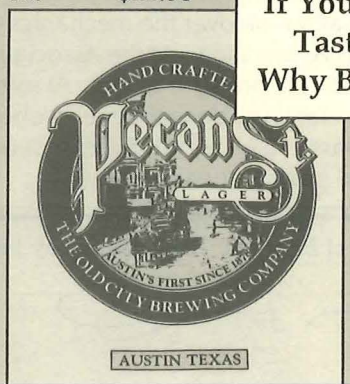
#206 3 oz. $9.95

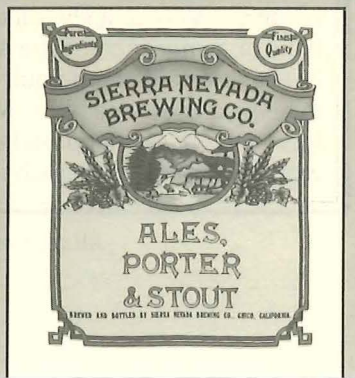
Sierra Ales, Porter and Stout

Sierra Nevada Brewing Co., Chico, Calif. Brilliant yellow, orange, green and blue logo of mountain scene on red shirt. 100% cotton. Sizes: M, L, XL.

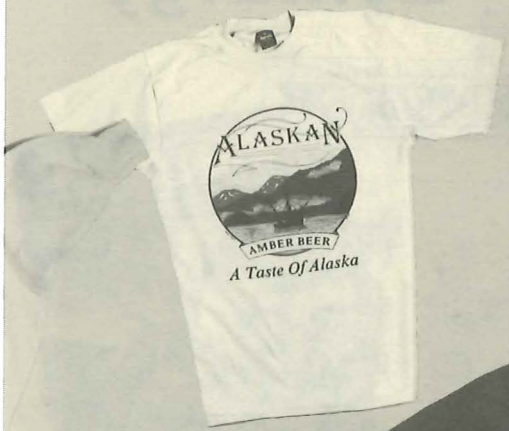
#908 8 oz. $12.95







of the Seasons.



Alaskan Amber

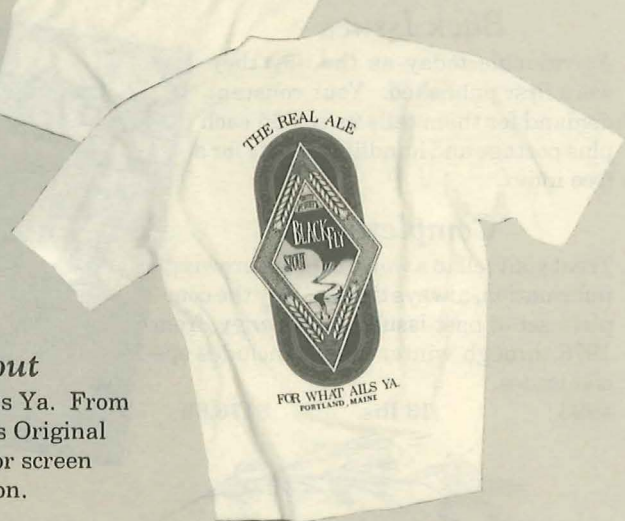
Alaskan Brewing Co., Douglas, Alaska. Elegant rendition of a schooner in green, gray and maroon on aqua shirt. 100% pre-shrunk cotton. Sizes: M, L, XL.

#907 8 oz. $12.95

Red Tail Ale

Mendocino Brewing Co., Hopland, Calif. Marvelously detailed hawk holding hops and wheat in its talons. Russet hawk on ecru T-shirt. 100% cotton. Sizes: M, L, XL.

#916 8 oz. $13.95



Old Nick (NEW)

"A Devilishly Good T-Shirt"

You won't have to sell your soul to get this bold, colorful T-shirt commemorating Old Nick, "a devilish brew." For the first time ever, Young & Co. Brewery in London has allowed us to bring you this outstanding T-shirt. The sponsor of the Barley Wine Category in the National Homebrew Competition, Young's own brew is internationally renowned. Bound to become your favorite, this shirt is black with a brilliant five-color logo on front. Sizes M, L, XL

#929 8 oz. $12.95

Black Fly Stout

The Real Ale For What Ails Ya. From Gritty McDuff's, Portland's Original BrewPub. Dramatic 8-color screen design on front. 100% cotton. Sizes M, L, XL

#928 8 oz. $13.95

Institute for Brewing Studies

Brad McQuhae
member of the Institute for Brewing Studies Board of Advisers

I'm a consultant as well as an equipment supplier with Newlands Services Inc. We install microbreweries and pubbreweries. I'm also the Vice President of the Canadian Independent Brewers Association. After four years of study in biochemistry, I started with Spinnakers in Victoria, B.C. Canada in 1984. I've been on the Board of Advisers of the IBS for three years now. The IBS is both important and useful for this new industry. Since the industry is so new and growing so fast, we need one point we can turn to, and the IBS is a handy information source. If we didn't have it, there would be factions all over the world and a lot of confusion. The IBS provides an identity for the whole industry, including both beginning and ongoing breweries. The IBS's National Microbrewers Conference is a great place for establishing contacts and meeting competitors. The Great American Beer Festival is an excellent opportunity to compare beers and to get to know brewers. I can see the IBS setting up policies and standards that can be used to insure quality in the new small brewing industry.

Zymurgy

Membership/Subscriptions

American Homebrewers Association membership includes:

- ***zymurgy*** (five issues annually).
- Discounts to the AHA National Conference.
- Discounts on Brewers Publications books.
- Free information to help you brew better beer.
- Discounts on the AHA Sanctioned Competition Program.
- Support for the Beer Judge Certification Program.
- Representation of your interests at beer conventions.
- Support for AHA efforts to educate the public about homebrewing and beer appreciation.

#701 One year	**$21.00**
#702 Two years	**$38.00**
#703 Three years	**$57.00**
#704 One year foreign	**$26.00**
#705 Two years foreign	**$43.00**
#706 Three years foreign	**$62.00**

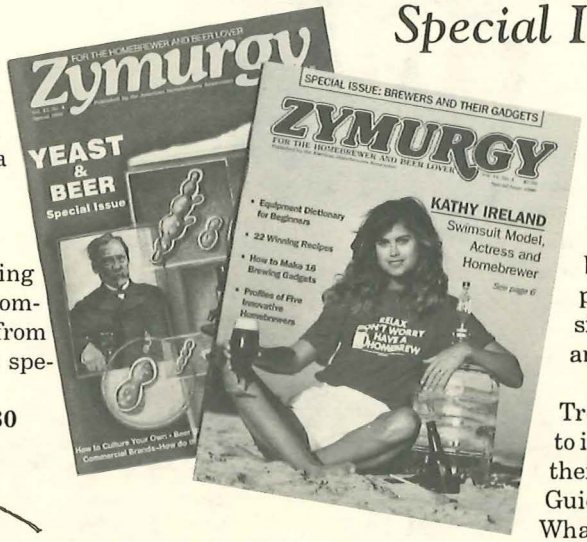
Back Issues

As valuable today as the day they were first published. Your constant demand for them tells us so! $5 each plus postage and handling. Write for a free index.

Complete Set

Treat yourself to a world of great brewing information, always timely. Buy the complete set of past issues of ***zymurgy***, from 1978 through winter 1989. Includes special issues.

#798 13 lbs. $176.80



Special Issues

Troubleshooting, Vol. 10, No. 4

Even if you brew near-perfect beer every single time, you'll be able to fine-tune your product with this comprehensive guide to brewing problems and their solutions.

Worth its weight in beer is the Troubleshooter's Chart—a guide to identifying common flavor flaws, their origin and correction. Also: Guide to Beer Flavor Descriptors, What Is Drinkability?, Tracking Down Off-Flavors, Tasting Techniques, Flavor Profiling, and more.

8 1/2 x 11, 64 pp., illus., magazine.

#746 6 oz. $8.50

All-Grain Issue, Vol. 8 No. 4

This unique magazine continues to be one of our most popular publications. This 80-page compendium on all-grain brewing took more than a year to produce. Since its publication in 1985, it has become a classic reference for all-grain brewers. It covers the important aspects of recipe formulation, ingredients, equipment, theory and philosophy of grain brewing in understandable, accurate terms.

8 1/2 x 11, 80 pp., illus., magazine, third edition.

#736 7 oz. $8.50

Brewers and Their Gadgets, Vol. 11, No. 4

Beermaking requires a balance of the practical and the creative, and this special ***zymurgy*** addresses both. Here are 14 unique, time-and-money-saving gadgets brewers swear by, along with an equipment dictionary for beginners. Combine these down-to-earth items with 24 winning recipes and the inspiration of five innovative homebrewers and you've got the magical mix it takes to produce a winning beer. *8 1/2 x 11, 64 pp., illus., magazine.*

#751 6 oz. $8.50

Malt Extract, Vol. 9, No. 4

A homebrew cookbook!

Try these easy recipes for the world's greatest beer styles from pale ale to stout. This AHA definitive guide to malt extract is the most comprehensive source ever compiled on malt extract products available today. Plus, it explains everything you need to know to design your own great beer the easy way, using a combination of malt extract, specialty grains and a good foundation in brewing techniques. Includes recipes.

8 1/2 x 11, 56 pp., illus., magazine, second edition.

#741 4 oz. $5.00

1989 Yeast Issue, Vol. 12, No. 4

This landmark ***zymurgy*** issue contains all the latest information and techniques regarding yeast. Subjects include test results on commercial brands, culturing yeast from bottle-conditioned beers, matching yeasts to beer styles and much more! *8 1/2 x 11, 80 pp., illus., magazine.*

#756 7 oz. $8.50

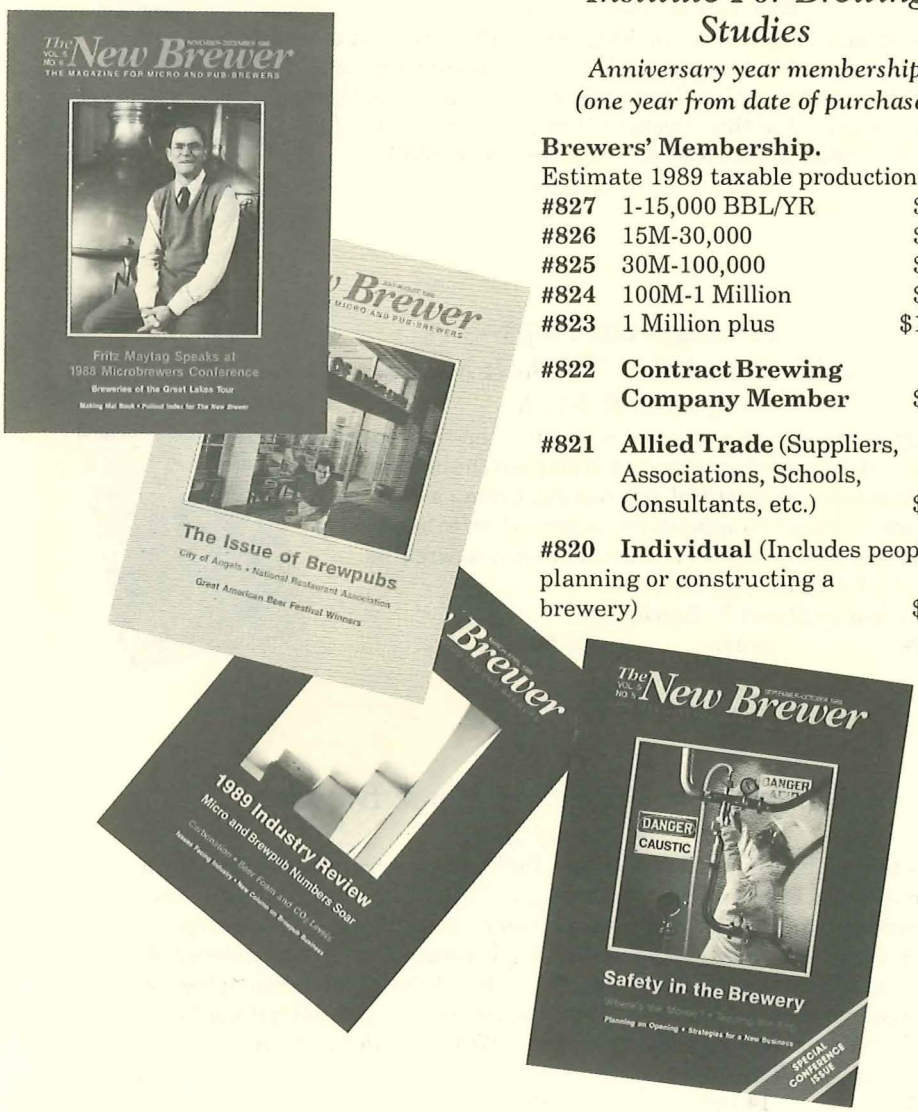
The New Brewer

Open up the world of microbrewing and pubbrewing

The New Brewer is the only trade magazine written to fill the information needs of microbrewers and brewpubs. It provides a broad range of technical and practical information to its nearly 1,000 readers, and its growing roster of advertisers makes it a valuable tool for accessing suppliers.

Topics include:
- Brewing Techniques
- Plant Operation
- New Products and Equipment
- Brewpub Legislation
- Marketing
- Business Management
- Beer Styles Worldwide
- Brewery Profiles
- Latest Industry News
- Vital Law and Liability Issues

Published bimonthly, 48 pages.



New Brewer Subscriptions

U.S.:

#81	**One year**	**$55**
#816	**Two years**	**$99**

Foreign:

#817	**One Year**	**$65**
#818	**Two Years**	**$119**

Back issues are $10 each. Call or write for a free, comprehensive index.

Membership in the Institute For Brewing Studies

Anniversary year membership (one year from date of purchase)

Brewers' Membership.
Estimate 1989 taxable production:

#827	1-15,000 BBL/YR	$165
#826	15M-30,000	$220
#825	30M-100,000	$275
#824	100M-1 Million	$550
#823	1 Million plus	$1100
#822	**Contract Brewing Company Member**	$220
#821	**Allied Trade** (Suppliers, Associations, Schools, Consultants, etc.)	$220
#820	**Individual** (Includes people planning or constructing a brewery)	$110

William Shakespeare's father was the official ale taster of Stratford-on-Avon.

The Pilgrims landed at Plymouth Rock instead of Virginia when a shortage of provisions forced them to alter their route. The ship's journal explains; "our victuals being much spent, especially our bere."

John Alden, a cooper by trade, joined the Mayflower's company with the vital task of caring for the cargo of wooden beer kegs.

America's first "help wanted" ad appeared in a London newspaper in 1609, it was for brewers to take up residence in Colonial Virginia.

The Internal Revenue Act of 1862, was the Federal government act of taxing one dollar per barrel on all beer sold in America. It was passed by Congress to raise revenue for the Union cause during the Civil War.

J. Adam Lemp, a German immigrant, founded the first brewery in St. Louis in 1842, his premier batch was the city's very first lager beer.

The Master Brewer's Association, also known as The Brewmaster's Association, was organized in Chicago on March 21, 1887. The group promoted the interests of brewing education, brewing and technical discussions.

Courtesy of Mike McQuade, member of the San Andreas Malts.

New Brewer Complete Set

A 37-issue compilation of the microbrewery movement since 1983, when there were only 15 micros in all of the United States and Canada. Now get a 20% discount by buying the whole set, from 1983 to 1989. A wealth of information on ingredients, marketing, financial planning, recipes, news and views. Free index.

#830 9 lbs. $235.00

More Than 110,000 in Print!

The Complete Joy of Home Brewing

By Charlie Papazian

In this comprehensive how-to book for all homebrewers, noted expert Papazian gives clear instructions for extract and grain brewing, plus tested recipes. Includes the history of beermaking, theory, practical how-to charts, tables and graphs. More than 80 illustrations. A classic beermaking guide. *Avon Books, 1984. 5 1/2 x 8 1/2, 352 pp., softcover.*

#306 14 oz. $8.95

Now in Its Sixth Printing

Brewing Quality Beers

By Byron Burch

This book sets a standard for brewing excellent beer.

Byron Burch, winner of the 1986 National Homebrew Competition, explains in plain terms the techniques for successfully homebrewing a kaleidoscope of beer styles. This updated guide to brewing contains recipes, tables and charts. *Copyright Byron Burch, 1986. 5 1/2x8 1/2,* 50 pp., illus., softcover.

#301 5 oz. $3.95

Sweet and Hard Cider

How to make strong and nonalcoholic cider using homebrew equipment. *Tables. 188 pp. Garden Way, 1980*

#312 1 lb. $10.95

Beer Judge Study Guide

Compiled by the American Homebrewers Association, this reference book has the relevant information you need to become a competent, confident beer judge.

We've supplied the information, now all you need to do is pass a bonafide beer-judge exam and gain experience in competitions. You'll soon find yourself in a fun and interesting new calling as a beer judge in demand.

8 1/2 x 11, 49 pp., softcover. American Homebrewers Association, 1988.

#412 5 oz. $12.95

Winners Circle

10 Years of Award-Winning Homebrew Recipes

126 ORIGINAL AWARD-WINNING HOMEBREW RECIPES—There is no other book like it! Start brewing with this refreshing collection of tried and true homebrew recipes selected from the winners of the AHA National Homebrew Competition.

- First North American book dedicated to homebrew recipes
- Includes recipes for 21 major styles of lager, ale and mead
- Fun and easy for both beginning and advanced homebrewers
- Design your own recipes
- Improve the taste of your beer

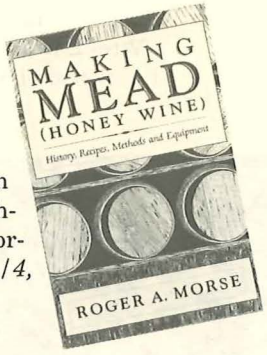
5 1/2 x 8 1/2, 208 pp., softcover. Brewers Publications, 1989.

#407 9 oz. Members $9.95 Nonmembers $11.95

Making Mead—

History, Recipes, Methods and Equipment

By Roger A. Morse, Ph. D



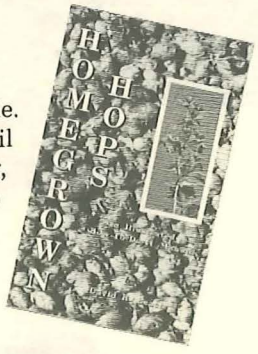
An in-depth study of meadmaking, written by an expert in beekeeping and horticulture. Covers basic brewing techniques, troubleshooting, home analysis and more. A thorough treatment of this "nectar of the gods." *5 1/2 x 8 1/4, 127 pp., index, illus., softcover. Wicwas Press, 1980.*

#323 8 oz. $10.95

Homegrown Hops—

An Illustrated How-To-Do-It Manual

By David R. Beach



Enjoy growing your own hops with this step-by-step guide. Practical, concise chapters cover laying out the hop yard, soil maintenance, pest control, harvesting, drying and storing, and more. Plus, two appendices show you how to build a hop dryer and how to make ornamental hop-vine wreaths.

5 1/3 x 8 1/2, 103 pp., softcover.
Published by David R. Beach, 1988.

#324 5 oz. $8.00

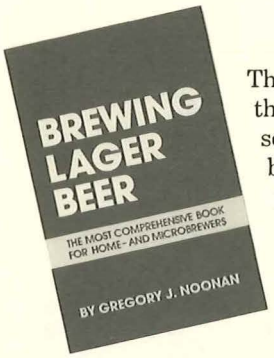
Complete Handbook of Home Brewing

By David Miller

This thorough book has been written for homebrewers of all abilities by a man who has been brewing for 11 years. Dave Miller makes the fine art of homebrewing accessible to every brewer. Everything from brewing equipment to bottling to troubleshooting is covered, as well as numerous recipes. "The reward for your efforts can be a brew of unquestionable quality, one that was not complicated to concoct . . . and did not bankrupt you in the process," says Miller. *Garden Way Publishing, 1988.*

9 x 6, 240 pp., illus., softcover.

#319 14 oz. $9.95

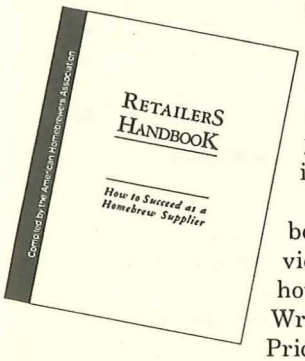


Brewing Lager Beer

By Greg Noonan

This respected, all-grain brewing reference book provides a thorough description of the brewing process, along with several select recipes. Greg Noonan guides you through the brewing of seven classic lager beers. Brewing information is presented in descriptive, easy-to-read tables. *5 1/2 x 8 1/2, 320 pp., index, illus., softcover. Brewers Publications, 1986.*

 # 417 13 oz. Members $12.95
Nonmembers $14.95



NEW

The Retailer's Handbook

How to Succeed as a Homebrew Supplier

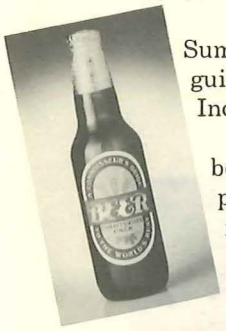
Whether it's a full-time occupation or part-time fun, selling homebrew supplies can be lucrative and interesting. Here, for the first time, are the specific steps you can take to start your own brewer's supply business—or dramatically increase your profits.

Compiled by the American Homebrewers Association, this book provides information based on years of research, interviews, first-hand experience, and surveys. Topics cover the how-to's for Organizing a Beer Tasting, Promoting an Event, Writing Direct Mail Advertising and Press Releases, Setting Prices, Controlling Inventory, Surveying Your Customers, Building a Sales Program Based on Customer Data, and many other subjects from *Tapping the Market. 8 1/2 x 11, 80 pp., softcover. Brewers Publications, 1990.*

#438 9 oz. Members $ 35.00 Nonmembers $ 50.00

Beer: A Connoisseur's Guide To The World's Best

By Christopher Finch



Sumptuous, informative and thoroughly readable, this lavish, full-color guide evaluates more than 500 different beers made in North America. Includes a completely up-to-date history of beer and brewing.

It's a delightfully opinionated book that helps you pick the best beers to buy. Plus, you'll enjoy hundreds of color illustrations and photographs of beer labels, vintage ads, bottles, pubs, breweries and food. A visual treat for all serious brewers and beer buffs alike. *Abbeville Press, 1989. 7 1/2 x 13, 183 pp., illus., hardcover.*

#321 2 lbs. 8 oz. $29.95

Brewing Mead—

Wassail! In Mazers of Mead

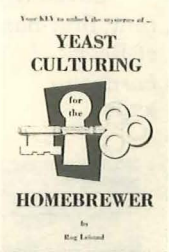
By Lt. Colonel Robert Gayre

Mysterious mead. Is it an aphrodesiac? Why was it treasured by ancient kings and Nordic gods? Delve into the past of this rare drink, through poetry, myth and history. Then brew your own with Charlie Papazian's easy instructions. *5 1/2 x 8 1/2, 208 pp., illus., softcover. Brewers Publications, 1986.*

#418 9 oz. Members $9.95
Nonmembers $11.95

Yeast Culturing for the Homebrewer

By Roger Leistad



Ah, the mystery of yeast, and its role in beer-making. Roger Leistad explains how to culture and grow yeast at home in this concise, easy-to-follow booklet. A proven authority on the topic of yeast. *G.W. Kent, Inc., 1983. 5 1/2 x 8 1/2, 40 pp., softcover.*

#310 3 oz. $4.25

Wine and Beers of Old New England

Recipes, history, odd facts and modern methods for recreating pioneer drinks. Birch, spruce, maple, and ivy beers. Applejack, mead. *157 pp. University Press of New England, 1978.*

#300 9 oz. $8.95

Brewers Publications

Greg Noonan
author *Brewing Lager Beer*

I began homebrewing in 1977 after realizing there was a whole lot more with beer than what I was drinking. Drinking homebrew, I discovered that there were phenomenal possibilities for beer. When I looked into mashing, I discovered that the information out there was very sparse. Consequently, I found myself in libraries going through professional brewing manuals. I felt that the information I found, more complex information, would be useful for other brewers who wanted to move farther into their brewing. The result is *Brewing Lager Beer.* I think that for getting to brewers who are serious about good brewing, Brewers Publications is the best means of reaching other homebrewers. As far as getting great information out there, the books are excellent. As far as the microbrewery volumes and classic beer style series, there is no better way to get information to the brewers about the world of beer making. Two books I really love are George Fix's book, *Principles of Brewing Science,* and Terry Foster's *Pale Ale.* The AOB, itself, is the heart and soul of the communication network for brewers.

Take a beer holiday

Revised Edition

The New World GuideTo Beer

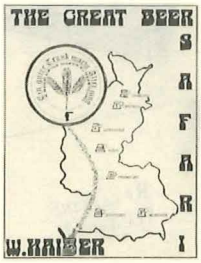
By Michael Jackson

This all-new edition replaces Michael Jackson's classic book of the same title written nearly a decade ago.

Recognized as a foremost authority on beer styles, Jackson's advice is sought by the world's largest and smallest brewers. In this text, with updated maps and more than 100 new photos, he discusses beers great and small the world over.

Lavishly illustrated with color photos, replete with current, first-hand information, this is sure to become the "Bible of Beer." *Running Press, 1988. 8 1/2 x 11, 256 pp., illus., hardcover.*

#307 2 lbs. 8 oz. $29.95



The Great Beer Safari

By William Haiber

A great source for those who like to track down all the facts on the lion-hearted species of German Beer.

Savor chapters on ancient history, beer statistics and flavor profiles. Plus, it's your complete source for German beer definitions and beer expressions.

This book also contains the names, addresses, phone numbers, and statistics for all of the breweries in West Germany. We've never seen another one quite like it. It's a "must have" for any self-respecting aficionado of German Beer. Dass ist gut, ja?

Info Devel Press, 1988. 8 1/2 x 11, 92 pp., softcover.

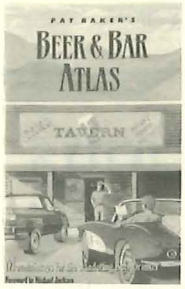
#320 10 oz. $9.95

The Essentials of Beer Style

by Fred Eckhardt

An essential part of any beer enthusiast's library, *The Essentials of Beer Style* is like three books in one. Part One covers some of the nuts and bolts of brewing beer, Part Two describes the great beer styles of the world, and Part Three is a complete guide to tasting and evaluating beer. A must for the avid homebrewer, The Essentials of Beer Style is also a great way to introduce a friend to the wonderful world of beer! *Fred Eckhardt Associates, 1989. 4 1/4 x 7 1/4, 224 pp., softcover, two indexes.*

#318 8 oz. $14.95



Beer and Bar Atlas

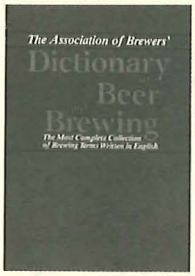
By Pat Baker

Here they are: the bars, the beers and the breweries on and off the beaten tracks of America. Have you dreamed of being able to taste your way through the Pacific Northwest or sip a route through the New England states?

Author Pat Baker highlights the bars you would love to visit on a cross-continent tour, along with their beers. "Mountaintops for the Wandering Beer Drinker" is how Pat describes it. Hemingway would have loved it. *Baker and Owens Books, 1988.*

5 1/2 x 8 1/2, 71 pp., illus., softcover.

#317 4 oz. $4.50



Association of Brewers'

Dictionary of Beer and Brewing

By Carl Forget

Once in a great while, a book comes along that makes an outstanding contribution to the nation's brewers. We believe this is such a book! For the first time, English-speaking brewers have a point of reference—a common language. Forget has compiled 1,929 essential definitions used in beermaking. They cover:

- Ingredients
- Brewing terms
- Types and styles of beer
- Abbreviations
- Arcane terms

Also includes conversion tables for temperatures, alcohol percentages, and weights and volumes. "This is an excellent dictionary. There is a real need for it," says Dr. George Fix, chemist and brewing expert.

5 1/2 x 8 1/2, 196 pp., softcover. Brewers Publications, 1988.

#414 10 oz. Members $15.95 Nonmembers $19.95

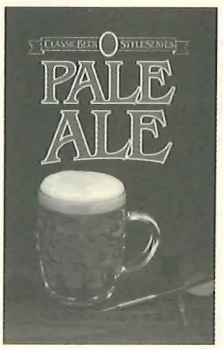
Bring the world of beer to your home

The gift of beers

Classic Beer Styles: Pale Ale

by Terry Foster
(First in a Series!)

Brewers Publications is pleased to announce an exciting new book series, Classic Beer Styles.



Foster, a British expatriot and renowned expert on British beers, has created a technical masterpiece on pale ale, the world's most popular style of ale. Written with an entertaining historical perspective, this book more than measures up to its subject matter.

Chapters include history, character, flavor, brewing, ingredients, methods and comparisons of pale ale. Recipes and data are in English and metric units, Balling and specific gravity, five-gallon and one-US-barrel batches. Fully indexed and eminently readable.

Watch for Continental Pilsener and Belgian-Style Lambic, in production for late 1990 or early 1991. *5 1/2 x 8 1/2, approx. 140 pp., illus., softcover. Brewers Publications, 1990.*

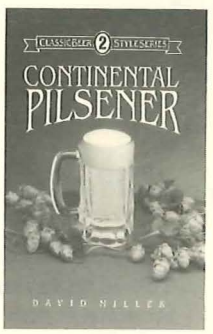
#431 9 oz. Members $9.95
Nonmembers $11.95

Classic Beer Styles: Continental Pilsener

NEW

by David Miller

This revolutionary beer style changed the course of brewing when its brewers in Plzeň, Czechoslovakia, introduced it to the world. It's a clean, refreshing style you know, you love, and you can brew to perfection **as it ought to be made** with this guide.



Award-winning homebrewer and author, David Miller examines the history of this venerable style, and then guides you through the process of brewing it. Includes recipes. Required reading for the bottom-fermenting brewer. *5 1/2 x 8 1/2, 120 pp., illus., softcover. Brewers Publications, 1990.* Available Nov. 15.

#434 9 oz. Members $9.95
Nonmembers $11.95

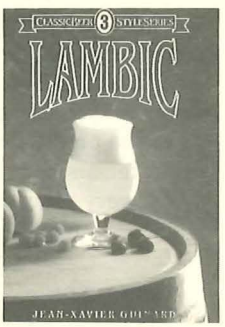
Classic Beer Styles: Lambic

NEW

by Jean-Xavier Guinard

Lambic: this beer conjures up images of the exotic, of traditional Belgian brewing, of the rich flavor of beer made with fruit. Now you can learn how to successfully brew this beer at home—or in your small commercial brewery—with these practical step-by-step instructions.

Jean-Xavier, a research associate with Dr. Michael Lewis, has studied the making of lambic—and its cousins kriek, gueuze, framboise, and pêche—both in Belgium and at UC-Davis. First, he examines these beers' unique origins in a country where spiders in the brewhouse are protected, fruit is a must for fermentation, and wild yeast is a national treasure. Then, he thoroughly explains how to brew these dramatic beers—complete with recipes. Beer lovers will love his directory of Belgian lambic breweries. An incredible book that is bound to broaden the scope of American brewing. *5 1/2 x 8 1/2, 180 pp., illus., softcover. Brewers Publications, 1990.* Available Dec.1.



#437 10 oz. Members $9.95
Nonmembers $11.95

The collections

Water and Brewing

NEW

Brewing experts agree that treating brewing water is one of the most critical—and most complex — aspects of producing top-quality beers. To help you address this issue, we've gleaned our sources for the best information available, and for the first time, we're offering this unique "Water and Brewing Set."

Information includes: How to Calculate Salt Adjustment (***zymurgy***, Vol. 12, No. 5), Changes in City Water Regulations May Affect Your Beer (***zymurgy***, Vol. 12, No. 2), Reverse Osmosis Water Purifiers and How to Build One (***zymurgy***, Vol. 12, No. 2), Boil Your Extract Water (***zymurgy***, Vol. 10, No. 5), A Guide to Filter Systems (***zymurgy***, Vol. 9, No. 5), and Turning Any Source of Water into Brewing Water (***The New Brewer***, Vol. 1, No. 3). May be ordered individually. ***zymurgy*** back issues are $5 each. ***The New Brewer*** back issues are $10. Or order the set at a 15% discount.

#767 1 lb. 10 oz $27, The Set.

SAVE 15% *The Microbrewer's Starter Set*

Here are three indispensable sources of information for those who want a clear, concise, detailed picture of the North American Brewing Industry. We've assembled this collection for both the serious amateur and those thinking about going professional. It's the most complete and most enlightening introduction to the industry you'll find.

Set includes:

- *The New Brewer* magazine, 1991 subscription
- *1990-91 Brewers Resource Directory*
- *Brewery Operations, Vol. 6* (1989)

#653 2 lbs. 2 oz. Members $109.60
Nonmembers $119.80

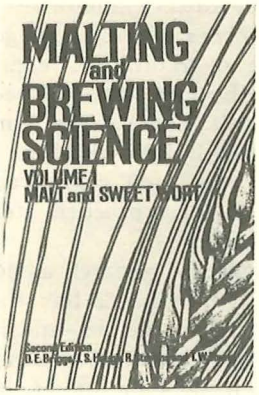
SAVE 15% *Brewpub Starter Set*

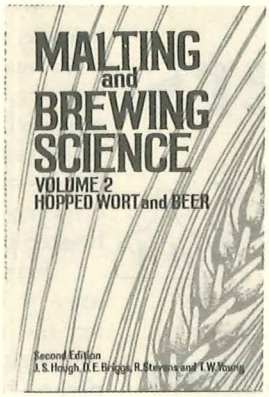
Here is the vital information you need if you're thinking brewpubs. Includes tips from the experts, financial projections, listings of suppliers and existing brewpubs, along with industry statistics. A must for anyone considering this business opportunity. Set includes:

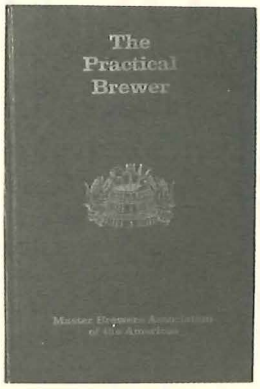
- *Brewery Operations, Vol. 6* (1989)
- *1990-1991 Brewers Resource Directory*
- *The New Brewer*, Vol. 5, No. 4 and Vol. 6, No. 4

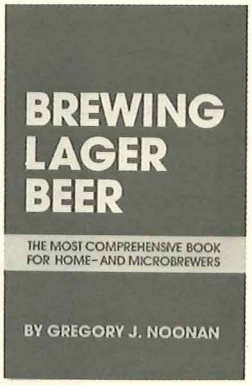
#655 2 lbs. 14 oz. $79.85 Members
$90.05 Nonmembers

The Satisfaction









Malting and Brewing Science Vols. 1 - 2

These two volumes explore modern and traditional brewing practices worldwide. The technical texts outline the biological and chemical principles involved in the production of brewing's raw materials, and describe how the brewery processes those materials.

Volume 1, Malt and Sweet Wort, covers the technology of all aspects of brewing prior to kettle boiling. Volume 2, Hopped Wort and Beer, continues with information on hop usage, boiling, fermentation and yeast. *Chapman and Hall, 1982.*

Call for availablity.

5 1/2 x 8 1/2, 914 pp. Two-volume set, illus., hardcover. Second edition.

Vol. 1	**1 lb. 11 oz.**	**#504**	**$85.00**
Vol. 2	**2 lbs. 5 oz.**	**#506**	**$85.00**
Both Vols.	**4 lbs.**	**#503**	**$150.00**

The Practical Brewer

The Master Brewers Association of the Americas

This is an invaluable manual for brewing at any scale, and a must for anyone contemplating professional brewing. Each of its 21 chapters covers a vital aspect of the brewing art. Technical information is supplied, but technical expertise is not necessary for the understanding and enjoyment of this book. Written by working research scientists and brewers from Canada, the U.S. and Central America. *Master Brewers Assn. of the Americas, 1977.*

5 1/2 x 8 1/2, 475 pp., hardcover.

#501 2 lbs. $39.95

Brewing Lager Beer

By Greg Noonan

This respected, all-grain brewing reference book provides a thorough description of the brewing process, along with several select recipes. Greg Noonan guides you through the brewing of seven classic lager beers. Brewing information is presented in descriptive, easy-to-read tables.

5 1/2 x 8 1/2, 320 pp., index, illus., softcover. Brewers Publications, 1986.

 # 417 13 oz. Members $12.95
Nonmembers $14.95

BREWER'S ALMANAC 1989

The Brewing Industry in the United States.

Totally up-to-date !

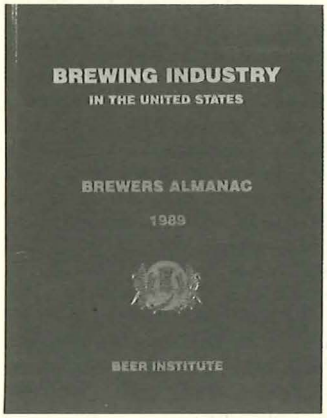
Published by the Beer Institute in Washington, D.C., the *1989 Brewer's Almanac* represents one of the world's most definitive sources of industry information. Without question, it is the most comprehensive collection of statistics, legal information and other brewing data available today.

The Brewer's Almanac provides invaluable insights for those seeking the "big picture" right down to the last detail. An indispensable tool for making critical management decisions. Over 67 tables and charts. Volume includes:

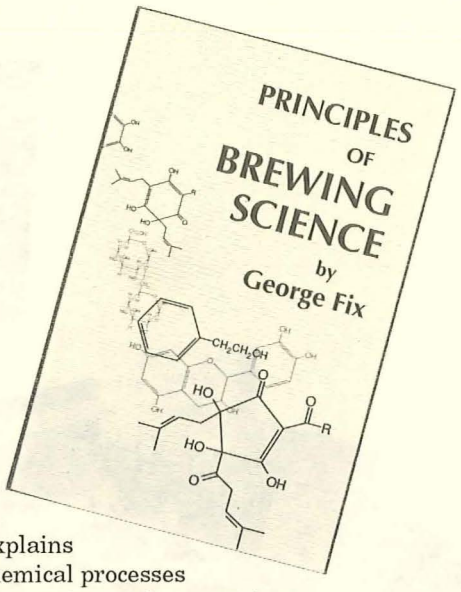
- Complete statistics for package, draft, cans and bottles.
- Data on U.S. malt beverage industry and operating ratios.
- Shipment/sales, including per capita consumptions of wine, beer and distilled spirits by area.
- Import/export statistics.
- Taxes and legal information.

Beer Institute, 1989. 8 1/2 x 11, 90 pp., illus., hardcover.

#322 1 lb. 5 oz. $100.00



# of Good Science



Principles of Brewing Science

by George Fix

Talk about good chemistry and great timing. We know many of you have waited patiently for a book such as this. And now, here it is!

Interesting and easy to understand, this exciting new work explains the fundamental chemical and biochemical processes involved in the creation of beer. From reactions to fermentation and metabolic pathways, you'll be able to fathom the forces and the formulas.

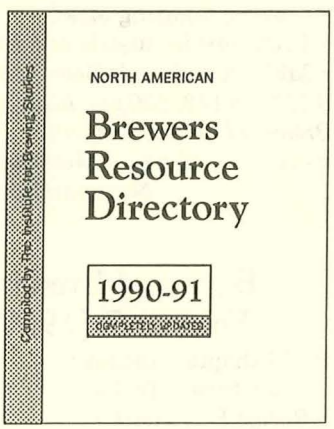
Water, malt, grains, hops, enzymes, yeast, carbohydrates, bacteria and proteins—this fascinating volume covers (and uncovers) them all.

Fully indexed. Appendix includes an overview of elementary chemistry. Scientific and sensational. Your satisfaction is guaranteed. *5 1/2 x 8 1/2 , 246 pp., illus., softcover. Brewers Publications, 1989.*

#415 11 oz. Members $24.95 Nonmembers $29.95

NEW

1990-91 North American Brewers Resource Directory



This is your most comprehensive source of vital information on the North American brewing industry. Updated every year, our directory lists the current phone numbers, addresses and contact people for valuable suppliers, legislative agencies, consultants and breweries. Plus, the latest legal developments in the industry. Provides you with complete listings for:

- Ingredient Suppliers
- Equipment Manufacturers
- Associations and Publications
- State Laws and Excise Taxes
- Microbreweries and Brewpubs
- Large Breweries
- Brewing Consultants

This year, we've also included suppliers of marketing, packaging and promotional materials. Plus, you'll have the facts on over 1,300 beers.

There are more than 300 breweries in North America, but you only need one book to keep you informed.

#436 1 lb. 5 oz. Members $50.00 Nonmembers $60.00

Long Before There was Budweiser

Long before there was Budweiser or Miller or Coors—or even Yuengling—there was beer.

In Mesopotamia, archaeologists have found pieces of pottery that clearly prove that there was brewing going on almost eight thousand years ago. And that ancient land's Queen Shu-Bad is known to have added a touch of class—and lots of bubbles, too—to her beer by sipping it through a golden straw.

...

In Babylon, priests knew how to make—and did make—over fifteen different varieties of beer more than four thousand years before the birth of Christ. Included in the varieties were dark beer, pale beer, red beer, three-fold beer, beer with a head and beer without a head, among others.

...

The ancient Egyptians placed great importance on the proper brewing of beer. It was, in fact, held in an almost mythical sense, a gift from Ibis, the goddess of nature. Nevertheless, a high government official was appointed the equivalent of Superintendent of Breweries and was charged with ensuring that the "gift" turned out just right.

...

The Egyptians called their beer hek *and made it by crumbling chunks of barley bread into jars, filling them with water, and allowing the resultant mixture to ferment. For those unpleasant trips across the desert, only the fermented bread crumbs were brought along. When an oasis was reached, water was added and, voilà, the result was instant beer.*

—taken from Will Anderson's *From Beer to Eternity*

NEW

Beer and Brewing Volume 10 (1990)

A whole conference at your fingertips! That's one way to describe this transcription of the conference held in Oakland, Calif. In this valuable reference book, an array of brewing experts speak directly to your need for practical information on brewing techniques. Topics include:

- Instructions for Infusion Mashing
- Yeast Culturing
- Quality Assessment for Homebrewers
- Going Pro in Your First Commercial Brewery
- New Brewers and Their Products
- Secrets of Beer Carbonation
- Brewing High-Quality Beers
- Learning from German Beers
- and Much More.

5 1/2 x 8 1/2, 260 pp., illus., softcover, Brewers Publications, 1990.

#432 12 oz. Members $18.95
Nonmembers $20.95

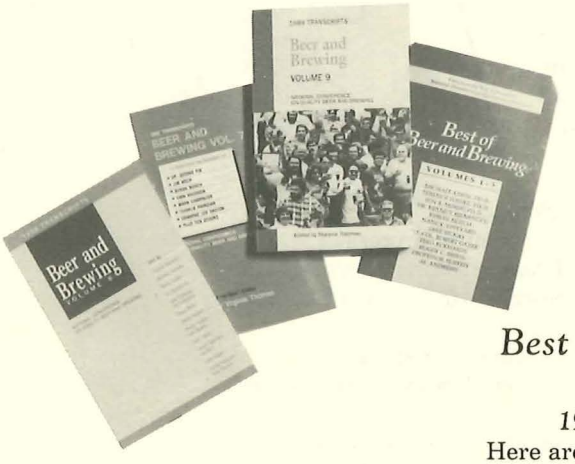
Beer and Brewing Volume 9 (1989)

Here are the transcripts from the conference at the Oldenberg Brewery in Fort Mitchell, Kentucky, where 420 enthusiasts met for four days of fun, education and beer. This exciting book recaptures the spirit of the event and is overflowing with invaluable tips from the nation's experts. Dozens of photos, hand-outs and diagrams from the talks. Topics include:

- What Makes an Ale an Ale
- Cause and Prevention of Hazy Beer
- Microbiology for Homebrewers
- A Micro-homebrewery
- Trends in Fermentaion and Lagering
- Microbreweries and Brewpubs
- Hop Madness
- Tips on Quality Control
- Yeast for the Amateur
- The Lakefront Brewery
- Michael Jackson's Quintessential Luncheon

5 1/2 x 8 1/2, 247 pp., illus., softcover. Brewers Publications, 1989.

#429 11 oz. Members $18.95
Nonmembers $20.95



Beer and Brewing Volume 8 (1988)

Chapters include:

- Improved Record-Keeping
- Practical All-Grain Brewing
- Hop Flavor in Beer
- Aroma ID Kit Development
- Flavor Recognition
- Making Amazing Mead
- Brewpubs in Austria and Bavaria
- Michael Jackson's Beer-Tour

5 1/2 x 8 1/2, 220 pp., illus., softcover. Brewers Publications, 1988.

#427 10 oz. Members $18.95
Nonmembers $20.95

Beer and Brewing Volume 7 (1987)

Its 17 chapters include:

- Yeast Strain Traits
- Recipe Formulation
- Brewing to Scale
- Origin of Beer Flavor
- Innovations in Equipment
- Confessions of a Microbrewer
- Contemporary Brewing

5 1/2 x 8 1/2, 280 pp., illus., softcover. Brewers Publications, 1987.

#423 11 oz. Members $18.95
Nonmembers $20.95

Best of Beer and Brewing Vols. 1 - 5

1982 - 1985 Conferences

Here are the very best 18 talks from previous years, updated and corrected by the authors, and compiled in one valuable, affordable volume.

Best of Beer and Brewing includes talks from Dr. Michael Lewis, Dr. Terry Foster, Byron Burch, Charlie Papazian, Fred Eckhardt and Nancy Vineyard. Topics are Mashing Theory, Yeast Culturing, All-grain Brewing, Hop Utilization, Microbiological Controls, Beer Styles, and more. *5 1/2 x 8 1/2, 260 pp., illus., softcover. Brewers Publications, 1987.*

#413 12 oz. Members $15.95
Nonmembers $17.95

Beer and Brewing Volume Set

Save 15% on this four-volume set of Brewers Publication's American Homebrewers Association National Conference transcripts. More than 1,000 pages of information on brewing and evaluating beer. Set includes:

- Beer and Brewing, Vol. 9 (1989)
- Beer and Brewing, Vol. 8 (1988)
- Beer and Brewing, Vol. 7 (1987)
- Best of Beer and Brewing (1982-1985)

#621 2 lbs. 11 oz.
Members $61.88
Nonmembers $68.68

# of Countless Brewers

Available January, 1991

Brewery Operations, Vol. 7

1990 Microbrewers Conference, Denver, Colo.

This conference brought together over 200 brewers, future brewers and industry people for four days of talks, discussions and presentations. *Brewery Operations Vol. 7* gathers these together in one handbook:

- Brewery Public Relations
- Yeast Management • Legal Issues
- Insurance • Affects of Trub
- Laboratory Procedures
- Strategic Planning
- Filtration and Bottling
- Brewpub Menu Design
- Identifying Off Aromas

5 1/2 x 8 1/2, 212 pp., illus., softcover. Brewers Publications, 1990.

#433 14 oz. Members $23.95
Nonmembers $25.95

Brewery Operations, Vol. 6

1989 Microbrewers Conference, San Francisco, Calif.

You'll profit from these transcripts of 21 talks given by the industry's experts. Topics include:

- Small Brewers and their State Legislators
- Quality Assurance Systems
- Practical Brewery Sanitation
- Brewpub Packaging for Off-Premise Sales
- Brewery Effluent: Facts and Issues
- Package Design

Book contains the hand-outs, charts and illustrations from the conference.

5 1/2 x 8 1/2, 212 pp., illus., softcover. Brewers Publications, 1990.

#430 14 oz. Members $23.95
Nonmembers $25.95

Save 15%!
Brewery Operations Set

Brewers Publications has compiled this four-volume set of National Microbrewers Conference transcripts at the request of our industry-oriented customers. You'll receive more than 700 pages of insights and tips from internationally known industry professionals. Set includes:

- Vol. 3 (1986) • Vol. 4 (1987)
- Vol. 5 (1988) • Vol. 6 (1989)

#651 3 lbs. 6 oz. Members $81.45
Nonmembers $88.25

Brewery Operations, Vol. 5

1988 Microbrewers Conference, Chicago, Ill.

Chapters include:

- Marketing and Distribution
- Franchising
- Practical Technology for the Small Brewer
- Brewpub Operation
- Starting a Brewery
- Brewery Expansion

5 1/2 x 8 1/2, 330 pp., illus., softcover. Brewers Publications, 1989.

#428 14 oz. Members $23.95
Nonmembers $25.95

Brewery Operations, Vol. 4

1987 Microbrewers Conference, Boston, Mass.

Topics include:

- Techniques of Major Breweries
- Engineering for the Microbrewer
- Types of Brewpubs
- BATF Regulations
- Developing a Marketing Plan
- A Restaurateur's Perspective on Beer
- Malt Extract in Microbrewing
- How to Hire Good People
- Equipment for the Brewpub

5 1/2 x 8 1/2, 210 pp., illus., softcover. Brewers Publications, 1988.

#424 10 oz. Members $23.95
Nonmembers $25.95

Brewery Operations, Vol. 3

1986 Microbrewers Conference, Portland, Ore.

The 15 chapters include:

- Getting Money for Expansion
- Contract Brewing
- Cottage Brewing
- Beer Flavor
- Brewery Public Relations
- Marketing the Pubbrewery
- Yeast and Fermentation
- Brewery Startup

5 1/2 x 8 1/2, 180 pp., illus., softcover. Brewers Publications, 1987.

#421 9 oz. Members $23.95
Nonmembers $25.95

American Homebrewers Association

Bill Murphy
Chairman of the American Homebrewers Association Board of Advisers

I'd always had the unconscious urge to try brewing. My brother had the equipment in my mother's garage, so I borrowed it. My first batch, eight years ago, was a classic sugar beer recipe. It was wretched, and I was really disappointed. ***zymurgy*** had come into my hands, and it said I really could make good homebrew—I'd just had a bad experience. The following fall, I started in again and made dramatically better beer. ***zymurgy*** got me into the American Homebrewers Association. It was all the information available from AHA that attracted me. Before my membership, I was out there by myself, separating voodoo brewing from state-of-the-art brewing. I learned what was behind beer and brewing, about tasting and brewing, and I met people who shared the same interest. The older I get, the more convinced I am that there are other people like me with an innate sense about beer. I've always had a bit of a missionary feeling. You've got to reach people who are interested in brewing and communicate about beer—being on the Board helps me get the word out.

To Add to Your

"Relax" Beer Mug

Raise your standard of sipping—The time-honored slogan of homebrewers, "Relax, Don't Worry, Have a Homebrew," graces these generous, 12-ounce beer mugs. Straight-sided mugs are made of heavy glass, with a sturdy handle and fluted base. Also features the new American Homebrewers Association logo. Absolutely mug-nificent.

#221 1 lb. 5 oz. $4.95

Homebrew-Size Beer Pitcher

Draw up a pitcher of suds for friends using this heavy-duty, graceful glass pitcher. Molded spout makes for easy pouring and quick, easy cleaning between beer styles. Perfect when used with a companion set of mugs. Printed in black with "Relax. Don't Worry Have a Homebrew."

#218 4 lbs. $11.95

Handy Six-Pack Holster

YOU CAN TAKE IT WITH YOU—Transporting bottles of homebrew to a friend's house, club activity or competition has always been a challenge. A box or bag doesn't offer enough protection, nor does it always keep the bottles upright.

We've updated our six-pack holster for 12-ounce bottles, including long-necks. Insulated nylon case with strong shoulder strap is easy to carry. Insulated interior divides cushioned bottles and keeps them separate. Handy inside pockets hold openers, large pocket holds Blue Ice™. Worth every cent! Emblazoned with black and white AHA Relax logo.

#224 11 oz. $23.95

Homebrewer's Coffee Mug

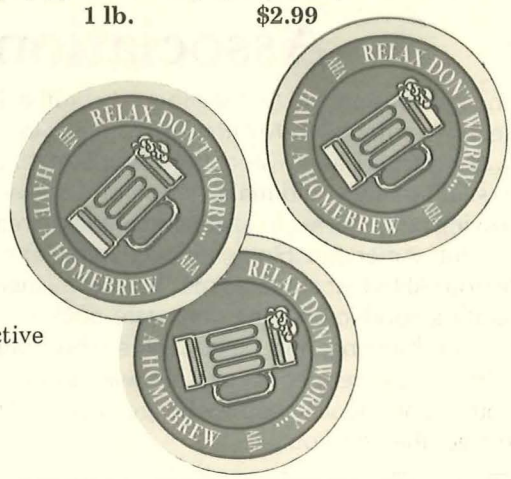
New Design—"I wish this were my homebrew," someone once said over coffee. And so it is (or appears to be) with this coffee or tea mug that says it all. Show your preference. Sip from this ceramic beauty that looks just like a full mug of homebrew. Seeing is believing. A great gift.

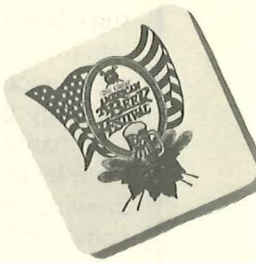
#220 13 oz. $4.95

Bottlecaps

Cap off your homebrewed best with pride. Our special bottlecaps proclaim the notorious "Relax" message, and are ringed with the slogan, "The Best Beer in the World is the One You're Holding." Burgundy with silver lettering. One-pound bags (approx. 200 caps per pound).

#202 1 lb. $2.99





Coasters

Give guests the "Relax" message with these colorful, tasteful beer coasters. Strong, attractive and reusable time after time.

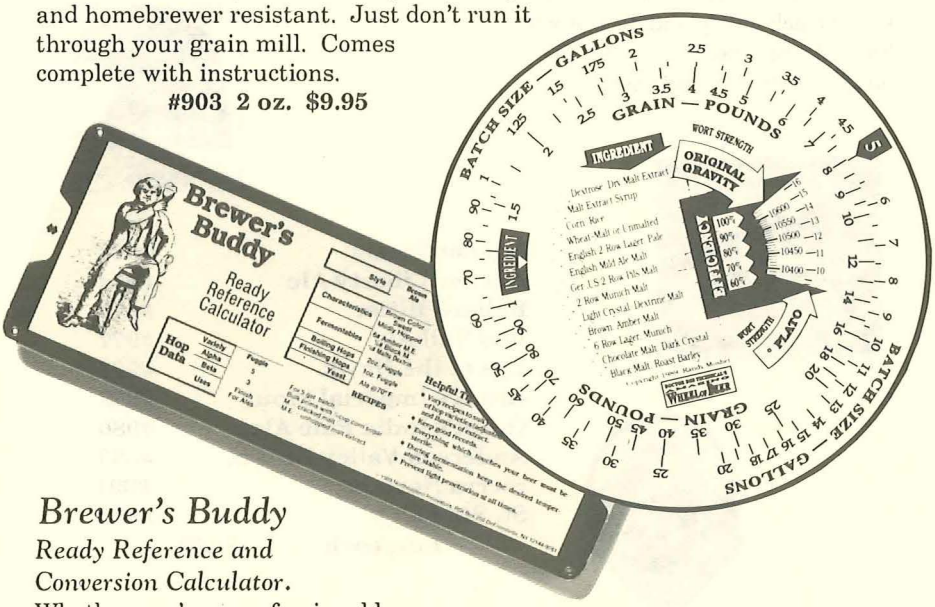
#208 10 for $1.50 2 oz.
#209 50 for $5.00 7 oz.

Experience of Beer

Doctor Bob Technical's Amazing Wheel of Beer

THE TOOL YOU'VE BEEN WAITING FOR—This astounding ingredient calculator quickly computes the amount of materials needed to bring your beer to the desired gravity. Created by homebrewer Randy Mosher, the Amazing Wheel of Beer can be used with 13 different malts and adjuncts (from extract to black malt), ingredient amounts of from one to 100 pounds and batch sizes of from one to 100 gallons. Contribution of each ingredient is measured in O.G. or degrees Plato and an efficiency factor is included. The Amazing Wheel of Beer is laminated, and is waterproof, wortproof and homebrewer resistant. Just don't run it through your grain mill. Comes complete with instructions.

#903 2 oz. $9.95



Brewer's Buddy

Ready Reference and Conversion Calculator.

Whether you're a professional brewer or a dedicated dabbler—this handy little hummer is all you need to accurately compute conversions and equivalents, and resize beer recipes in a flash. It's like having a math whiz and a brewmaster—right in the palm of your hand.

Integrated on this extremly useful slide calculator are 11 world beer style recipes; 11 hop varieties, with alpha and beta percentage uses; steps for extract brewing; and windows for hydrometer correction and hop equivalent bitterness.

Plus, there are helpful tips for making great beer, a recipe sizer, *and* conversion windows for volume, mass, litres/gallons, kilos/pounds and temperatures.

Constructed from heavy card stock and riveted, it's durable and dependable. You'll never want to brew without your Brewer's Buddy again. Slide calculator measures 8 1/2 x 3 inches and fits in your shirt pocket.

#904 1 oz. $6.50

NEW

1990 GABF Official Coasters

Sop up those spilled suds or absorb the glass perspiration with these 4-color commemorative coasters. You can enjoy your brew when you know it's resting on truly authentic memorabeerlia!

#216 10 coasters, 2 oz. $1.50
#216a 50 coasters, 7 oz. $5.00

Toast of the Town

Toasting—to drink to someone's health or happiness—is a custom that goes back about as far as drinking itself. In fact, it is one of mankind's oldest social customs. Prehistoric tribes are known to have practiced variations of toasting. The ancient Greeks and Romans solemnized their drinking by offering up "good healths" to their numerous gods and to their dead. Norsemen did much the same, saluting Thor, Odin and Freya.

...

It wasn't until seventeenth-century England, however, that the word toast came into being. In those days beer was often enjoyed near the fireplace, with bits of toasted bread frequently added to the brew for a little extra flavor. Because the addition of the toast was done before imbibing, it stands to reason that the name for the latter took its name from that of the former.

May the most you wish for be the least you get.

Here's to a long life and a merry one,
A quick death and an easy one,
A pretty girl and a true one,
A cold beer—and another one.

May all your labors be in vein.
—Miner's toast

Here's to us that are here,
to you
that are there, and the rest
of us
everywhere

—Kipling

There was a story from Ireland in the 19th century; The brewery foreman was showing a new widow how her husband had drowned in a huge vat of beer. "Did he suffer much?" she asked. "Oh, no man, he even got out three times to go to the toilet!"

Doing It with Vitamins

There's always been barley and hops and water. There's often been corn or rice. And for a time in the late 1930s, there were vitamins.

Schlitz announced the addition of vitamin D to its beer in early 1936. In ads in major markets across the country, the Milwaukee giant hailed it as "one of the greatest brewing achievements of all time!"

...

In early 1937 the Auto City Brewing Co., of Detroit went Schlitz one vitamin better. It started putting vitamins B and G (riboflavin) in its Altweiser Beer. Ad copy stressed that now Altweiser "is more refreshing because of the vitamins B and G which it contains. These are the vitamins which are absolutely essential to proper digestion."

...

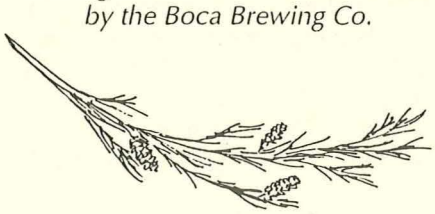
What next? Well what was next was the Federal Alcoholic Administration's (FAA) ruling in early 1940 that beer labeling could not make mention of vitamins. The FAA's reasoning: such labeling might lead some consumers to believe that beer had curative value.

—taken from Will Anderson's *From Beer to Eternity*

America's first "help wanted" ad appeared in a London newspaper in 1609, it was for brewers to take up residence in Colonial Virginia.

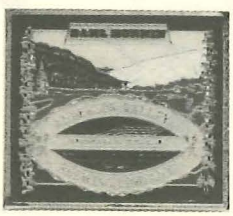
The Internal Revenue Act of 1862, was the Federal government act of taxing one dollar per barrel on all beer sold in America. It was passed by Congress to raise revenue for the Union cause during the Civil War.

English replaced German as the official language of the U.S. Brewers Association in 1873. By 1875, the first lager brewed in California was by the Boca Brewing Co.



Cloisonné and Enamel Brewery Pins

For those with a penchant for pins—Collect these colorful and distinctive microbrewery pins and wear them proudly at all beer events. Each pin is meticulously crafted and sure to be treasured by every microbrewer enthusiast and supporter. Pins attach easily and securely to hats, clothes, neckties, etc. The height of style in suds society.



Anchor Steam	**#973**
Anchor Liberty Ale	**#974**
Ballard Bitter	**#975**
Red Tail Ale	**#977**
Eye of the Hawk	**#978**
Grant's Imperial Stout	**#979**
Grant's India Pale Ale	**#980**
Anderson Valley Br. Co.	**#983**
Sierra Nevada	**#991**
St. Stan's	**#992**

1 oz. each $3.50

Official Judges' Cloisonné Pins

For Recognized and Certified Judges Only

If you've passed the National Beer Judge Certification examinations and your experience qualifies you as a Recognized or Certified Judge, you are eligible to purchase these pins.

A symbol of a special group of individuals, these Official Judges' Cloisonné Pins recognize your status and expertise in evaluating beer, as well as your in-depth knowledge of brewing and beer styles.

Made with exceptional craftsmanship and beauty, they reflect your pride and prestige as an expert. Wear at all judging events. Your purchase helps support The National Beer Judge Certification Program.

#230	**Recognized**	**$20.00**	**1 oz.**
#231	**Certified**	**$20.00**	

AHA "Relax" Cloisonné Enamel Pin

The Pin-nacle of Pride—Our full-color AHA "Relax" logo is now featured on a spectacular five-color lapel pin. This superior quality pin is 1 1/8 inches in diameter and inscribed with our motto: "Relax. Don't Worry Have a Homebrew!" Add it to your collection and wear it with pride.

#222 1 oz. $3.50

OUR GUARANTEE

Every item in the *Beer Enthusiast Catalogue* has been carefully selected. If you are not completely satisfied with the product you ordered, for any reason, at any time, we will promptly replace it or refund the full purchase price.

Association of Brewers • PO Box 287 • Boulder CO 80306-0287 USA
(303) 447-0816 • FAX (303) 447-2825 • Office hours: M-F, 9-5 MST

Turkey Window Decal

MAY THE TURKEY BE WITH YOU—Display this high-quality, full-color decal on your car or home window and identify yourself as one who knows and loves good beer. Decal features the American Homebrewers Association's turkey logo, printed in red, gold, brown, blue and black.

#205 1 oz. $3.95

Bumper Banners

#210 *Go For Greatness.* An uplifting motto if we ever saw one.
#211 *Relax Don't Worry Have a Homebrew.* Advice for stressed-out roadies.
#212 *I Brew the Beer I Drink.* Proudly state your priorities and skills.
#213 *I Brew Therefore I Am.* A time-honored phrase with a twist.

Red with white letters. Non-fading.

One 1 oz. $.89
Set of four #214 1 oz. $2.99

AHA Turkey Lapel Pin

A TIME-HONORED TRADITION—Every special fellowship has an insignia that makes its members known to each other and to the public. This is ours. Six-color cloisonné lapel pin. Measures 1 inch.

#204 1 oz. $3.95

The Great American Beer Festival

I came to this country in 1986 and worked as brewmaster for two breweries before joining Frankenmuth. I went to my first Great American Beer Festival in 1986—it was very well-organized. I have participated in the judgings in Europe for fifteen years. The organization and judging at the Great American Beer Festival is equal to the quality of these European judgings. The secrecy about the beers makes it interesting for me as I sit there and judge the beers in front of me, discussing it with five or six knowledgeable people. When the medals are given out, I can see how my ratings as a judge were. For brewers, this is the greatest opportunity of the year to introduce their beers and see the reaction of the public and colleagues. The Frankenmuth Bock beer, which we brought to the Great American Beer Festival, won a silver medal. This is a measurement of the beer's quality. Getting a medal says quality, and the best thing in the United States for making this statement comes from the Great American Beer Festival.

Fred Scheer
Frankenmuth Brewery Inc., judge at the Professional Panel Blind Tasting

QUAN.	ITEM NO.	SIZE	DESCRIPTION	WEIGHT	PRICE EA.	TOTAL
Please use additional sheet of paper if necessary.			TOTAL WEIGHT (16 oz. = 1 lb.)		SUBTOTAL	
					Colorado residents please add 3.7% sales tax	
					S & H (from chart)	
					CANADA + $3	
					TOTAL	

NAME _____

ADDRESS _____

CITY _____ STATE/PROVINCE _____

ZIP/POSTAL CODE _____ COUNTRY _____

DAYTIME PHONE (_____) _____

☐ **SHIP TO A DIFFERENT ADDRESS:**

NAME _____

ADDRESS _____

CITY _____ STATE/PROVINCE _____

ZIP/POSTAL CODE _____ COUNTRY _____

Payment Method

☐ CHECK OR MONEY ORDER ENCLOSED, PAYABLE TO THE ASSOCIATION OF BREWERS

☐ VISA ☐ MC $10 minimum credit card order

SIGNATURE _____

CARD NUMBER: EXP. DATE _____

Items and prices valid through Feb. 28, 1991. If catalog has expired, write or call for a new edition.

SHIPPING INFO

CANADIAN ORDERS

will be shipped Parcel Post. Canadians desiring UPS or 2nd Day Air shipping must call first.

OVERSEAS ORDERS

must have checks payable on a U.S. bank. Specify air or sea shipping. You will be billed for shipping.

SHIPPING AND HANDLING CHART

Total Weight	UPS	Second Day Air	CANADA
up to 1 lb.	$3.00	$6.00	$3.00
over 1 lb. to 2 lbs.	$4.00	$7.00	$5.00
over 2 lbs. to 3 lbs.	$5.00	$7.50	$7.00
over 3 lbs. to 5 lbs.	$6.00	$8.50	$10.00
over 5 lbs. to 10 lbs.	$7.00	*(over 5*	*(over 5*
over 10 lbs. to 20 lbs.	$10.00	*lbs. add*	*lbs. add*
over 20 lbs.	$12.00	*$1.00/lb.)*	*$1.50/lb.)*

☐ **CHECK HERE FOR *SECOND DAY AIR* SERVICE.** CALL for Federal Express. Orders to a PO Box will be shipped parcel post.

NOTE: If items you have ordered are not in stock, check the option you prefer: ☐ **back order** ☐ **refund**

➪ ORDER BY FAX (303) 447-2825

➪ ORDER BY PHONE (303) 447-0816

Weekdays 9 a.m. to 5 p.m. Mountain Time.

Association of Brewers

PO Box 287 • Boulder CO 80306-0287 • USA

Multiplying Hop Plants

Fortunately for growers, the hop plant (*Humulus lupulus*) is very easy to propagate using various techniques that can best be applied at various times during the year.

Sexual Reproduction

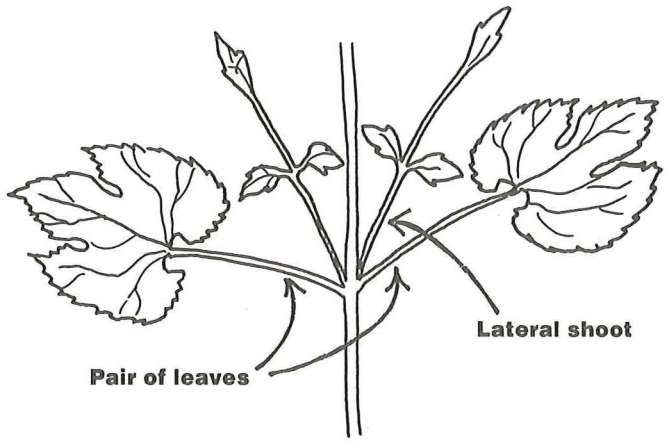
Like all plants, hops produce seeds that can be sown to grow new plants. However, hops have a peculiarity in that both a male and a female plant are required. Because only the flower of the female plant is used in brewing, the males are few and far between if at all encountered. They are not usually sold and are most often encountered in plant research centers where they are used for breeding new varieties.

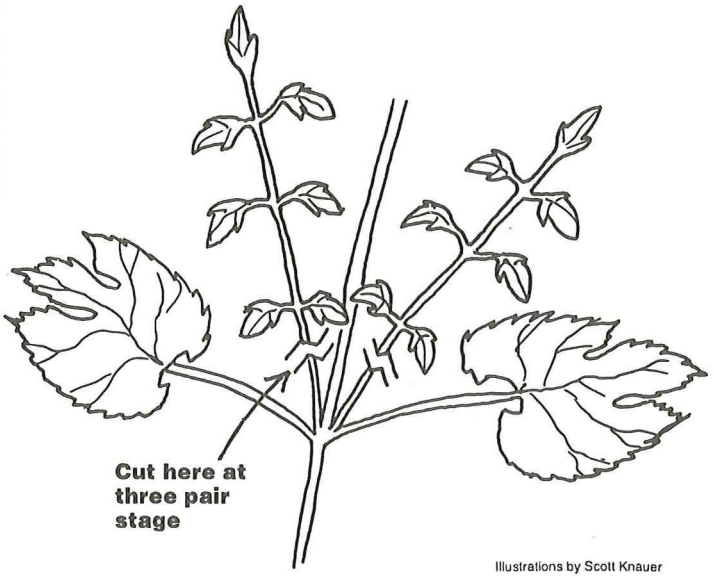
Plant scientists using various techniques fertilize female plants using different male plants, ending up with lots of seeds and thousands of seedlings. Within a year they will have eliminated almost all of these seed plants. The few that remain will be further evaluated and every few years one will be selected as a new variety. This multiplication process is quite chancy and frequently results in inferior plants. Even if you have a male plant of known parentage this technique is not for the amateur (unless you have lots of space and lots of time) and best left to the professional plant breeders.

Asexual Reproduction

This reproduction method is quite common in the world of plants and is advantageously used by amateurs and professionals alike to duplicate subjects of known qualities.

PIERRE RAJOTTE





Illustrations by Scott Knauer

Most of these techniques are centuries old. Within the past 10 years a new technique of plant propagation, *in vitro* propagation, has become quite common on the commercial scene. The method is basically the same as yeast culture. Every move must be done under absolutely sterile conditions. A minute portion of the growing tip of a hop plant is removed, (the operation takes place under a microscope), and is placed on a selected nutrient medium. There it sets roots and starts to grow. Using this technique, plant breeders can multiply one plant into thousands of copies within a few months. This is being used more and more frequently to produce disease-free plants and new varieties commercially. However, it does require very sophisticated lab equipment.

Winter and Spring Multiplication

Of interest to the casual grower are the older techniques. First let's have a look at the hop plant itself. When starting to grow in the spring it sends shoots out of the ground. In the central portion there might be more than two dozen shoots. Further out, more shoots are appearing. If you were to remove all the earth over the plant you would notice all the shoots coming out of the central plant and going out in all directions like a spider web. These are known as rhizomes. Sometimes they will run a few inches underground then emerge as a new shoot. Sometimes they will run a few feet underground before emerging. One of the convenient things about hop plants is that when you cut the rhizome from the central plant, the cut portion will make roots and start to grow by itself. This is the way hop plants have been propagated for ages.

Multiplication at the Dormant Stage

This is the way propagation is done commercially, usually in the winter when the plant is at rest. The ground must not be frozen, so this works best in areas that experience mild winters. Carefully remove the earth around the plant until you come to the rhizome. It can be from a quarter inch to one-half inch in diameter. Try to get a big rhizome. They are usually deeper than the smaller ones. Look at it carefully and you will notice every few inches a bud or slight swelling, usually lighter in color, over the root. This is where a new root will emerge. With a sharp knife cut the rhizome near the central portion and take the whole rhizome out of the ground. Now cut the rhizome about two inches left of a bud and two inches to the right. You will have a piece of rhizome about four inches long with a nice bud right in the middle. Make as many portions as you have buds.

Put these portions in individual plastic bags and keep them refrigerated. This is probably how you got your hop in the first place. When spring comes you just plant this portion. In this dormant condition hop plants can be shipped anywhere. You can also use this propagation method in early spring when growth has started. It is best, however, to take the tip portion of the rhizome that has started to shoot out of the ground, cut it and put it either directly in ground that has been previously worked or in a container filled with earth where it can stay for a couple of weeks. It will make roots and stop growing for a few days, but you will be surprised how fast it gets going again. In this form it is quite convenient to give away to friends.

Multiplication at the Growing Stage

The previous methods of multiplication are simple to do for anyone who already has hop plants. But what if you have only one plant? During the first year of growth, the new hop plant will at best just produce a few cones, so why not divide the plant? This can be done easily using the green cutting technique. When starting to grow, the new shoot will lengthen and wind itself around any suitable support. For the first month, it grows in length, making a new pair of leaves every few inches. Then it starts to send out lateral growth from the main stem where a pair of leaves is situated.

These side growths are where the flowers emerge. Because the first year will probably not produce flowers, you can use these lateral growths to better advantage by rooting them. Wait until

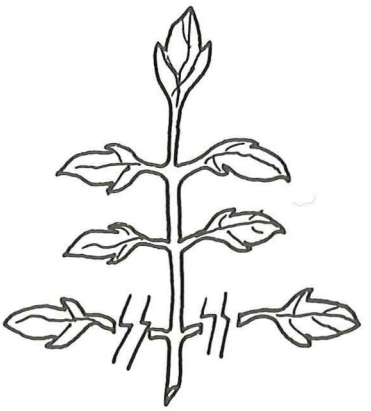
the side shoot has made three pairs of leaves. It will be no more than six inches long. With a sharp knife or scissors cut it just below the last leaf pair. Now cut away the two leaves at the bottom. You will be left with a shoot with two growing pairs of leaves, a growing tip and a bottom portion about an inch long with the two leaves removed. Have your pots of rooting medium prepared either with commercial rooting mixture or one made from equal parts of peat moss, sand and vermiculite. This gives good drainage and is quite free of insects and fungus. Now just stick the lower end of the shoot in the mixture at least a half inch and so the leaves are not touching the media. With a household mister, spray a fine mist of water and cover the whole pot with a clear plastic bag. Keep the pot out of direct sunlight.

Now and then verify that the leaves are moist, and if drying up, just spray again. After about two weeks give a little tug on the cutting. If it just pulls out stick it in again. If it feels solid, it has already made roots. Remove the rooted cutting and transfer it to a new half-gallon pot of good garden soil. Keep a plastic bag over it for a week or so, then remove it. The new plant is now on its own. You can keep it in the pot until it starts to make significant new growth. Plants propagated this way and placed in the ground will usually have attained a growth of six feet in September and will be able to produce a full crop the next year. Even if you do not have a garden you can keep hop plants in half-gallon jars for quite a while. They will grow from three to four feet on a proper support, just like a bonsai hop. However, during the winter they need a rest and a period of cold. I have plants kept this way for more than three years.

I have found this method of green cutting propagation quite convenient for the amateur. With just one new plant, you can make easily six more within your first growing season. The following year they will produce as big a crop as your original plant. You can use this method to propagate plants that you encounter during the summer. Let's say you visit a friend who has a variety that you do not have or you know of a wild hop plant growing somewhere and would like to try it.

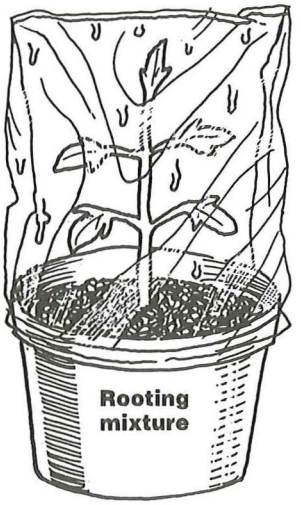
Take a green cutting. You can also keep these for a few days before putting them in the rooting medium. Put the cutting between wet paper towels. Everything must be kept moist but not soggy. Put it in a plastic bag and keep it cool. It can keep like that for a few days. When you get home just root it as you would normally.

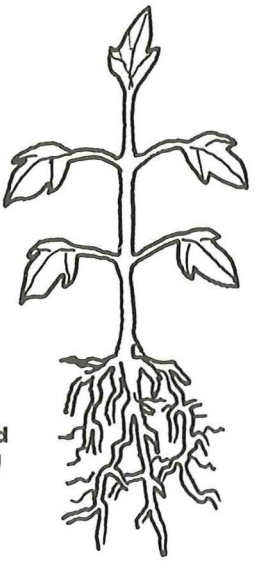
Even people who have never done plant propagation can have excellent results at multiplying hop plants. Hops are easy to work with and quite tolerant of mishandling. It's just eager to spread its good qualities around.



Remove two side leaves. Cut stem just below bud.

Transparent plastic cover





Rooted cutting

AHA Guide to Hop-Flavored Malt Extract

The AHA Guide to Hopped Flavored Malt Extract is a convenient reference to products available in the United States and Canada. It represents information received from manufacturers and distributors who responded to our inquiry. With this information homebrewers will be able to formulate better recipes and gauge bitterness from using hopped malt extract products and units.

	Dry or Syrup	Pkg. Size (lbs.)	*HBU per can	*HBU per lb.
Edme Ltd.				
Manningtree, England				
Superbrew Gold Bitter	S	4.0	12	3
Superbrew Gold Lager	S	4.0	8.5	2.1
Superbrew Strong Ale	S	4.0	12	3
Dogbolter	S	4.0	9	2.25
Arkells Bitter	S	4.0	15	3.75
Arkells Lager	S	4.0	15	3.75
Superbrew Light	S	3.3	9	2.7
Superbrew Dark	S	3.3	9	2.7
Superbrew Pale Lager	S	3.3	7.5	2.3
Superbrew English Bitter	S	3.3	9	2.7
Superbrew Stout	S	4.0	9	2.25
Brewcraft Traditional Bitter	S	4.0	15	3.75
Brewcraft Pilsner Lager	S	4.0	11	2.75
Paine's PLC.				
St. Neots, England				
John Bull Hopped Light	S	3.3	9	2.7
John Bull Hopped Amber	S	3.3	10	3
John Bull Master Class Bitter	S	4	18	4.6
John Bull Master Class Lager	S	4	13.5	3.4
John Bull American Beer	S	4	4.5	1.4
John Bull American Lite	S	4	5.3	1.6

John Bull information supplied by Robert P. Makuch, Crosby & Baker, Westport, Mass.

	Dry or Syrup	Pkg. Size (lbs.)	*HBU per can	*HBU per lb.
Brewing Products Ltd.				
West Lothian, Scotland				
Ironmaster Lager	S	4	6	1.5
Ironmaster Stout	S	4	10	2.5
Ironmaster Pilsner	S	4	8	2
Ironmaster Bitter	S	4	12	3
Ironmaster Brown Ale	S	4	6-7	1.5-1.75
Ironmaster Pale Ale	S	4	7	1.75
Ironmaster Belgian Dark	S	4	10	2.5
Ironmaster Canadian Ale	S	4	8	2
Ironmaster Belgian Light	S	4	9	2.25
Ironmaster Export Bitter	S	4	10	2.5
Telfords Nut Brown Ale	S	3.3	8	2.4
Telfords Pilsner	S	3.3	8	2.4
Telfords Stout	S	3.3	12	3.6
Telfords Porter (new)	S	3.3	7	2.1
Telfords Wheat Beer (new)	S	3.3	9	2.7
Telfords Lager		3.3	9	2.7
Telfords Export Ale		3.3	8.5	2.5
Telfords Traditional Ale		3.3	10	3
Telfords Extra Pale Ale		3.3	7	2.1

* The expression "HBU" refers to homebrew bittering units. HBU equals the number of ounces of hops multiplied by the percent of alpha acid in the hops.

	Dry or Syrup	Pkg. Size (lbs.)	*HBU per can	*HBU per lb.
Glenbrew Ltd.				
Edinburgh, Scotland				
Light Hopped	S	3.3	8.5	2.6
Amber Hopped	S	3.3	11	3.3
Dark Hopped	S	3.3	8.5	2.6
Pilsner Lager	S	3.3	7	2.1
Scotch Bitter	S	3.3	11	3.3
Scottish Lager	S	3.3	11	3.3
80/-Ale; Heavy	S	3.3	8.5	2.6
70/-Ale; Special	S	3.3	7	2.1
Brewmart Imported Danish Pilsner	S	3.3	11	3.3
Brewmart Imported Dutch Lager	S	3.3	9	2.7
Brewmart Imported Special Pilsner Brew	S	3.3	12	3.6
Brewmart Imported Australian Lager	S	3.3	8.5	2.6
Brewmart Imported Dry	S	3.3	9	2.7
Specialty Products International Ltd.				
North Carolina				
Light	S	3.1	7.5	2.3
Amber	S	3.1	7.5	2.3
Dark	S	3.1	7.5	2.3
Pilsner	S	5.5	7.5	1.4
Octoberfest	S	5.5	7.5	1.4
Bock	S	5.5	7.5	1.4
Munton & Fison PLC.				
Suffolk, England				
Hopped Light	S	3.3	7.5	2.3
Hopped Amber	S	3.3	12.5	3.8
Hopped Dark	S	3.3	12.5	3.8
Old Ale	S	3.3	12.5	3.8
Lager	S	3.3	7.5	2.3
Premium	S	3.3	12.5	3.8
Stout	S	3.3	13.75	4.2
American Light	S	3.3	5.75	1.7
Pilsner	S	3.3	7.5	2.3
Canadian Ale	S	3.3	7.5	2.3
Spraymalt Hopped Light	D	3 or bulk	n/a	2.3
Spraymalt Hopped Amber	D	3 or bulk	n/a	3.5
Tom Caxton Ltd.				
Durham, Norfolk, England				
Super System Bitter	S	3.3	8.0	2.4
Super System Lager	S	3.3	8.0	2.4
Super System Yorkshire	S	3.3	11.0	3.3
Super System Pilsner	S	3.3	9.0	2.7
Super System Export	S	3.3	11.0	2.4
Standard Bitter	S	3.3	11.0	2.4
Standard Lager	S	3.3	8.5	2.6

zymurgy thanks the manufacturers and distributors who supplied information for this chart.

Courtesy of Al Haunold

Hand-picking in a modern-day Yugoslavian hop yard.

Factors Influencing Hop Utilization or Where Does It All Go?

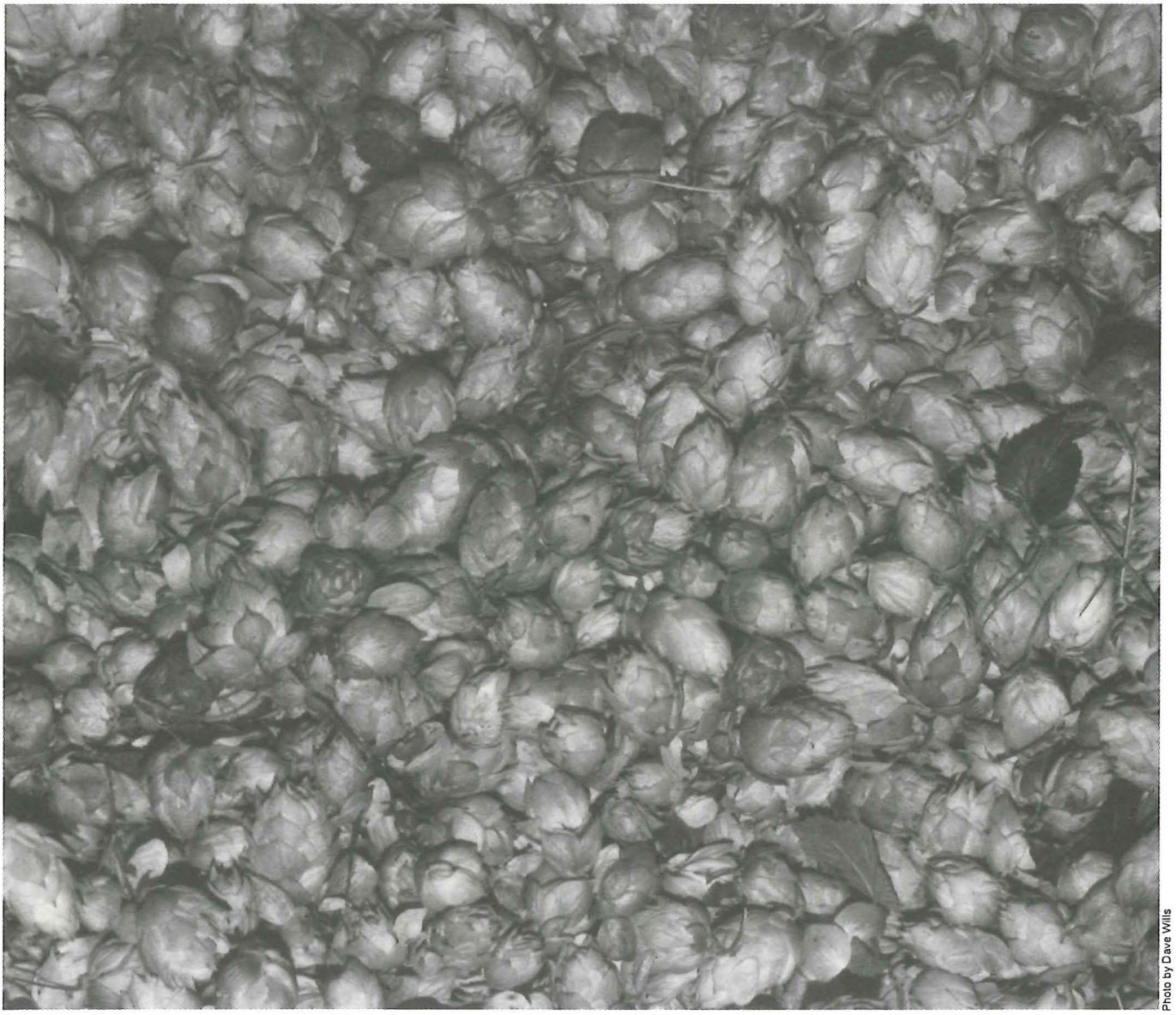


Photo by Dave Wills

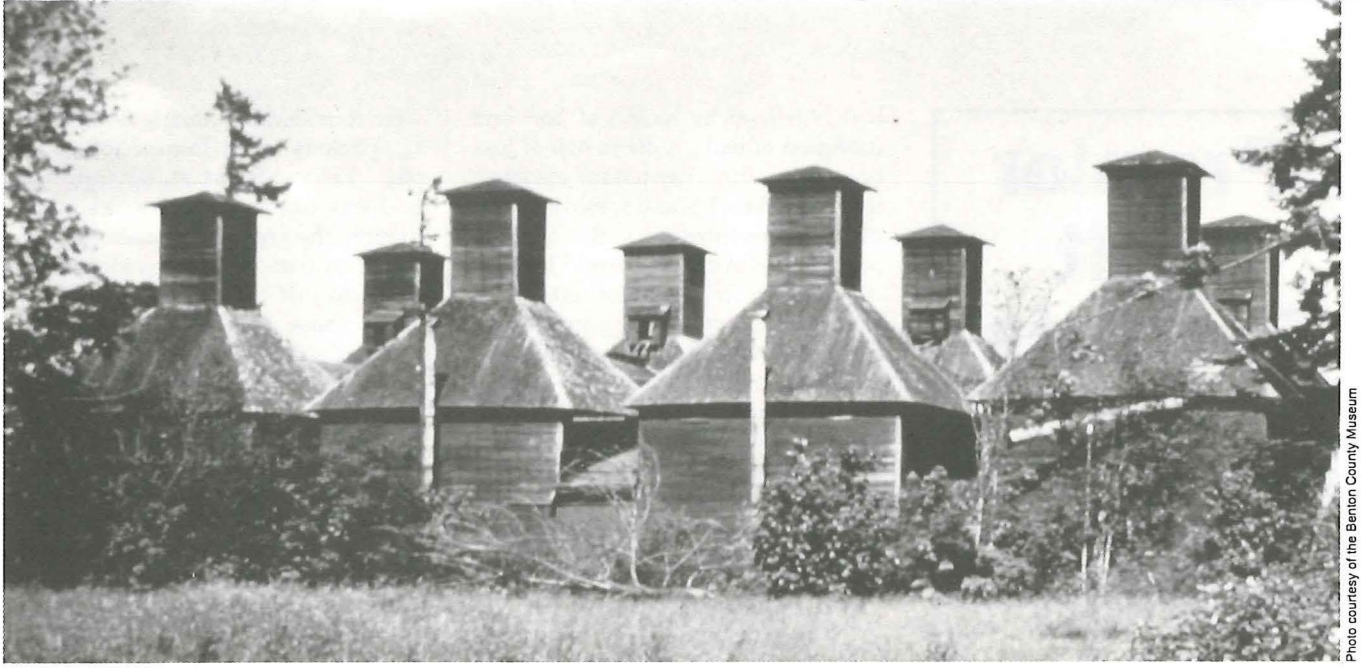


Photo courtesy of the Benton County Museum

Abandoned oast houses (hop kilning barns) in Oregon. Opposite: Hops in kiln.

Despite basic brewing education done in recent years by the American Homebrewers Association, among others, many homebrewers are still unaware of the effects of alpha acids in beer and the alpha-acid content of different hop varieties. Every so often, a homebrewer will bring me a sample of a prized homebrew, and the conversation usually goes something like this. . .

Ramsey: (after eye-popping, tongue bursting blast of homebrew) How many BUs in here?

Homebrewer: What's a BU?

Ramsey: [Short explanation.]

Homebrewer: Well, I always put in about three ounces.

Ramsey: Of what variety?

Homebrewer: Whatever I have on hand.

This was acceptable back in the "dark ages" of homebrewing. When I first started in California, circa 1970, if you were lucky enough to find someone selling hops they more closely resembled brown compost than fresh dried hops. Varieties were seldom listed, much less the alpha-acid content. There was no way then to produce a consistent recipe or to seriously duplicate a style. Today, the number of hop varieties available is staggering, and hop companies gladly supply alpha-acid information.

So what is a BU? BU is short for bitterness unit. A BU is a calculable or analytical way of determining how bitter a beer is or will be. Bitterness is that sensation perceived on the back of the tongue and sometimes on the back of the throat. Bitterness is generally recognized as independent of hop variety. Bitterness units measure the active ingredient in hops that bitters beer, namely the isoalpha acids, which are converted from alpha acids (humulone, adhumulone and cohumulone) during the kettle boil. Isoalpha acids provide 70 to 80 percent of beer bitterness. (For those interested in chemical formulas, see the chapter on "Chemistry of Hops" by M. Verzeli in *Brewing Science Vol. 1*, edited by J. R. A. Pollack, Academic Press, London, 1979.)

Hop oils do not contribute to bitterness. BU measurement is given as a number; for example, a certain beer may be said to have 40 BUs. This is actually the measurement of milligrams per liter of beer (or parts per million) of isoalpha acids. Many factors affect how this number is brought about. Homebrew Bitterness Units, (HBUs), provided by ***zymurgy*** on many occasions, are a good rule of thumb especially for beginners.

Why do we measure BUs? The concept is important for duplicating a style of beer (such as brown ale, weizenbock) or a specific brand with consistency from batch to batch. Differences of only two BUs in the same recipe can be detected. Or to duplicate a recipe given by noteworthy brewers like Greg Noonan or Dan Carey. Large breweries like to know their efficiency of hop utilization, defined as the ratio of bitter substances present in beer to the quantity of alpha acids used to bitter the beer.

$$\text{percent utilization} = \frac{\text{amount of isoalpha acids present}}{\text{amount of alpha acids used}} \times 100$$

As homebrewers, we should be aware of the factors that affect the total amount of isoalpha acids in our beers—otherwise known as utilization. The total alpha acids we add as hops do not end up as isoalpha acids. On the contrary, only about 30 percent of the alpha acids end up as isoalpha acids. Let's look at some of the factors that affect utilization and why it can be so low.

In conventional brewing, only about 50 percent of the alpha acids available go into the wort during the boil—a big loss. Alpha acids are extremely insoluble. As you will see later, some pretty potent chemicals are needed to dissolve them for measurement. Solubility during the

MICHAEL RAMSEY

boil is helped by length of boil and condition of boil. A short boil of less than 60 minutes does not fully isomerize the alpha acids and would contribute to non-utilization. Some alpha acids can be "overisomerized." In other words, they are "overconverted," or isomerized past isoalpha acids to a compound that does not contribute to bitterness. This generally occurs if the wort is overboiled (say, more than an hour and a half) but can also occur at 80 to 85 degrees. This is why it is important to cool the hot wort as soon as possible. Leaving the kettle on the stove too long will nullify your careful calculations.

Higher utilization also is obtained from low-gravity worts. Thus the higher the gravity of your wort, the less efficient your hop utilization, or the more hops you have to add to achieve the same BU level that would be obtained in a weaker beer. The more vigorous the boil, the more isomerization will occur. That is why we look for a "good rolling boil" in our kettles. The best utilization occurs with one hop addition, but, as homebrewers, we usually are more interested in sensory profile than efficiency!

With most strains of yeast, losses occur during fermentation. The isoalpha acids possess a slight electrical charge, are absorbed to the cell walls of the yeast and are lost during blowoff or when the yeast settles out. Any homebrewer who has tasted the yeast he has saved to repitch will appreciate this.

Every time you cause the wort or fermenting beer to foam and the foam sticks to something, isoalpha acids are lost because they are retained in the foam. Protein particles will pick up the charged isoalpha-acid particles and pull them out as the protein drops out, during both the hot and cold break. Tannins in the hops themselves, while helping to precipitate proteins, also precipitate alpha acids as they drop out.

The use of pellets will not only increase utilization percentage but will help produce a more consistent product. In the hop, alpha acids are found in the lupulin gland at the base of each bract on the hop cone. These glands are knocked loose from the dried cone during processing, shipment and storage, causing alpha-acid content to vary considerably among 3-ounce retail packets taken from a 200-pound bag. Pellets do not suffer from this problem. Isomerized extracts actually provide the greatest efficiency (above 90 percent) and are added after filtration and just before bottling. Sometimes these "isomer" additions are changed past the point where they can be affected by light—which is how some brewers market their product in a clear bottle without the beer going "skunky."

The efficiency of utilization and the amount of BUs in your beer also will depend on the freshness of your hops. Hop freshness determines how much of the alpha acid still exists, as oxygen catalyzes the enzymes responsible for the breakdown of alpha acids. Temperature also affects the breakdown of alpha acids. The deterioration rate doubles for every 59 degrees F (15 degrees C) rise in temperature during storage. Dried hops and open packets of pelletized hops should be kept as close to 32 degrees F (0 degrees C) as possible. Wrap them well to avoid freezer burn.

As time progresses, changes in alpha acid can be as high as 75 percent. Buy only green or yellow-green hops with fresh aromas. Never buy brown hops. Look for shops that keep them refrigerated or frozen. Oxidized hops sometimes develop a cheese aroma as other volatile acids deteriorate. Buy from shops that provide the alpha-acid content. (The percent alpha acid is the percent of the total weight of the hop taken up by the acid. This ranges from as low as 3 percent for older varieties, such as German Hallertauer or Tettnanger, and as high as 13 percent for newer North American varieties such as Chinook.)

Some varieties deteriorate faster than others. Bullion breaks down very fast—one of the reasons it has fallen into disfavor. Cluster is one of the most stable. Pellets store well vacuum packed but break down quickly when exposed to air. Open packs of pellets should be stored chilled in freezer wrap. Packets purchased in homebrew shops probably have been repackaged and are not under vacuum or nitrogen and should be refrigerated or frozen as soon as possible. Other hops with poor storage characteristics include Brewer's Gold, Eroica, Cascade,

Fuggle, Hallertauer, Saaz and Tettnanger. In addition, poor treatment of hops can cause loss of floral character and increases in yeast and dirty aromas in the finished beer. Studies have shown that consumer preference of beer decreases with stale hops.

Because alpha acids are so insoluble, the more hops you add the less efficient your utilization will be! Alpha acids are harder to bring into solution if there are a lot of them around. And finally, if you filter your beer through a filter pad, you will lose isoalpha acids on the cellulose molecules, which possess a slight electrical charge. If you are using a small home winemaker's filter, such as a Vin Buon, there is a small surface-to-volume ratio and your loss could be excessive.

So why are BUs important to the brewing industry? From what you taste (or don't taste), you may not think the big brewers use much in the way of hops. To be sure, their hopping rates are vastly lower than what homebrewers or even microbrewers use (around 10 to 15 BUs). However, hops represent a significant portion of the cost of commercial beer. I have stood in the hop rooms of several megabreweries and been amazed by the wide variety used—quality and variety any homebrewer would covet. Bittering unit measurement becomes important to these breweries, not only for product consistency (especially important if the product is produced at more than one location), but also because accountants purchase the raw materials—including hops. Accountants don't like getting a mere 30 percent utilization rate from something, especially if it's costly.

Any large brewery will have a pilot plant spending time and money on projects that compare different varieties (or different alpha-acid types within the same variety), their cost and the boil times required to convert the alpha acids to the required BU level. For example, a large hop producer has harvested Cascade hops and the alpha acids, among other flavor and aroma constituents, are considerably lower this year than would be expected with this variety. The hop company decides to sell them at a discount. Our megabrewery uses Cascades in their main product and could get them from another hop producer with a "normal" alpha-acid content, but the accountants want to see if there would be a cost savings if the discounted Cascades were purchased.

The measurement of bitterness units becomes a way to ensure that the final product will remain the same bitterness, and the costs can be compared. There may be problems (i.e., increased costs) using the discounted hops, such as dealing with increased bulk in the kettle, or a longer boil time that raises energy costs. Of course, the discounted hops may cause a sensory change, but that would be detected by other means. Mercifully, as homebrewers we are not usually under the cost-cutting requirements and restraints of an accountant.

How are BUs measured? As hops arrive at large breweries, samples are taken. If a brewery uses baled hops, a core is cut from every 10th bale. If pellets are used, samples are required

dog's nose. *A mixed drink of hot beer laced with gin and flavored with sugar.*

invertase. *An enzyme that hydrolyzes disaccharides to monosaccharides.*

godisgood. *An early name given to yeast by English brewers who did not understand its chemistry and workings.*

ebulum. *In old England, an ale flavored with elder, juniper, ginger and other herbs and spices.*

distiller's beer. *Fully fermented, non-hopped, all-malt beer that is distilled directly into whiskey.*

cant. *The piece of wood, at the head of the cask, in which a tap hole is pierced.*

from every 10th box. The content of both alpha and beta acids is tested by two methods approved by the American Society of Brewing Chemists and requires specialized equipment and chemical reagents. The first is a spectrophotographic method where the acids are "dissolved" in a mixture of benzene, toluene and methanol. An analytical balance for measuring and a mechanical shaker also are required. The dissolved alpha acids are then measured in the spectrophotometer, which measures the wavelength of refracted light. Every substance on earth refracts light at a certain wavelength. The reading is inserted into a standard equation and the totals are determined. Speaking from personal experience, this procedure is quite difficult as alpha acids register at a very low wavelength and are extremely sensitive to light anytime during the procedure.

The converted isoalpha acids, or BUs, in beer are measured by a spectrophotometric method also, similar to the method described for alpha acids.

The second method involves titration of a hop infusion with lead acetate and sulfuric acid. An electrical conductivity meter is hooked up to measure conductance of the solution changes, which are plotted on a graph. Alpha acids can then be determined by joining the points on the graph.

As you can see, these methods involve costly equipment and some nasty chemicals. They are not really practical for the homebrewer (or microbrewer). Some laboratories will measure BUs for the homebrewer, such as J.E. Siebel of Chicago who will do it as part of their complete lab service and sensory profile.

We can't do much about our utilization rate—about 30 percent is maximum for homebrewers. It's just one of those facts of life. With the amount of hops we use, it's not really critical to increase utilization. But it is important to realize where it all goes and why hop utilization is not efficient. Homebrew bitterness units (see "Easy Hops" by Monica Favre and Tracy Loysen, ***zymurgy***, Spring 1990 Vol. 13, No. 1) are a good, basic way of determining how bitter your beer will be, or duplicating a general style, but these calculations do not take into account the 30 percent efficiency of hop additions.

Some published homebrew recipes merely call for a certain number of ounces or grams of a hop variety. Year-to-year variation exists and to substitute another variety is a ballpark guess. To make these recipes you have to use an average alpha-acid content for that variety (available in books) and figure. But let's say you are trying to duplicate a Maibock that Greg Noonan says has 30 BUs. Or you have learned from a visit to your local microbrewery that your favorite beer, John Butler Brown Ale, has 25 BUs, provided by Northern Brewer and Galena hops. For maximum utilization, hops should get at least a one-hour boil and no more than 1 1/2 hours. Although commercial brewers are moving toward a single hop addition,

Equation 1.

$$\text{weight of hops required (in grams)} = \frac{\text{volume of wort} \times \text{BUs required} \times (.001)}{\text{percent utilization} \times \text{percent alpha acid}}$$

Equation 2.

$$\frac{18.9 \text{ Liters} \times 30 \text{ BUs} \times 0.001}{0.30 \text{ (utilization)} \times 0.048 \text{ (alpha acid)}} = 39.4 \text{ grams (or about 1 1/2 ounces)}$$

Equations 3 and 4.

$$\frac{18.9 \text{ Liters} \times 10 \text{ BUs} \times 0.001}{0.30 \text{ (utilization)} \times 0.065 \text{ (alpha acid)}} = 9.7 \text{ grams (or 1/3 ounce) from Northern Brewer}$$

$$\frac{18.9 \text{ Liters} \times 15 \text{ BUs} \times 0.001}{0.30 \text{ (utilization)} \times 0.131 \text{ (alpha acid)}} = 7.2 \text{ grams (or 1/4 ounce)}$$

approximately 10 percent of the total hop charge is added at the start of the boil to help eliminate boilovers. Homebrewers should add a small amount of hops at the beginning of the boil and keep an additional small amount handy to toss into the kettle if it should get "overactive!" So, for the example of the Maibock with 30 BUs we can assume a one-time addition and a one-hour boil. There is a nice equation used in Michael Lewis' lab at the University of California–Davis (see Equation 1).

Courtesy of The Maine Hopper

Picking the hop.

If you use a full five-gallon carboy, the volume of wort is 18.9 liters. Because BUs are actually milligrams per liter, the rest of the equation must be determined metrically. If your carboy is smaller or larger, just multiply the total gallons by 3.785. The .001 is a constant and is used every time you use the equation. We will consider 30 percent to be our utilization rate, which is about right for homebrewers. The alpha acid will depend on the hop variety and will change every time. If you are not using metric measurements, you really should. But if you still need to know the amount of hops in ounces, just multiply the total grams by 0.0353 (1 gram equals 0.0353 ounces).

For the 30 BU Maibock let's use Yakima Hallertauer at 4.8 percent alpha acid. The equation for a full five-gallon carboy would be as in Equation 2.

For the John Butler Brown Ale, we want the bitterness to come from two varieties of hops, Northern Brewer (6.5 percent alpha acid) and Galena (13.1 percent alpha acid). We've decided to get 10 of the 25 total BUs from the Galena and the other 15 from the Northern Brewer. We do two separate calculations (Equations 3 and 4).

Because characteristics other than bitterness derived during the boil are somewhat subjective, I will leave it to you to decide if your bittering should come from one hop or several. If you like to spread your hop additions out over the entire boil, then you will have less BUs than a recipe you are using and the flavor may be different—but it still could be great. Dry hopping can add alpha acids to the beer and increase the perception of bitterness, but it will not increase the actual BU level. However, if you keep good records, and that is the key to good brewing, you should be able to duplicate your recipe again.

Author's note—You will note that I have not considered beta acids. The betas influence bitterness only somewhat and are not considered in any calculations. However, some studies have shown that as hops age, the oxidation of betas provides the bitterness lost by the alpha acids.

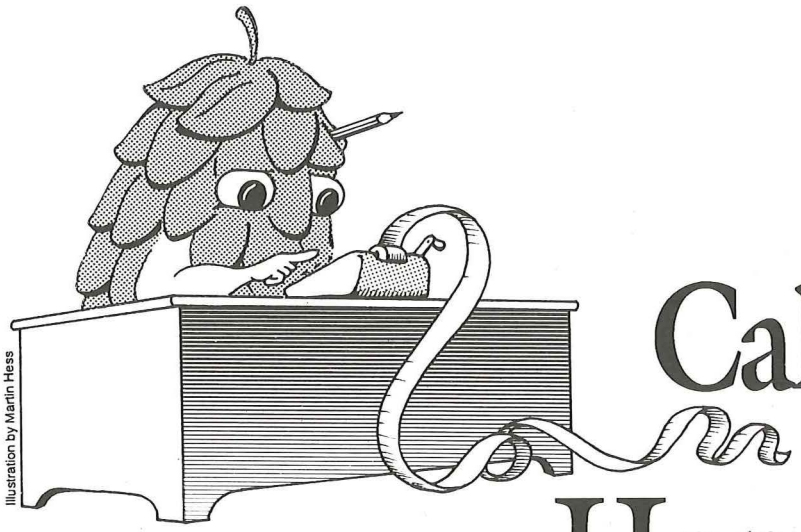


Illustration by Martin Hess

Calculating Hop Bitterness in Beer

Has confusion over the use of AAU, BU, HBU and IBU left you with a bitter taste in your mouth? Was that bitter taste left by your latest homebrew that should have emphasized the malt? If so, this article may be your ticket to better-balanced brews.

First, let's familiarize ourselves with the four terms for the two calculation methods used to determine the bitterness in beer. They are BU (Bittering Units), HBU (Homebrew Bittering Units), AAU (Alpha Acid Units), and IBU (International Bittering Units). Why we need two names for each calculation is beyond me. That's an issue best left up to the HSC (Homebrewing Standards Committee), if one exists. If I understand what I've read, AAU and HBU are calculated by multiplying the weight of hops (in ounces) by their alpha acid. IBU and BU include boiling time in the calculation.

Which is best for determining bitterness in beer? What do you do if you want to decrease or increase the hop bitterness of a particular recipe, or if you want to develop your own recipe? What would happen if you boiled the hops 20 minutes less or more? To answer these questions, you need more data on the effect boiling has on hop utilization.

JACKIE RAGER

What homebrewers need is a formula for determining how much bitterness will be derived from a hop addition or how to determine how much hops to add to get the desired bitterness. The following utilization chart (Table 2) and formulas have been developed to satisfy that need. I must give credit to Fred Eckhardt, Dave Miller and Byron Burch because information gleaned from their books forms the basis for this chart and formula. My contribution was to experiment with their data, fill in some of the gaps and develop the formula to cover any batch size and wort density.

Keep in mind that Table 2 and the calculations are for bitterness only. Your aroma, flavoring and bittering hop rates should be determined based on the style of beer being brewed. Hops boiled five minutes or less contribute more to aroma than to bitterness. Hops boiled six to 25 minutes contribute greatly to the flavor of the beer. Bitterness is extracted in greater amounts by longer active boiling.

Table 1.

Abbreviations used in the following formulas:

%U	Percent utilization
%A	Percent alpha acid
W_{gr}	Weight in grams
W_{oz}	Weight in ounces
V_{gal}	Volume in U.S. gallons
V_L	Volume in liters
GA	Gravity adjustment
GB	Gravity of boiling wort
IBU	(International) Bittering Units

A gravity adjustment calculation is used for high-gravity beers or when the brew kettle is too small to boil the full batch. It is calculated by taking the larger of gravity of boil (GB) minus .050, divided by 0.2. If neither gravity is greater than 1.050, then (GA) equals 0.

$$\frac{(GB) - .050}{0.2} = GA$$

All percentages should be expressed as decimal equivalents.

If using metric measurements of grams and liters, the equations for finding IBUs and grams of hops are:

$$IBU = \frac{\%U \times \%A \times W_{gr}}{V_L \times (1+GA)} \times 1000$$

$$W_{gr} = \frac{V_L \times (1+GA) \times IBU \times .001}{\%U \times \%A}$$

If using English measurements of ounces and U.S. gallons the equations for finding IBUs and ounces of hops are:

$$IBU = \frac{W_{oz} \times \%U \times \%A \times 7462}{V_{gal} \times (1+GA)}$$

$$W_{oz} = \frac{V_{gal} \times (1+GA) \times IBU}{\%U \times \%A \times 7462}$$

Suppose you have 1 1/2 ounces of Bullion hops with an alpha acid of 8.0. You want to know how many IBUs you would get by boiling them 45 minutes in five gallons of 1.045 OG wort.

$$IBU = \frac{W_{oz} \times \%U \times \%A \times 7462}{V_{gal} \times (1+GA)}$$

$$= \frac{1.5 \times .269 \times .08 \times 7462}{5 \times (1+0)}$$

$$IBU = 48.2$$

To determine how many hops to add to get a desired IBU; say 32 IBU:

$$W_{oz} = \frac{V_{gal} \times (1+GA) \times IBU}{\%U \times \%A \times 7462}$$

$$= \frac{5 \times (1+0) \times 32}{.269 \times .08 \times 7462}$$

$$W_{oz} = 1.0 \text{ oz}$$

Example:

How many Hallertau hops at 4.8 alpha acid boiled 40 minutes are required to give 32 IBUs in a five-gallon batch with a specific gravity of 1.048? If the gravity is below 1.050, the GA is not calculated. But if my brew kettle will only boil 2.5 gallons (half the batch) then my gravity of boil (GB) would be 1.096, twice the 1.048 OG.

$$GA = \frac{1.096 - .050}{0.2} = .24$$

The hop weight calculation is:

$$W_{oz} = \frac{V_{gal} \times (1+GA) \times IBU}{\%U \times \%A \times 7462}$$

$$= \frac{5 \times (1+.24) \times 32}{.228 \times .048 \times 7462}$$

$$W_{oz} = 2.4 \text{ oz}$$

Table 2.
IBU Chart.

Boiling Time	Percent Utilization
Less than 5 minutes	5.0%
6 - 10 minutes	6.0%
11 - 15 minutes	8.0%
16 - 20 minutes	10.1%
21 - 25 minutes	12.1%
26 - 30 minutes	15.3%
31 - 35 minutes	18.8%
36 - 40 minutes	22.8%
41 - 45 minutes	26.9%
46 - 50 minutes	28.1%
51 - 60 minutes	30.0%

Note: In formulas, percent utilization must be expressed as a decimal.

Table 3.
Beer Style.

	IBU Range
Light Beers	
American Light	7.0 - 19.5
American Standard Premium	9.3 - 17.0
International Style Lager	18.0 - 40.0
North German Lager and Pils	28.5 - 40.0
Cream Ale	20.0 - 70.0
Amber Beers	
Vienna Lager	14.6 - 26.0
Oktoberfest/Maerzen	17.0 - 34.0
Steam	40.0
Bitter	23.0 - 44.0
Pale Ale	19.0 - 54.0
Kölsch and Alt	21.0 - 31.0
India Pale Ale	19.0 - 87.0
Trappist	11.2 - 24.0
Dark Beers	
Schwarzbier	28.0 - 40.0
Bock	26.0 - 35.0
Brown Ale and Mild	31.0 - 38.0
Black Beers	
Porter	34.0 - 56.0
Sweet Stout	29.0
Dry Stout	35.0 - 90.0
Belgian Triples/ Barleywines	32.0 -100.0
Wheat Beers	
Weisse and Weizen	10.5 - 20.0
Berliner Wiesse	4.0 - 5.0
American Wheat	15.0 - 27.0

IBU figures were derived from *Essentials of Beer Styles*, by Fred Eckhardt.

Matching Hops with Beer Styles

Photo courtesy of the author

At a meeting last October of the Sonoma Beerocrats in Santa Rosa, Calif., we were discussing the Beer Judge Certification written test we had taken. I had finished with a respectable score, enough to grant me national status once gaining enough experience points. I was reflecting on how my studies were lengthy and comprehensive but not necessarily complete enough to judge all the beer styles in the AHA categories with absolute confidence. Not all of the styles are commercially available for comparison, and few of the more exotic styles were being brewed by club members.

I had a notion that if I went to the trouble of brewing each of the styles in all the beer categories that I could gain that knowledge through research, hard work and a certain amount of luck. Quite a formidable task, considering I brew all-grain beers. To my knowledge, no one had ever attempted this in the history of the AHA and I doubt they would be canonized if it were accomplished. But with the prospect of attaining immortality, and being completely bereft of sound mind, it was easy to conjure up a plan to do that very thing.

QUENTIN B. SMITH

I was hoping no one took me too seriously, but by the Christmas meeting word had circulated to the point where everyone was asking how I was doing on the project. Frankly, I hadn't started, nor was I really prepared to conduct such an effort. I think I was shamed into it for opening my big mouth. Doubly troubling was the fact that most recipes in past issues of *zymurgy* for the beers I planned to brew were for extract brewers. I

would have to create a good share of the recipes myself and hope for the best.

I have now completed 26 separate and individual beers for the cause, 24 of which I sent to the 1990 AHA National Competition. Of the two beers I was unsatisfied with, one turned out to be a gusher so I rebrewed it, and the other, a weizen, was set aside because I don't care for the clovelike flavor. In May, the club met to sample each of the beers I brewed, to discuss style, color, hops and quality of the brew, and fill out a simplified judging sheet to help the members get up to speed in brewing styles they weren't familiar with. The judging sheets were returned to the participant, along with the scores from the first-round national competition, to allow them to compare their knowledge with the experts. Hopefully the club will gain new insights from the experience. Certainly the cost was right—nothing. To conduct a similar event with five bottles of the commercial beer for each style, the cost would be prohibitive.

Space prevents me from detailing the complete effort, but I did plan out each beer to be made, along with the ingredients and the date I intended to brew. As the beers were moved about, racked and bottled, I could repitch those yeasts available for succeeding batches, thereby saving expense and, above all, fermentation time because I was pitching large amounts. This article is limited to the hops I used and how I arrived at their particular values. As an aside, I've been accused of "shotgunning" the contest; that is, to fire off a broad salvo hoping to hit something in an effort to win an award. I don't see it that way at all.

In fact, I see several benefits. I believe that my future brewing efforts and the quality of my beers will be that much better for having done this. I have compressed five or six years of brewing experience into a few months of frenzied activity. I will have the judges' comments to help me upgrade my beers, as well as an information bank to refer to. I keep all my score sheets from year to year. A side benefit is gained by those who choose to draw upon my knowledge. Additionally, the beers I judge in the coming years will get the best effort I can muster. Likewise, providing informative written answers to correct brewing problems will be much easier to deal with, because I probably suffered from the same character builders during my sojourns.

My source materials were very helpful and should be part of every serious (and not so serious) homebrewer's library. Charlie Papazian's *The Complete Joy of Home Brewing* contains an excellent section on hops, their importance and styles with appropriate photographs. Michael Jackson's two books, *The New World Guide to Beer* was used for beginning gravities, color, bittering units and taste profiles and his updated version of *Pocket Guide to Beer* allowed me to find the better commercial versions of beers within a style. I also found Fred Eckhardt's new book, *The Essentials of Beer Style*, quite useful in comparing his notes on color, beginning and final gravities and bittering units with Jackson's. The All Grain Special Issue of ***zymurgy*** (Vol. 8, No. 4) is an important bible and a must for grain brewers. I used it heavily, as well as all back issues, for award-winning recipes.

The most important reference book to me, however, is Byron Burch's *Brewing Quality Beers*. The information on bittering units, color and gravities needs to be interpreted for the final product. You will find all of these in tables and formulas provided in the last portion of this book. Commercial brewmasters use the American Society of Brewing Chemists (ASBC) system of bittering units (BUs, and also called IBUs). It works with information obtained from Eckhardt and Jackson, articles from

Photo courtesy of the Benton County Museum

Indians had reputations as good pickers. Some growers regularly recruited Indians from local reservations.

the *New Brewer* and conversations I've had with local brewmasters. It is easy to understand and no interpolation is needed. Burch's book allows me to calculate BUs for any batch as long as I know the alpha-acid content of my hops. All suppliers should provide this to you as a standard practice. You cannot consistently brew duplicate or award-winning beers without it.

Part of my education in hopping came from judging sheets from earlier contests that used the phrase "balanced beer." Obviously, not all my beers were "balanced," as some styles would dictate otherwise. But the term has some merit, so I developed a formula that will help you fit your beer in the stream of balance between hop and malt. The chart on balanced beer hop formulas shows original gravities starting with 1.010 in increments of 10, and up to a gravity of 1.100. The hop rates provided will yield a neutral balance of hop and malt, and allow you to customize your beer to one side or the other.

Balanced Beer Hop Formula

Quentin B. Smith © 1990

Beer Wort Original Gravity	Hop Level Total Bittering Units (BU)
1.010	4
1.020	8
1.030	12
1.040	16
1.050	24
1.060	32
1.070	40
1.080	48
1.090	56
1.100	64

You will note that gravity is shown in 4 BU increments until 1.040, then jumps 8 BU rates thereafter. To explain why would take the better part of this article, but the table will provide you with a starting point based on original gravity. If your gravity falls between the numbers, say 1.045, you have several choices. One is to use the lesser number at 1.040, or you can combine the 1.040 BU of 16 and 1.050 of 24 BU, and divide by two to arrive at 20 BU. I wouldn't recommend jumping to the next category by rounding off, but this would be up to the brewer based on fondness for hops and the kind of finishing hop used.

I hop almost all my beers at three intervals—the boiling hops for 60 minutes, the flavoring hops for 30 minutes and the aroma hops at the end of the boil, then immediately chill the wort. Occasionally I will dry hop using Byron Burch's formula for figuring total bittering units. I indicate where I differ from the times of 60, 30 and end of boil. The balanced beer table indicates whether these beers are hoppy, malty sweet or truly balanced because I have provided the starting gravities. Now for the beers that I brewed.

American Light

I won first place at the HWBTA last year with nothing but Cascade and Tettnanger hops in the recipe, New Ulm yeast and 21 BU, proving that a rather angular beer can win in a tough category. I have softened my approach to this group, using St. Louis lager yeast and Chinook hops as a base bittering of 11.6 BU, 2.53 BU of Perle hops (30 minutes), and 2.28 BU of Hallertauer and Tettnanger at the end, for a total of 15.4 BU (OG = 1.046). Budweiser uses 10.5 BU, but makes up for it by increasing its carbonation level. They use up to 11 different varieties of hops, not relying on any one producer. Coors regular beer (15 BU), according to a retired FDA official, used to use Czechoslovakian hops, although Cascade and Hallertauer have been seen there recently. Complexity is the keynote for these beers, so mix up your different hops and have at it!

Continental Pilsener

Pilsener Urquell is the style's flagship beer that everyone tries to duplicate. Nothing but soft water and Saaz hops will do for this beer. I was able to get my hands on a yeast from Wyeast (Bohemian Lager) from Czechoslovakia. Use 40 BU only if you have soft water; hardness increases hop bitterness. I used Saaz hops throughout, with Chinook providing base bittering of 20 BU. Saaz hops are expensive, and Chinook is a benign hop of great strength, so I use it in almost all my beers for base bittering to save money. (OG = 1.046).

Dortmunder

Water hardness prevails in this beer and the recommended BU appears to be from 24 to 29. I settled on 29 BU because I used the Wyeast Bavarian yeast, which has a tendency to leave residual sweetness in the final product, so I went to the higher level. Again, Chinook was used for base bittering of 23.5 BU The remainder was a mixture of Hallertauer and Tettnanger for flavor and aroma. On light-colored beers, I usually add aroma hops 10 minutes from the end of the boil instead of the exact end for better dispersal. (OG.= 1.059).

Munich Helles

This beer has a nice round body and fullness from malt (OG = 1.058), and the hops are continental in nature. I skipped the Chinook and used only Hallertauer and Tettnanger throughout. Total BU was 24.35.

Cream Ale

Not unlike our American lagers, on the light side (OG = 1.042), this beer can use any indigenous hop—Cascade, Northern Brewer, that is found in any U.S. beer. I used Perle as a bittering base at 13.34 BU, with Cascade at 30 minutes, and at the end for a total of 19.95 BU.

Sourmash Lager

Having only heard about this beer from Oldenburg at the 1989 AHA National Conference, I had to guess its makeup and corresponding BU. I used Bavarian yeast for authentic German characteristics and Chinook as a base bitter (10 BU). Then I mixed Hallertauer and Tettnanger for the 30-minute and 10-minute boil. Total BU was 21.45 (OG = 1.044).

Weizen

Not my favorite beer, with clove preponderance. Base of Chinook (5 BU) and a mixture of Hallertauer and Perle for flavor and aromatics. Total BU was 10, (OG = 1.046).

American Wheat

My wife Karen's favorite beer. I've taken a number of firsts with this beer and a second place at the 1989 AHA National Competition (recipe in ***zymurgy*** Spring 1990, Vol. 13, No. 1). I've played with this one successfully a number of times, varying the type of hops. The national winner used Chinook, Eroica and Tettnanger for a 17 BU total, OG = 1.052. I have subsequently used Perle and Hallertauer with Chinook as the base with equal results, still 17 BU total.

India Pale Ale

This beer was fashioned after my favorite local ale, Liberty from Anchor Brewing in San Francisco. The taste is strictly Cascade hops from head to toe, a total of 45 BU. I used Chinook as a base for bitterness of 24 BU, 12 BU in the flavor and 9 BU dry hopped with Cascade. (OG = 1.062).

Helles Bock

One of my favorites. I use only Hallertauer and Tettnanger mixed throughout. Total BU was 24. A beautiful color of dark gold and an unforgettable malty sweetness with an original gravity of 1.072. I brewed this beer a year ago; all the others except two were brewed between Feb. 12 and March 23, 1990.

Helles Dopplebock

A stalwart beer, hopped the same as the Helles Bock, but 29 total BU, and a higher original gravity of 1.082.

Kriek Lambic

I was really lost on this one. The original uses two-year-old hops. Thankfully my supplier was unable to give me anything but fresh hops, so I finagled. I put hops in the oven at 250 degrees for a 15-minute period and "aged" them. I used 1 1/2 ounces of Cluster (7.3 alpha acid) and put them in the beginning boil (OG = 1.052) and boiled for two hours. Approximate BU was 24. No more hops were added according to the Belgian tradition. The yeast was cultured from Lindemans Kriek.

Vienna

Another traditional style. I used Chinook to base bitter for 11.6 BU, the remainder a mixture of Hallertauer and Tettnanger for flavor and aromatics. Original gravity was 1.046, the total BU was 27.

Steam

My friend Mark Carpenter at Anchor helped me on this one, while still guarding the secrecy of their process. Northern Brewer hops exclusively, three additions to the boil (OG = 1.054), no dry hopping. Total BU was 40. Another favorite of mine.

Alt Beer

Good examples of commercial alt are hard to come by and, again, I went to the examples Jackson and Eckhardt produced. I used base bitter Chinook for 23 BU and the remainder of Hallertauer for a total of 38 BU (OG = 1.049). I am pleased with the outcome of this particular brewing effort.

Steinbiere

Hot rocks! What a sensation watching the smoke and steam erupt from the wort when dumping heaps of rocks in your beer. An age-old style from Germany, no known commercial examples were available, so I guessed. *Do not hop the wort before introducing the rocks!* You will have a mess! I used Jackson's BU rate of 35 and Chinook as a base, Northern Brewer for flavor and Hallertauer at the end. Unbelievable! Original gravity, minus rocks, was 1.046.

Brown Ale

I tried to duplicate Newcastle Brown Ale here. A low-gravity beer (OG = 1.032) and not much hop aroma. I kept the hops to the base bitter with Northern Brewer, Perle at midpoint, and Northern Brewer again in the end. Total was 15 BU.

Scotch Ale

I'm not fond of this style, either, because it tends to be so sweet. I kept the gravity in the mid-40s and the total BU to 16. Again I used Northern Brewer and Perle as in the Brown Ale above.

Rauchbiere

The smoke in the commercial examples tends to overwhelm anything else in the beer, so any hop will do. I used 28 to 38 BU, depending on gravity.

My original gravity was 1.052 and I used 38 BU.

Fruit Beer

I used blueberries in this recipe, a completely foreign beer style and first attempt for me. I used only Hallertauer on an original gravity of 1.052 and total BU of 25.

Herb Beer

With all the spice—ginger, nutmeg, cinnamon, allspice and tangerine essence—I thought Cascade would be appropriate here with its own flowery spice. Spices were added 10 minutes from the end of the boil. Total BU was 25 with an original gravity of 1.050.

Porter

Actually this was a stout porter, high original gravity of 1.072 à la Anchor Porter. Base bitter Chinook for 56 BU, Northern Brewer for flavor at 10 BU, and Cascade at the end with 3 BU. Total was 69 BU.

Sweet Stout

At an original gravity actually lighter than my porter (1.062), the total BU came in at 83. Chinook base bitter, Northern Brewer for flavor and Cluster at the end.

Barley Wine Ale

The granddaddy of them all! Again, thanks to Carpenter for his help on this one. I only had six weeks in which to brew and felt that I could not enter this category because most of these beers require lengthy aging to smooth out and develop the complexities so important to their profile. I wanted to duplicate "Old Foghorn" if I could and that told me Cascade hops! Unfortunately, Eckhardt's book indicated a 30 BU total. Maybe 130 total, but not 30. Because my beer couldn't age very long, Carpenter said to keep the total BU to 60 with heavy dry hopping at the end, to avoid overhopping. Anchor keeps their barley wine on the yeast for nine months, while dry hopping. I still don't know what their total BU is—trade secret, of course—but I am happy with the beer I made. Original gravity was 1.100, 47 BU during the boil with Chinook, 14 BU for 30 minutes and 7 BU worth of dry hops over six weeks with Cascade.

One final note: I only used pelletized hops and have never reduced my BU by the recommended 10 to 20 percent some claim comes from better utilization. For extract brewing, I would cut back on the total BU given here to make up for the body and dextrin content that all-grain recipes have in greater quantity. This completes a rather overwhelming task that I am very happy with. Next year? It would be nice if someone else grabbed the gauntlet and ran with it. But, just in case they don't, let me know *early*!

WINNERS CIRCLE

DAVID EDGAR

America's Best, 1990

Wow! The biggest brewing competition in the world keeps getting bigger! While the 975 entries at the 1989 National Homebrew Competition demonstrated unprecedented growth (30 percent over 1988), the number of entries submitted to the 1990 National Competition was more than 50 percent greater than that—a total of 1,548.

This year's competition also is significant for the two brewery trip prizes awarded to the winners of the Barley Wine and Bock categories. Barley Wine champion Clay Biberdorf of Portland, Ore., will be flown to London courtesy of Young and Co. Brewery, to assist in the brewing of a batch of Young's famous Old Nick Barley Wine. And best bock brewer Darryl Richman will visit Drammen, Norway, courtesy of Aass Brewery, to help in the brewing of the legendary Aass Bock. The AHA's goal is to eventually have a brewery-prize sponsor for all 23 categories of the National Competition.

Of the total 1,541 entries, the five most popular categories (in order of number of entries) were Pale Ale, Stout, Brown Ale, Bock and Pilsener. The classes that experienced the most dramatic growth (more than 90 percent over 1989) were Traditional Mead, Belgian-style Beer, Pale Ale, Fruit Beer and Wheat Beer. Nine other classes experienced more than 50 percent growth over last year: Bock, Barley Wine, Flavored Mead, Cream Ale, Scotch Ale, Munich, Alt, Brown Ale and Stout. Two categories received fewer entries this year than last, Continental Dark and Rauch.

So here are the 21 best beers and two best meads—extracted from the 1,500-plus entries with the invaluable help of the critical palates of 190 judges—ready for you to try your hand. There is something for every level of brewer here, novice to expert. Four of the first-place beers were brewed with malt extract only, five with malt extract and grains, and 12 all grain.

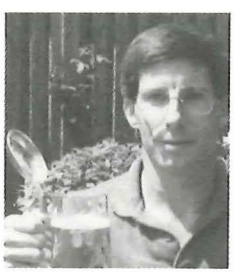
The winner of the wheat beers, Michael Croddy, said his winning beer was one of the easiest beers he has brewed. On the other hand, for those who prefer a challenge—on a Herculean scale, no less—there is Byron Burch's "Breakfast of Champions Imperial Stout Framboise," which calls for two types of malt extract, seven different grain malts, eight varieties of hops, and, *as if that weren't enough*, raspberries and wheat breakfast cereal to boot.

STATISTICS
1990 NATIONAL HOMEBREW COMPETITION
Based on data from 1,548 entries

	ENTERED	PLACED 1ST, 2ND, 3RD
Malt extract	22%	20%
Extract and mash	27%	20%
All-grain	51%	60%
	100%	100%
Glass fermenters	85%	86%
Plastic fermenters	10%	8%
Stainless steel	5%	5%
	100%	~100%
Two-stage fermentation	74%	77%
One-stage fermentation	26%	23%
	100%	100%
Used dry yeast	33%	16%
Used liquid cultures	67%	84%
	100%	100%

CREAM ALE

Yellow Dog Award
Sponsored by The Home Brewery, Ozark, Missouri



"Arlington Ale No. 33"
First Place
Richard Schmit
Arlington Heights, Illinois

1990 BEST OF SHOW

Miniature Copper Mash-Tun Trophy
Sponsored by Munton & Fison, Suffolk, England

Ingredients for 5 gallons
3 1/3 pounds John Bull light hopped malt extract
2 pounds light dry malt extract

4 ounces toasted pale malt
3 ounces crystal malt
1/4 ounce Cascade hops (10 minutes)
1/4 ounce Willamette hops (10 minutes)
1/4 ounce Cascade hops (two minutes)
1/4 ounce Willamette hops (two minutes)
1 teaspoon Irish moss
1 teaspoon ascorbic acid
Wyeast No. 1056 American ale liquid yeast
3/4 cup corn sugar for priming

- Original specific gravity: 1.042
- Terminal specific gravity: 1.013
- Primary fermentation: eight days at 65 degrees F (18.5 degrees C) in plastic
- Secondary fermentation: two days at 65 degrees F (18.5 degrees C) in plastic
- Age when judged (since bottling): six and a half months

Brewer's specifics

"Steep grains, bring to 200 degrees F (93.5 degrees C) and sparge. Hops added at end of boil."

Judges' comments

"Fruity bouquet! Good color and clarity! Nice flavor balance and aftertaste. Appropriate body for style. Very flavorful and enjoyable!"

"Aroma—clean, fresh and faintly malty, with pleasant background hops. Appearance—cream ale looking! Flavor—really nice, well-balanced. Overall—the head was a bit too creamy; otherwise a fine, delicate brew with superb balance."

"Slight phenolic aroma. Faint, sweet malt nose; no hops. Great head, fine beading. A little dark for category. Very slight haze. Very good balance; just a tad sweet. Very slight astringency. Wonderfully creamy! The tingle of the fine bead on the tongue is delightful."

ALT

Great Fermentations of Santa Rosa
Altbier Challenge Cup
Sponsored by Great Fermentations of Santa Rosa, California

"Kolsh" (Kölsch)

First Place
Norman Dickenson
Santa Rosa, California

Ingredients for 5 gallons

9 pounds Klages 2-row malt
1 pound wheat malt
4 ounces crystal malt (20 degrees Lovibond)
2 ounces carapils malt
1 teaspoon gypsum
1/4 ounce Perle hop pellets (60 minutes)
1/4 ounce Saaz hop pellets (60 minutes)
1/2 ounce Tettnanger hop pellets (30 minutes)
1/2 ounce Hallertauer hop pellets (5 minutes)
1/2 ounce Hallertauer hop pellets (dry hop)
Wyeast No. 1338 Altbier liquid yeast
3/4 cup corn sugar for priming

- Original specific gravity: 1.050
- Terminal specific gravity: 1.018
- Primary fermentation: eight days at 68 degrees F (20 degrees C) in glass
- Secondary fermentation: four days at 55 degrees F (12 degrees C) in glass
- Age when judged (since bottling): three and a half months

Brewer's specifics

Mash 60 minutes at 156 degrees F (69 degrees C).

Judges' comments

"Malty aroma. Clear, gold color; excellent head retention. Good malt-hop balance. Well conditioned (maybe too well). Appropriate body. Very good beer. Dry palate. A little sweet."

"Very clean, light, fruity nose up front. Bouquet stays light. Very high, fine white head. Golden, light haze, fine bead. Malty tone with balanced hop aftertaste. Light balance of ingredients for true Kölsch. Body appropriate for style. Good mouth feel. Very good brewing effort at a difficult style. High head and haze cost points."

"Aroma—malty—slight hops—fresh and clean. Appearance—dark golden; almost clear. Too big a head, but it holds well. Flavor—nice lingering aftertaste; nice mouth feel. Nice little long-lasting bubbles. Overall—nice, neutral, fresh, pleasant beer."

BARLEY WINE

EDME Centenary Barley Wine Trophy
Sponsored by Edme Ltd., Mistley, Manningtree, England.
Brewery trip prize to Young & Co. Brewery, London, England, sponsored by Young & Co.

"Tsampa"

First Place
B. Clay Biberdorf
Portland, Oregon

Ingredients for 5 gallons

12 pounds pale ale malt
8 pounds Alexander's light malt extract
1/2 pound crystal malt
1/2 pound Munich malt
2 ounces Eroica hops (60 minutes)
2 ounces Galena hops (40 minutes)
1 ounce Hallertauer hops (five minutes)
2 ounces Hallertauer hops (dry hop)
1 ounce Tettnanger hops (dry hop)
Wyeast liquid ale yeast
Montrachet Champagne yeast
3/4 cup corn sugar for priming

- Original specific gravity: 1.103
- Terminal specific gravity: 1.030
- Primary fermentation: five days at 66 degrees F (19 degrees C) in glass

Richard Schmit
1990 Homebrewer of the year

Photo courtesy of Richard Schmit

Richard Schmit of Arlington Heights, Ill., took the 1990 Homebrewer of the Year award with a cream ale called "Arlington Ale No. 33." This year's AHA National Competition was the first beer competition he had ever entered and his beer went all the way to best of show.

Arlington Ale No. 33 was brewed with hopped malt extract and steeped specialty grains. All fermentation took place in plastic fermenters with spigots on the bottom. He used Wyeast liquid yeast and fermented at 75 degrees F.

"It was a very basic, very simple recipe," Schmit said. "That's one reason I was surprised it went all the way." He said he entered the beer primarily to gain feedback about his brewing from experienced judges. "I thought it was very drinkable and clean, but wow! I didn't expect this."

Schmit's victory was out of the ordinary because of his relative lack of brewing experience compared to past winners, he said. Many previous winners used fancy brewing equipment, brewed all-grain beers and went to all kinds of trouble to make their beer, Schmit said. "I want people to look at my success and say 'I guess anyone can do it.' I hope my victory is an inspiration for beginning brewers all over. I know it's an inspiration for me!"

Schmit brewed his first batch in 1983, and then brewed only once a year for the next two years using a starter kit from a magazine that called for large amounts of cane sugar. "I think poor-quality dry yeast was another reason I didn't have good beers at first," he said.

In 1988 Schmit met a homebrew shop owner who steered him in the right direction. He joined the Headhunters homebrew club at the same time. "Since then I've brewed 45 batches in two years," he said.

There's an interesting story behind Arlington Ale No. 33's name. Before brewing it, Schmit turned 33 years old on March 3. His license plate reads "RPS 33," and right before brewing he took third place in a triathlon with a time of 1:33, after being given a race number of 33. Schmit said he laughed about the threes as he brewed the batch. "I said this is the one that's going to do it!"

When he was notified that the beer had made the second round, Schmit said he realized he had only one bottle left. Luckily, a friend came through with one last bottle that Schmit had given him earlier.

For the future, Schmit said he plans to stick with extract brewing, though he has dabbled in mash-extract procedures. He has started growing hops organically and wants to continue improving on his favorite styles, light pale ale and mild.

You don't need fancy equipment to brew good beer, Schmit believes. "All-grain brewers who are into digital pH meters and other elaborate equipment have tasted my beer at club meetings and said, 'I like yours better than mine!'"

Schmit's advice to beginning brewers is right to the point: If your sanitation is thorough and your recipe is all-malt, there's no reason anyone can't brew an award-winning beer. "Keep it simple and keep it clean, that's the key."

DAN FINK

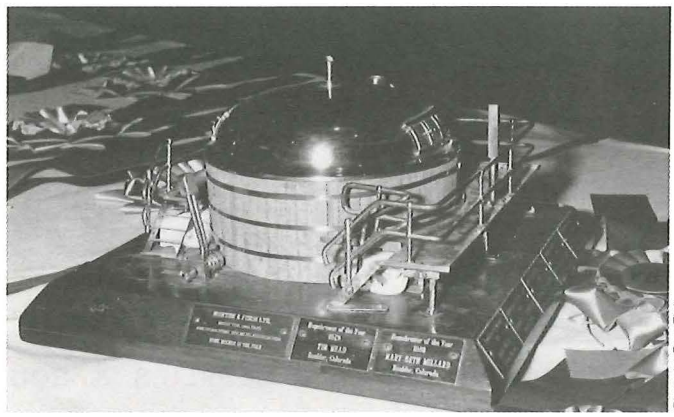


Photo by Dan Fink

Richard Schmit's name was added to the miniature copper mash-tun trophy, made by Munton and Fison, sponsor since 1981 of the Homebrewer of the Year Award. The trophy is kept in the AHA office.

• Secondary fermentation: five weeks at 66 degrees F (19 degrees C) in glass
• Age when judged (since bottling): 27 months

Brewer's specifics

Mash 80 minutes at 155 degrees F (68.5 degrees C).

Judges' comments

"Aroma—very full malt aroma. Clean. Very inviting! Alcohol comes through. Appearance—amber color, good clarity; nice conditioning. Flavor—beautiful, full flavor; superb balance. Very clean. Intense and satisfying. Overall—super."

"Aroma—bingo! Estery, fruity, malt, hops and alcohol—this smells delicious! Appearance—color is fine, slightly hazy. Flavor—very well balanced between malt, hops and alcohol. A little too bitter but the malt fights through. Overall—excellent finish, superb beer."

"Malty, alcoholic aroma with some hops in background. Color OK. Good clarity, fair head. Flavor has lots of malt, well balanced with hops. It has a fruity esteriness and slightly sour background. Very drinkable with honeylike overtones as it sits opened."

BELGIAN-STYLE SPECIALTY BEER

Chimay Award by Manneken-Brussels Imports
Sponsored by Manneken-Brussels Imports, Austin, Texas

Name unknown (Trappist ale)

First Place
Terry Oleson
St. Charles, Missouri

Ingredients for 5 gallons

6 pounds Edme light dry malt extract
2 pounds Munich malt
1/2 pound wheat malt
2 ounces black patent malt
1 ounce Hallertauer hops (35 minutes)
1 ounce Hallertauer hops (25 minutes)
1 ounce Hallertauer hops (15 minutes)
1 ounce Hallertauer hops (10 minutes)
1/2 ounce Fuggles hop pellets (dry hop)
2 1/2 pounds orange blossom honey
cultured Chimay yeast
force CO_2 injected by keg

• Original specific gravity: 1.074
• Terminal specific gravity: 1.012
• Primary fermentation: four days at 60 degrees F (15.5 degrees C) in glass
• Secondary fermentation: eight days at 60 degrees F (15.5 degrees C) in glass
• Third-stage fermentation: five months at 40 degrees F (4.5 degrees C) in stainless steel keg
• Age when judged (since bottling): two months

Brewer's specifics

Preboil all water. Mash for 30 minutes at 130 degrees F (54.5 degrees C). Bring to 150 degrees F (65.5 degrees C) for 90 minutes. Raise to 168 degrees F (75.5 degrees C) for 10 minutes. Sparge with 160-degree-F (71-degree-C) water.

Judges' comments

"Trappist yeast-phenolic nose very appropriate! Dry and phenolic warming in the finish. Could use a bit more malt body for balance of a wonderful beer. Great beer. One of the best tonight. Good job. Mash a little higher to create more limit dextrins and you'll have the perfect Trappist Chimay."

"Buttery, caramel nose. Good malt and some hops in aroma. Excellent appearance, pretty beer. Good malt sweetness, balanced. Some lactic taste; good hop bitterness. Very good body. Right amount of alcohol. Slightly phenolic, but to style. Tart, refreshing finish. Good try."

"Aroma—spicy. Appearance—very clear, nice color. Flavor—nice malt and traditional spice. Alcohol and hops make a long, warm finish. Body—just about right. Overall—very fine effort."

"Aroma—really nice fruity, estery nose. Subtle, rich, malty and complex. Appearance—excellent. Flavor—Phew! I wonder what the peasants are doing. Body—almost a camel-hair shirt, hardwood-pewed, genuflecting Trappist ale. Overall—I think I saw God."

BOCK

Yakima Valley Hop Growers Bock Beer Trophy
Sponsored by Yakima Valley Hop Growers, Yakima, Washington
Brewery trip prize to Aass Brewery, Drammen, Norway, sponsored by Aass Brewery.

"Bock Aasswards" (Doppelbock)

First Place
Darryl Richman
Northridge, California

Ingredients for 5 gallons

24 pounds Munich malt
6 pounds Vienna malt
6 pounds Klages malt
1 1/2 pounds crystal malt (80 degrees Lovibond)
7 ounces Hallertauer hops (180 minutes)
2/3 ounce calcium carbonate
ML-1 liquid lager yeast
14 ounces dextrose for priming

• Original specific gravity: 1.074
• Terminal specific gravity: 1.022
• Age when judged (since bottling): two and a half months
• Primary fermentation: four weeks at 48 degrees F (9 degrees C)
• Secondary fermentation: 6 weeks at 33 degrees F (0.5 degrees C)

Brewer's specifics

Mash at 122 degrees F (50 degrees C) for 50 minutes; bring to 136 degrees F (58 degrees C) for 30 minutes; bring to 149

degrees F (65 degrees C) for 40 minutes; bring to 160 degrees F (71 degrees C) for 90 minutes; bring to 171 degrees F (77 degrees C) for 15 minutes.

Judges' comments

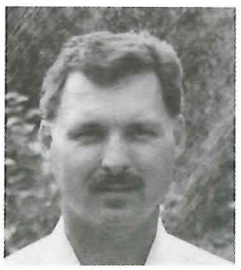
"Alcoholic, malty aroma; no off-flavors. Good color and clarity. Nice head retention. Very sweet, malty flavor. Good balance. Nice bubbles. Smooth; sweet aftertaste. Nice malty body. Very nice beer. Good malty body and flavor. Tastes strong. Good job!"

"Nice perfumy, malt nose with some hops and alcohol evident. Darkish brown, but within the appropriate color range. Good clarity; big tan head with active beading. Nice smooth balance between hops and malt. Good, subtle-but-strong alcohol kick. Smooth finish. Some huskiness, with lingering hop flavor. Clean and very drinkable; nice job. Very well balanced in malt, hops and alcohol."

"Aroma—has a slight alelike fruitiness, with bananalike notes. Cooler fermentation needed. Appearance—deep copper color. Hazy because of overcarbonation. Excellent head retention. Conditioning a bit high—it almost gushed, but I saved it. Flavor—excellent alcohol. Good balance of bitter and sweet. Malty aftertaste. Your recipe is excellent. Don't mess with it. Body—perfect. Overall—excellent maltiness. Only fault is overconditioning and the slight banana ester."

BROWN ALE

Premier Malt Brown Ale Trophy
Sponsored by Premier Malt Products,
Grosse Pointe, Michigan



"T-Brown" (Texas brown ale)

First Place
Phil Rahn
St. Peters, Missouri

Ingredients for 5 gallons

5 1/2 pounds pale malt
3 pounds dark Munich malt
1 pound light Munich malt
1 pound crystal malt
8 ounces wheat malt
1 1/2 ounce Perle hops (60 minutes)
1 ounce Hallertauer hops (60 minutes)
1 ounce Tettnanger hops (four minutes)
Wyeast No. 1007 German liquid yeast
forced CO_2 to prime

- Original specific gravity: 1.050
- Terminal specific gravity: 1.016
- Age when judged (since bottling): three and a half months
- Primary fermentation: 21 days at 65 degrees F (18.5 degrees C) in glass

Brewer's specifics

Mash at 153 degrees F (67 degrees C) for 90 minutes.

Judges' comments

"Aroma a little hoppy, faint, slightly tangy. Amber color, maybe slightly light. Clear; very fine bubbles. Nice, malty flavor. A little hoppy, sweet, fades to bittersweet; has a little caramel flavor. Could use more flavor hops. Good body, easy to drink. A really pleasant beer, very enjoyable. Get more fresh hops aroma and flavor and darken a bit."

"Aroma—malty; not much hops. Appearance—good clarity; a bit light for style. Flavor—good balance of malt and hops, good aftertaste. Body—good. Overall—good beer. Some hop aroma and a darker color would make this great."

"Aroma—nice malt aroma; could use more hops. Appearance—very clear, good head retention with pinpoint bubbles to hold it up. Should be just a bit darker. Flavor—good balance between malt and hops. Clean finish. Body—add some more crystal malt both for body and color. Overall—a good brew. Very clean. Build the body and darken the color."

CONTINENTAL DARK

Dave Line Memorial
Continental Dark Beer Trophy
Sponsored by Crosby & Baker, Westport, Massachusetts

"Diversey Lager"

First Place
Ray Daniels
Chicago, Illinois

Ingredients for 5 gallons

6 pounds Yellow Dog amber malt extract
1 1/2 pounds Munich malt
2 ounces black patent malt
1/2 ounce Saaz hops (60 minutes)
1 ounce Saaz hops (45 minutes)
1 ounce Saaz hops (15 minutes)
1/4 ounce Saaz hops (two minutes)
Wyeast No. 2042 Danish Lager liquid yeast
2 ounces maltodextrin to prime

- Original specific gravity: 1.054
- Terminal specific gravity: 1.024
- Primary fermentation: 14 days at 50 degrees F (10 degrees C) in plastic
- Lagering: 60 days at 35 degrees F (1.5 degrees C) in plastic
- Age when judged (since bottling): four months

Brewer's specifics

"Munich malt mashed 60 minutes at 150 degrees F (65.5 degrees C). Black malt boiled for 60 minutes."

Judges' comments

"Clean aroma. Wonderful effort. The best I've drunk in competition. I can't find fault with your beer."

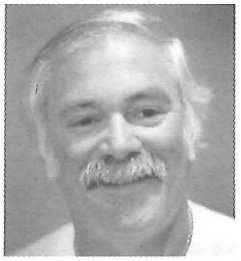
"Very fruity hop aroma—a little too flowery. Good color,

clear. Right amount of hop and malt flavors. Good body. I was pleasantly surprised with the flavor after the aroma of hops. Good job!"

"Aroma—just right for category. Appearance—moderate head retention. Flavor—very nice; very smooth and well balanced. Overall—best yet. A great example of a dark lager."

EXPORT

DeFalco's Wine & House Beer Export Beer Trophy
Sponsored by DeFalco's Wine & House Beer,
Dallas, Texas



"Expert Export"

First Place
Quentin B. Smith
Rohnert Park, California

Ingredients for 6 gallons

9 pounds Klages malt
1 pound Munich malt
1 pound carapils malt
1/2 ounce Chinook hops (60 minutes)
1/4 ounce Chinook hops (30 minutes)
1/2 ounce Hallertauer hops (30 minutes)
1 ounce Hallertauer hops (end of boil)
1 ounce Tettnanger hops (end of boil)
2 teaspoons Irish moss
1 1/4 teaspoon gypsum
1/2 teaspoon calcium carbonate
Wyeast No. 2206 Bavarian lager yeast
1 1/4 cup corn sugar for priming

- Original specific gravity: 1.059
- Terminal specific gravity: 1.015
- Primary fermentation: six days at 64 degrees F (18 degrees C) in glass
- Secondary fermentation: eight days at 56 degrees F (13.5 degrees C) in glass
- Age when judged (since bottling): three months

Brewer's specifics

Mash for 90 minutes at 152 degrees F (66.5 degrees C). Sparge with 170-degree-F (76.5-degree-C) water. Salts added to sparge water. Irish moss added 15 minutes into boil.

Judges' comments

"Good, clean-smelling beer. Slightly thin head. Nothing wrong with the flavor. Great job. Very nice beer. See you at the awards banquet."

"Aroma—clean; nice balance. Very slight DMS. Appearance—excellent. Flavor—excellent. Could use just a bit more hop bitterness to balance malt sweetness. Body—a bit too full-bodied. Overall—excellent beer. Just use a bit more bittering hops."

"Aroma—oh boy! Pretty clean. Appearance—excellent. Flavor—well done; balanced just right. Body—OK. Overall—excellent effort. Great export."

Photo by Michael Lichter

Judging beer

FRUIT BEER

Purple Foot® Fruit Beer Trophy
Sponsored by The Purple Foot, Milwaukee, Wisconsin

"3-Dimensional Raspberry Ale" (Fruit ale)

First Place
John Abbott
Chico, California

Ingredients for 5 gallons

5 pounds Alexander's light malt extract
1/6 ounce Saaz hop pellets (60 minutes)
1/6 ounce Saaz hop pellets (45 minutes)
1/6 ounce Saaz hop pellets (two minutes)
6 pounds frozen red raspberries
1 2/3 ounces M.eV. No. 004 liquid ale yeast
3/4 cup dextrose to prime

- Original specific gravity: 1.033
- Terminal specific gravity: 1.006
- Primary fermentation: four days at 70 degrees F (21 degrees C) in glass
- Secondary fermentation: three weeks at 70 degrees F (21 degrees C) in glass
- Age when judged (since bottling): six and a half months

Judges' comments

"Aroma—very raspberry! Appearance—nice color; clear but not brilliant. Flavor—a bit sour, but nice! Like a framboise. Could use a little more hops. Body—great! Overall—wow! Like Lindemann's Framboise. I want more."

"Aroma—slightly sour, creamy. A kiss of hops comes through. Appearance—beautiful color and clarity. Flavor—nice lactic maltiness coupled with raspberry and slight hops. Creamy like triple cream brie—lovely. Overall—beautiful beer. Apéritif or summer cooler. The best beer today."

"Nice bouquet. Slight sour tone in aroma. Excellent bubbles. Good clarity and color. Nice creamy mouthfeel. Definite sour profile; sourness tends to dominate a tad too much. Nice beer. Maybe sour tone could be cut back ever so slightly."

HERB BEER

Henry Siebens Herb Beer Award
Sponsored by Oregon Specialty Co., Portland, Oregon

"Ginger Honey Lager" (Herb lager)

First Place
Matthew Ennis
Cincinnati, Ohio

Ingredients for 5 gallons

3 pounds Laaglander light dry malt extract
1 1/2 ounce Cascade hops (60 minutes)
1/2 ounce Cascade hops (two minutes)
2 1/2 pounds light clover honey
1/2 cup freshly grated ginger root
1/4 teaspoon Irish moss
1/2 teaspoon gypsum
1 packet Red Star lager yeast
1 tablespoon gelatin
3/4 cup corn sugar for priming

- Original specific gravity: 1.044
- Terminal specific gravity: 1.016
- Age when judged (since bottling): seven and a half months
- Boiling time: 60 minutes
- Primary fermentation: seven days at 58 to 65 degrees F (14.5 to 18.5 degrees C) in glass
- Secondary fermentation: 22 days at 39 degrees F (4 degrees C) in glass

Brewer's specifics

Bring one and a half gallons water to boil and add gypsum, malt extract, honey, 1/4 cup ginger root and boiling hops. Boil 40 minutes, then add Irish moss. Two minutes before the end of boil add the last 1/4 cup of ginger root and finishing hops. Add to prechilled water to make five gallons, pitch yeast at 70 degrees F. Bottle with gelatin and corn sugar.

Judges' comments

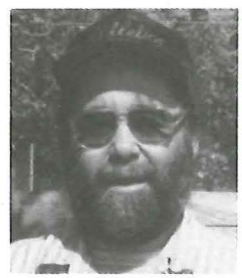
"Delicate ginger aroma. Beautiful golden color. Crystal clear; nice creamy head. Very well balanced. Nice conditioning; very clean. A very delicate brew. Thin to medium body. A very nice summer beer. It could have had more to it, but then again, it couldn't have been better balanced."

"Aroma is a bit thin. I would like more assertive hop or ginger character. Great color. Brilliant clarity. Too effervescent; long-lasting big head. Tight, delicate bubbles; nice lacing. Lively conditioning. Clean, crisp aftertaste. Body appropriate but thin. Excellent beer."

"Gingery, fruity aroma with some hops. Light golden color, big head, good retention, very clear. Gingery flavor with a slight grainy finish. Some maltiness with appropriate hop bitterness in finish—nice balance. Medium body for style; good carbonation feel. A nice ginger ale with just a slight grainy finish. Don't boil grains or oversparge or overgrind grains, etc."

MUNICH

Wines Inc. Munich Beer Trophy
Sponsored by Wines Inc., Akron, Ohio



"Handbasket Helles" (Munich helles)

First Place
Byron Burch
Santa Rosa, California

Ingredients for 10 gallons

16 pounds Klages lager malt
1 3/4 pounds Vienna malt

1 pound Munich malt
4 ounces crystal malt (20 degrees Lovibond)
2 ounces crystal malt (40 degrees Lovibond)
2 ounces crystal malt (90 degrees Lovibond)
1 ounce Perle-Hallertauer-Tettnanger hop pellet blend (60 minutes)
1 ounce Perle-Hallertauer-Tettnanger hop pellet blend (30 minutes)
1 ounce Hallertauer hop pellets (30 minutes)
1 ounce Tettnanger hop pellets (30 minutes)
1 1/2 ounce Hallertauer hop pellets (two minutes)
1 ounce Tettnanger hop pellets (two minutes)
1 tablespoon Irish moss
1 teaspoon gypsum
1 teaspoon chalk (calcium carbonate)
1/8 teaspoon Epsom salts
1/8 teaspoon salt
2 pints Bavarian lager liquid yeast starter
corn sugar to prime

- Original specific gravity: 1.050
- Terminal specific gravity: 1.018
- Primary fermentation: 10 days at 48 degrees F (9 degrees C) in glass
- Secondary fermentation: seven weeks at 60 degrees F (15.5 degrees C) in glass
- Age when judged (since bottling): three and a half months

Brewer's specifics

Mash at 153 degrees F (67 degrees C) for 60 minutes. Sparge with 165-degree-F (74-degree-C) water.

Judges' comments

"Hoppy aroma with a hint of malt. Clear, good head, good color. Good malt-hop balance. Good body. A good example of Munich helles."

"Light aroma, beery, pleasant. Pretty; nice gold color. Very fine tasting; clean, on the light side, well balanced, with nice carbonation. Great beer. Medium body. Very drinkable!"

"Very appealing grainy malt aroma; quite clean, with subdued hops. Perfect gold to faint orange color. Lightly toasted malt flavors. Very clean, low on hop character. Fine conditioning and balance. Moderately full body. Quite drinkable; refreshing, with super barley character. Great brewing job! A little more hop aromatics next time, please."

PALE ALE

Wynkoop Brewing Co. Pale Ale Award
Sponsored by Wynkoop Brewing Co., Denver, Colorado

"Cascade Delight"
(Classic pale ale)
First Place
Tom Cooper
Houston, Texas

BEST OF CLASS

Ingredients for 5 gallons
10 pounds Klages 2-row malt
1/2 pound Munton and Fison medium crystal malt
3/4 ounce Cluster hops (60 minutes)
1/2 ounce Cascade hops (60 minutes)
1/2 ounce Cascade hops (30 minutes)
1 ounce Cascade hops (steeped 30 minutes)
1 1/2 ounce Cascade hops (dry hop)
1 teaspoon Irish moss
1 teaspoon gypsum
1/2 teaspoon citric acid
Wyeast No. 1056 Chico Ale liquid yeast
3/4 cup dextrose to prime

- Original specific gravity: 1.053
- Terminal specific gravity: 1.010
- Primary fermentation: eight days at 60 to 65 degrees F (15.5 to 18.5 degrees C) in glass
- Secondary fermentation: 24 days at 65 to 68 degrees F (18.5 to 20 degrees C) in glass
- Age when judged (since bottling): three and a half months

Brewer's specifics

Mash for 90 minutes at 152 degrees F (66.5 degrees C). Mashout for 10 minutes at 170 degrees F (76.5 degrees C). Sparge with 170-degree-F (76.5-degree-C) water and collect seven gallons.

Judges' comments

"Aroma—wonderful! Good hop bouquet, with malt highlights sneaking in and out. Appearance—good color. Nice and clear; good head. Flavor—great! Malt and hops both come through! Clean and balanced. Body—just right—beautiful! Overall—this is very true to style and drinks quite nicely. Can you say Sierra Nevada?"

"Nice hoppy, estery nose. Clear, good head and carbonation. Nice malt-hop balance. Good body—hops dominate. Great overall ale."

"Aroma—hops, but no malt. Very clean. Some buttery notes but OK for category. Appearance—very pretty color; very good clarity; decent head retention. Flavor—light malt; excellent hops. The hops come through stronger than the malt. Conditioning is appropriately light. Hops dominate the aftertaste. Body—a bit thin. Overall—very pleasant, but could use some more malt in finish and to help balance hops."

PILSENER

Alexander's Pilsener Trophy
Sponsored by California Concentrates, Acampo, California

"BME Pilsener"
(Continental Pilsener)
First Place
Sal Pennacchio
Staten Island, New York

Ingredients for 5 gallons
6 2/3 pounds BME Munich Gold malt extract
1 1/4 ounces Hallertauer hops (45 minutes)

3/4 ounce Saaz hops (30 minutes)
1/2 ounce Saaz hops (two minutes)
1/4 ounce Saaz hops (dry hop)
1 pint M.eV. No. 001 German lager yeast
forced CO_2 to prime

- Original specific gravity: 1.048
- Terminal specific gravity: 1.012
- Primary fermentation: one week at 50 degrees F (10 degrees C) in glass
- Secondary fermentation: two weeks at 35 to 40 degrees F (1.5 to 4.5 degrees C) in glass
- Age when judged (since bottling): three and a half months

Judges' comments

Aroma is very light. Good color, great head, crystal clear—very good. Finish is a little pronounced. Malt-hop balance is good. Good body. Very good beer."

"Faint aroma but no points off. Excellent color, good head, clear. Flavor a little dry and overcarbonated at the start. Nice malt but could use a touch more hop kick. Good body. Very pleasant and drinkable. Clean, just a touch bland."

"Aroma—good spicy hop aroma. Mild malt aroma not perceptible. Yeast spiciness maybe from a temperamental yeast fermented at the wrong temperature. Appearance—nice tiny bubbles. Flavor—bitter aftertaste not appropriate. What type of hops are you using? It's not the continental character. Overall—very nice beer. Look to improvements in yeast, hops and fermentation temperature. What kind of yeast did you use? It might be the wrong yeast."

PORTER

The Cellar Porter Award
Sponsored by The Cellar, Seattle, Washington

"Entirely Yours"

First Place
Padraic Giffen
Cotati, California

Ingredients for 5 gallons

5 pounds British pale malt
4 pounds Klages malt
1 1/2 pounds Vienna malt
1 pound crystal malt (90 degrees Lovibond)
1 pound chocolate malt
1/2 pound carapils malt
1/4 pound black patent malt
1/4 ounce Northern Brewer hops (60 minutes)
1/4 ounce Perle hops (60 minutes)
3/4 ounce Chinook hops (30 minutes)
1 ounce Cascade hops (30 minutes)
1 ounce Cascade hops (dry hop in primary)

Brewer's Choice No. 1084 Irish stout liquid yeast
2/3 cup corn sugar for priming

- Original specific gravity: 1.057
- Terminal specific gravity: 1.021
- Primary fermentation: seven days at 65 degrees F (18.5 degrees C) in glass
- Secondary fermentation: six weeks at 65 degrees F (18.5 degrees C) in glass
- Age when judged (since bottling): two and a half months

Brewer's specifics

"One step infusion mash. British pale, Klages, Vienna, carapils and 3/4 pound crystal malts mashed at 158 degrees F (70 degrees C) for 60 minutes. Chocolate, black patent and 1/4 pound crystal malts cracked and steeped in one gallon of cold water, brought to a boil and sparged with one pint 170-degree-F (76.5 degree-C) water."

Judges' comments

"A little buttery-caramel in nose. Pleasant, balanced. Very dark for style. Nice head. Lots of CO_2—good retention. Nice roasted character. Good chocolate taste, hops balanced with sweetness. Good full body. A fine example of the style. Very full and well-balanced. Buttery taste evident but doesn't detract."

"Slightly phenolic but good malt aroma with appropriate hoppiness. Beautiful head retention. Creamy crown. Nice color. Very slightly sour aftertaste. Overall a fine beer. Rich body. Almost too dark, but I like that! A great porter—good beer!"

"Roast, fruity, hoppy in a nice balance; some diactyl. Good head. Soft, well-balanced, clean. A bit lacking in depth of roasted character. Some sweetness. Full-bodied. A very satisfying beer, but a bit on the brown-aleish side. A bit more roast character would help."

RAUCH

Jim's Homebrew Supply Shop Rauch Beer Award
Sponsored by Jim's Homebrew Supply Shop, Spokane, Washington

"Across Quincy Smoke"

First Place
Ron Butt
Aurora, Colorado

Ingredients for 5 1/2 gallons

6 pounds 2-row German Pilsener malt
4 pounds smoked 6-row American malt
2 pounds toasted 2-row German Pilsener malt
1 ounce Chinook hops (60 minutes)
1 ounce Cascade hops (finish)
2 packets Edme ale yeast
forced CO_2 to prime

- Original specific gravity: 1.055
- Terminal specific gravity: 1.018
- Primary fermentation: one week at 67 degrees F (19.5 degrees C) in glass
- Secondary fermentation: eight weeks at 50 degrees F (10 degrees C) in stainless steel
- Age when judged (since bottling): six and a half months

Brewer's specifics

Soak 6-row malt in water for 10 minutes and then smoke over mesquite for 90 minutes. After smoking, dry (and slightly roast) grain in oven at 350 degrees F (176.5 degrees C) for 20 minutes.

Infusion mash. Mash at 152 degrees F (66.5 degrees C) for two hours. Sparge with six gallons 170-degree-F (76.5-degree-C) water.

Judges' comments

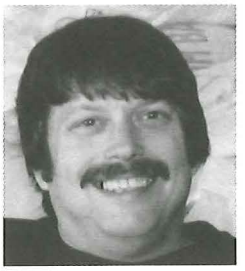
"Good clean smoky bouquet, with some malt and hops coming through. Good clarity. Color a bit dark for style. Flavor has nice blend of malt, hops and smokiness! Good medium to heavy body. Good beer!"

"Very nice complex smoky aroma. A bit of phenol in the background; some maltiness comes through. Not much head and it falls quickly. Very pretty, though. Nice flavor; the best so far. Good full character. Somewhat lacking in conditioning and a slight astringency in the aftertaste. Body very nice and full. Good clean beer."

"Aroma—smoke is good, but behind it there is an oxidized aroma of rotten vegetables. Appearance—perfect garnet color, excellent clarity, excellent head retention. Flavor—excellent balance of malt and hops. Aeration in siphoning or old age or warm storage or a combination of those gives beer some oxidized character. Don't change the recipe, just attend to the process. Overall—recipe is authentic Bamberg-type rauchbier, but subtle oxidation detracts. Excellent brewing and recipe formulation. Care needed in handling."

SCOTCH ALE

Wine and Hop Shop Scotch Ale Award
Sponsored by Wine and Hop Shop, Denver, Colorado



"Scotch Ale" (Strong Scotch ale)

First Place
Jerry Bockmore
Dayton, Oregon

Ingredients for 5 gallons

3 1/2 pounds mild ale malt
3 pounds Klages malt
3 pounds pale ale malt
2 pounds British crystal malt
2 ounces chocolate malt
2 ounces black patent malt
1 ounce Chinook hops (60 minutes)
1/2 ounce Goldings hops (60 minutes)
1 ounce Goldings hops (10 minutes)
1 pound dark brown sugar
1 teaspoon gypsum
1 teaspoon Burton salts
1 pint Wyeast No. 1028 British Ale liquid yeast
3/4 cup dextrose to prime

- Original specific gravity: 1.063
- Terminal specific gravity: 1.020
- Primary fermentation: three weeks at 65 degrees F (18.5 degrees C) in glass
- Age when judged (since bottling): three and a half months

Brewer's specifics

Mash for 60 minutes at 154 degrees F (68 degrees C).

Judges' comments

"Aroma—very faint malt. Appearance—pretty clear, nice head, color OK. Flavor—balance fair, good quality malt; a bit astringent. Body—full. Overall—nice brew."

"Nice fruity nose. Big, long lasting head. Slight haze, but OK. Sweetness and hops come to a good balance in flavor, but a dryer finish would be more appealing. Nice soft body, but a little light for the category. Very nice all around. Might be a bit bigger and a little dryer."

"Aroma—nice maltiness. Appearance—color, clarity and head retention all very good. Flavor—good balance and aftertaste. Body—good. Overall—very drinkable. A very good beer. Good work. Send me the recipe."

SPECIALTY BEER

Beer and Wine Hobby Award
Sponsored by Beer and Wine Hobby,
Woburn, Massachusetts

"Anne's Choice Christmas Ale"

First Place
Philip Fleming
Broomfield, Colorado

Ingredients for 5 gallons

3 1/2 pounds Munton and Fison stout kit
3 1/3 pounds Munton and Fison amber dry malt extract
3 pounds Munton and Fison amber dry malt extract
1/2 ounce Hallertauer hops (60 minutes)
1/2 ounce Hallertauer hops (five minutes)
3/4 pound honey
5 3-inch cinnamon sticks
2 teaspoons allspice
1 teaspoon cloves
6 ounces ginger root
6 rinds from medium size oranges
Wyeast No. 1007 German ale liquid yeast
7 ounces corn sugar for priming

- Original specific gravity: 1.069
- Terminal specific gravity: 1.030
- Primary fermentation: 14 days at 61 degrees F (16 degrees C) in glass
- Age when judged (since bottling): six months

Brewer's specifics

Simmer spices and honey (45 minutes). Boil malt and hops (50 minutes). Add finishing hops and boil (5 minutes). Cool, strain and pitch yeast.

Judges' comments

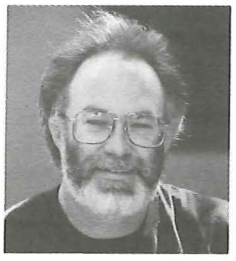
"Cloves dominate aroma. Nice creamy head. Wonderful Christmas spice. This is what I call a *spice* beer. Full-bodied, very spicy with a sweet finish, which is difficult to accomplish with all the spices. Great effort."

"Aroma—inviting, lots of spice. Appearance—good; hazy. Flavor—all the specialty ingredients are present. Good warming, lingering taste. It could be sweeter; too bland in finish. Body—OK, but could be fuller. Overall—enjoyable holiday beer. Well made."

"Plenty of spice in nose. I can detect some clove. Good head retention. Clarity OK. Color is not as sharp or brilliant. Flavor has cloves all over, with a warming cinnamon backing. Body is OK, except that it thins out in the rear. Nice "winter warmer" spice beer; plenty of spice abounds."

STEAM*

Anchor Steam®* Beer Trophy
Sponsored by Anchor Brewing Co.,
San Francisco, California



"No. 26 Steam*"

First Place
David Sherfey
La Crescenta, California

Ingredients for 7 gallons

5 pounds German 2-row malt
3 pounds Vienna malt
3 pounds Klages malt
1 pound dextrin malt
1/3 pound crystal malt (80 degrees Lovibond)
2/3 ounce Northern Brewer hops (60 minutes)
1/3 ounce Saaz hop pellets (60 minutes)
1/3 ounce Tettnanger hops (60 minutes)
1/3 ounce Hallertauer hops (60 minutes)
1 ounce Tettnanger hops (15 minutes)
1 ounce Hallertauer hops (15 minutes)
1/2 ounce Hallertauer hops (end of boil)
2 ounces Northern Brewer (dry hop)
1/4 ounce gypsum
1/2 ounce Polycar
1/8 teaspoon rock salt
23 ounces yeast cultured from a bottle of Sierra Nevada Pale Ale
23 ounces Wyeast No. 2007 St. Louis Lager liquid yeast
1/2 teaspoon dextrose per bottle to prime

- Original specific gravity: 1.048
- Terminal specific gravity: 1.017
- Primary fermentation: one month at 60 degrees F (15.5 degrees C) in glass
- Secondary fermentation: one month at 60 degrees F (15.5 degrees C) in glass
- Age when judged (since bottling): five months

Brewer's specifics

Mash at 122 degrees F (50 degrees C). Hold for 30 minutes. After 60 minutes, raise to 158 degrees F (70 degrees C) and hold

**The term "steam" beer is trademarked by the Anchor Brewing Company and may not be used by other breweries for commercial purposes.*

for 120 minutes. Raise to 168 degrees F (75.5 degrees C). Transfer to lauter and sparge to collect 7 gallons. Add salts. Boil for one hour. Whirlpool for two minutes and rack through chiller into carboy. Pitch Sierra Nevada yeast at 69 degrees F (20.5 degrees C).

Hold temperature at 69 degrees F (20.5 degrees C) for three days. Lower temperature one degree per day until it reaches 58 degrees F (14.5 degrees C). Pitch Wyeast starter. Reduce temperature one degree per day to 55 degrees F (13 degrees C). Hold for two weeks. Rack to secondary with dry hops. Transfer to keg and hold at 30 degrees F (-1 degree C) for three days. Sprinkle 1/2 ounce Polyclar onto surface using a clean dry soup spoon. Hold at 30 degrees F (-1 degree C) for three weeks.

Bottle with fresh Sierra Nevada yeast (from a bottle of Sierra Nevada) and 1/2 teaspoon of dry dextrose per bottle. Pour two ounces of sterile water onto the sediment in the bottle, swish it around and place in a sterile pint canning jar. Using a sterile plastic syringe, place five drops of the yeast solution in each bottle. Use a small plastic funnel to aid in putting the yeast-dextrose mixture in each bottle.

Judges' comments

"Fruity bouquet slightly dominates malt and hops, which seem well balanced. Appearance good: great head, small bubbles. Smooth, malty flavor. Maybe could use more hop bitterness. Slightly astringent. Body good, appropriate for style. Overall, very good. Nice appearance and body; pretty clean."

"Aroma—malt sweetness but with little hop aroma. Some DMS presence; otherwise clean. Appearance—slight hazing. Color appropriate. Nice, rocky small-bead head with excellent retention. Flavor—lacks crispness. Needs more malt character and sharper Northern Brewer aggressive quality. Body—OK. Overall—excellent beer but lacks malt to round out flavor and bitterness in finish."

"Aroma—diacetyl notes. Little hops in nose. Some fruitiness. Some stale odors. Appearance—good color; could be a bit more red. Very nice clarity; head retention—wow! Head formation a bit much. Flavor—hops should be more aggressive. Just a trifle too sweet, could be due to age. Good conditioning. Aftertaste is sweet; not bitter enough. Diacetyl present. Body—a bit thin. Overall—this is a very nice beer. It has no outstanding defects. It should have more hops for style. Buttery (diacetyl) flavor could be from cooling too quickly."

STOUT

Coal Black Kidney Stout Award
Sponsored by Great Fermentations of Marin, California

"Breakfast of Champions Imperial Stout Framboise" (Imperial stout)

First Place
Byron Burch
Santa Rosa, California

Ingredients for 5 gallons

5 pounds The Beverage People dark dry malt extract
2 3/4 pounds The Beverage People amber dry malt extract
1 pound chocolate malt
8 ounces Klages lager malt
8 ounces Vienna malt
8 ounces crystal malt (20 degrees Lovibond)
8 ounces crystal malt (40 degrees Lovibond)
4 ounces crystal malt (90 degrees Lovibond)
4 ounces Munich malt
2 ounces Perle hop pellets (60 minutes)
1 ounce Northern Brewer hop pellets (60 minutes)
1 3/4 ounce Nugget hop pellets (30 minutes)
1/4 ounce Eroica hop pellets (30 minutes)
1/4 ounce Chinook hop pellets (30 minutes)
2 ounces Hallertauer hop pellets (dry hop)
2 ounces Tettnanger hop pellets (dry hop)
1/4 ounce Saaz hop pellets (dry hop)
6 pounds The Beverage People dry rice extract
2 ounces wheat flakes breakfast cereal
30 ounces frozen raspberries in syrup
1 tablespoon Irish moss
1/3 ounce Pasteur Champagne yeast
corn sugar to prime

- Original specific gravity: 1.105
- Terminal specific gravity: 1.040
- Primary fermentation: one week at 60 degrees F (15.5 degrees C) in stainless steel
- Secondary fermentation: one week at 60 degrees F (15.5 degrees C) in glass
- Age when judged (since bottling): three months

Judges' comments

"Fruity, roasty aroma. Great color and clarity. Flavor very appropriate for style. Wonderfully rich and fruity, with barley and alcohol taste! Wonderful full body. I want some more. Excellent."

"Very fruity aroma. Deep color. Could have more head retention. Wonderful, big, full, fruity, complex flavor. A great brew! Good job. Very drinkable. Can I get a case?"

"Aroma—lots of alcohol; fruity, heavy raspberry. Appearance—pretty! Flavor—Not too much raspberry, which is good, as that would have put it out of the style. Very clean, malty, good balance. Body—a tiny bit thin. Overall—very alcoholic. I think this would be better in the fruit ale category, although it certainly fits in this one. The raspberries are an interesting touch."

VIENNA

Frank H. Steinbart's Memorial Vienna Beer Award
Sponsored by F.H. Steinbart, Portland, Oregon

"Les Dames de Paris"

First Place
Ron Page
Middletown, Connecticut

Ingredients for 13 gallons

15 pounds 2-row malt
10 pounds pale ale malt
6 pounds Munich malt

1 1/2 pounds crystal malt
1 pound dextrin malt
2 ounces chocolate malt
3 ounces Hallertauer hops (60 minutes)
1 ounce Saaz hops (60 minutes)
1 ounce Tettnanger hops (60 minutes)
1/3 ounce Hallertauer hops (end of boil)
1/3 ounce Saaz hops (end of boil)
1/3 ounce Tettnanger hops (end of boil)
Wyeast No. 2308 Munich lager liquid yeast
forced CO_2 to prime

- Original specific gravity: 1.055
- Terminal specific gravity: 1.018
- Primary fermentation: 20 days at 52 degrees F (11 degrees C) in glass
- Secondary fermentation: seven weeks at 40 degrees F (4.5 degrees C) in glass
- Age when judged (since bottling): two and a half months

Brewer's specifics

"Mash at 123 degrees F (50.5 degrees C) for 20 minutes. Bring to 154 degrees F (68 degrees C) for 45 minutes. Bring to 158 degrees F (70 degrees C) for 45 minutes."

Judges' comments

"Aroma—nice intense maltiness, good balance. Appearance—good color, nice head. Flavor—nice malty sweetness comes through very well. A tad sweet but OK for style. Could have more alcohol. Body—good. Overall—very good Vienna. I could drink this all day!"

"Very nice malt aroma. Appearance almost perfect. Tastes almost like a commercial beer. Well balanced and smooth, malty. I could drink this all night."

"The head would not stand up at pour or when swirled in the glass. The flavor is right on! The hops are nice but I could use a bit more. Outstanding beer! Gimme more!"

WHEAT BEER

Wheat Growers Challenge Cup
Sponsored by National Association of Wheat Growers Foundation, Washington, D.C.

"Colorado Weizen" (German weizen)

First Place
Michael Croddy
Colorado Springs, Colorado

Ingredients for 5 gallons

6 2/3 pounds American Brewmaster American Classic wheat malt extract
1 pound American Brewmaster malted rice extract
2 ounces Tettnanger hops (45 minutes)
1 ounce Tettnanger hops (one minute)
4 ounces maltodextrin
Wyeast No. 1028 British Ale liquid yeast
1/2 cup corn sugar to prime

- Original specific gravity: 1.050
- Terminal specific gravity: 1.010
- Boiling time: 45 minutes
- Primary fermentation: three days at 65 to 70 degrees F (18.5 to 21 degrees C) in glass
- Secondary fermentation: 17 days at 65 to 70 degrees F (18.5 to 21 degrees C) in glass
- Age when judged (since bottling): two and a half months

Judges' comments

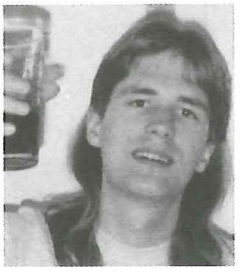
"Nice clovelike aroma. Nice color and clarity. Little head, lacks retention. Distinct wheat flavor and lots of clove flavor. Very spicy, but well balanced. Medium bodied. Very nice example of German weizen."

"Aroma—fruity; faint hint of cloves. Malt comes through; hops faint. Appearance—good color, head retention OK, slightly cloudy, but OK for category. Flavor—cloves and green apples. Malt comes through well. Hops are faint. Very good balance, good conditioning, very good fruity aftertaste. Body—full, appropriate to style. Overall—excellent weizen. Very drinkable. I love it."

"Nice wheat, hop aroma; a bit of sour aroma. Color and clarity good. Not much head. Lovely wheat flavor. A little sour and sweet. Good hopping rate. Quite nice. Very drinkable. Fruity and sour tones in a wonderful combination."

FLAVORED MEAD

Friends of Mead Award
Sponsored by Friends of Mead, Boulder, Colorado



"Raspberry" (Sparkling flavored mead)

First Place
John McKew and Graca Vicente
Davis, California

1989 MEADMAKERS OF THE YEAR

Sponsored by Home Wine and Beer Trade Association

Ingredients for 5 gallons

14 pounds orange blossom honey
5 pounds raspberries
2 1/2 pounds blueberries
Red Star Champagne yeast
corn sugar to prime

- Original specific gravity: 1.083
- Terminal specific gravity: 1.017
- Primary fermentation: three months at 85 degrees F (29.5 degrees C) in glass
- Age when judged (since bottling): two years, seven months

Brewer's specifics

Pasteurize honey and one gallon of water by keeping at 176 degrees F (80 degrees C) for 1/2 hour. Pasteurize berries by heating to 176 to 194 degrees F (80 to 90 degrees C). Mix, cool and pitch yeast.

Judges' comments

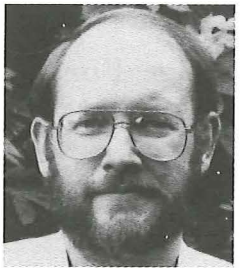
"Nice raspberry-blueberry nose with some orange blossom type honey—lots of honey. Dark amber color; should be reddish-blue. Clear, nice bubbles, legs. Flavor is sweet but not too sweet, and has nice raspberry, blueberry and honey characteristics. Slight astringency; carbonation is good. Very drinkable; great balance of fruit and honey. Awesome mead. Keep up the good work. Send me this recipe and I'll trade you some of my mead, *please*."

"Nice fruit aroma. Nice clarity and color. Nice honey flavor. Raspberries and blueberries blend nicely. Very, very good, and smooth!"

"Aroma—great fruit; good alcohol nose. Appearance—good color, tight bead. Flavor—good balance of fruit and honey, good carbonation. Excellent. Overall—great balance. Slight bitterness in finish."

TRADITIONAL MEAD

Havill's Mazer Mead Cup
Sponsored by Havill's Mazer Mead, Rangiora, New Zealand



"Sack Mead" (Traditional still mead)

First Place
Gordon Olson
Los Alamos, New Mexico

Ingredients for 5 1/2 gallons

15 pounds grade A fancy honey
1/2 teaspoon Irish moss
4 teaspoons acid blend
6 teaspoons yeast nutrient
2 packets Red Star Champagne yeast

- Original specific gravity: 1.110
- Terminal specific gravity: 1.016
- Primary fermentation: six months at 65 to 75 degrees F (18.5 to 24 degrees C) in glass
- Age when judged (since bottling): 10 and one-half months

Judges' comments

"Strong sweet honey aroma, very inviting. Pale yellow color; clear. Sweet start—strong honey flavor, smooth gradually drying finish, nice alcohol warmth. Very nice. Strong sweet honey character, but not cloying or lingering."

"Aroma—very heavy. Nice. Appearance—Excellent color and clarity. Very good-looking sample! Flavor—excellent. Very slight carbonation combines with acidity for nice, sharp aftertaste. Overall—potential winner. This is good!"

"Wonderful honey aroma; strong alcohol. Clear for having sediment. Small bubbles at bottom of glass. Wonderful traditional flavor, strong alcohol, sweet. Carbonation exists, but slight. Great mead!"

CLASSIFIED

Deadlines: Spring—January 12, Summer—April 6, Fall—June 29, Special Issue—August 10, Winter—September 14. Pre-payment required. Please specify in which issue(s) your ad is to run. Call Linda Starck, Advertising Representative, at (303) 447-0816 for options and rates.

BOOKS

WORLD BEER REVIEW—newsletter for the beer gourmet and enthusiast. Request free copy or subscribe now for only $16.50. WBR, Box 71A, Clemson, SC 29633.

INGREDIENTS

THE HOMEBREWERS' STORE see our ad in the fall issue for a special price on our "Hops Sampler" kit. (or call 1-800-TAP-BREW).

DOUBLE FERMENTATION, extended exposure to yeast in crown capped bottle. Highest quality Pinot Noir & Chardonnay provides classic Champenoise ingredient. Five gallons of pure, frozen sparkling wine juice available with full instructions. Peter Brehm, 932 Evelyn Ave, Albany, CA (415) 527-3675.

ELECTRONIC DIGITAL SCALE

By 1/10 oz.—2# max.
By Gram—1000G max.
Measures tare, gross & net
Batteries not included
$67.50 + $2.50 P & H

AMERICAN BREWMASTER
2940-6Z Trawick Rd.
Raleigh, NC 27604
919-850-0095

MESQUITE HONEY 24 lbs $16, 12 lbs $9 plus shipping. Chaparral Honey Co, 1655 W. Ajo Way, #154, Tucson, AZ 85713.

Bo doesn't know diddley about low prices! We do. We specialize in bulk purchases. We're:

Brew for Le$$ (Chicago)
1-800-347-3011
For Free Catalog.

Malt extracts for 5.00 for 3 lbs.
Send 1.00 for catalog
The Basement Brewmaster
4280 N. 160th St, Brookfield, WI 53005

True Value

Hops. Truly one of nature's wonders. Especially when combined with malted barley. Our all-grain primer "True Brew" will show you how for just 15¢/bottle. For a free copy contact: Stew's Brew, RR4 Box 243, River Falls, WI 54022 (715) 425-2424.

DRAFT SYSTEMS, CTSP
Filters, Bottle Fillers

Everything for complete homebrewer: SS systems, books, parts. Braukunst, PO Box 786-Z, Duluth, MN 55801.

MAKE QUALITY BEERS! Free catalog and guidebook. Low prices, fastest service guaranteed. Reliable. Freshest hops, grains, yeast, extracts. Full line equipment. The Cellar, Dept. AZ, PO Box 33525, Seattle, WA 98133. (206) 365-7660, 1-800-342-1871.

ADVANCED HOMEBREWERS BUY DIRECT—Brewery-grade malt, rice and wheat extracts. Fifteen different hops. Liquid yeast cultures. Quantity discounts. American Brewmaster, 2940-6Z Trawick Road, Raleigh, NC 27604. (919) 850-0095.

KEY TO GREAT BEER—Pure liquid yeast cultures. Full array of beer and winemaking supplies. Frozen Wort, PO Box 947, Greenfield, MA 01302. (413) 773-5920.

BEST MAIL-ORDER PRICES. FREE CATALOG. QUALITY HOPS, GRAINS. FRIENDLY, FAST SERVICE. WINEMAKER'S MARKET, 4349 N. ESSEX, SPRINGFIELD, MO 65803.

BAVARIAN CRYSTAL MALT—Light and Dark. Large selection of hops, malt extracts & grains. Bulk light and dark syrups for the brewer on a budget. Since 1971. Call (713) 523-8154 or write for Free Catalog: DeFalco's Home Beer Supplies, 5611 Morningside Dr-Z, Houston, TX 77005.

BEER AND WINE MAKERS—request free catalog, fast reliable service. Large selection of malt, hops and concentrate. The Purple Foot, 3167 S. 92nd St., Dept. Z, Milwaukee, WI 53227. (414) 327-2130.

WHAT WOULD YOU EXPECT FROM A TOWN CALLED HOPLAND?

The largest in-stock selection of **Vacuum Packed**, **Whole** and **Pelletized Hops**, with crop year and alpha acid labelling; **Hop Extract**, **Hop Oil** and **Hop Vine Root Cuttings**; quality and bulk purchase savings; Check, VISA and MasterCard, seven day phone and mail order service, with prompt nationwide shipping, direct from **(707) 744-1704 • MCC Hop Dept. 707 Hwy. 175 • HOPLAND, CA, 95449.**

BREW MORE FOR LOTS LESS FREE CATALOG—GRAINS, EXTRACTS, YEASTS, 18 DIFFERENT HOPS, EQUIPMENT—BRYANT BREWING, RD1, BOX 262, AUSTIN, PA 16720.

SUPPLIES

Supplies on Tap
Everything for the homebrewer. Free catalog. Supplies on Tap, 87-72 94th St., Woodhaven, NY 11421. (718) 849-3947.

BEERMAKERSWINEMAKERS***
Free catalog of over 600 quality items. Brewing and Winemaking Software, Specialty Beer and Wine kits, and more at discount prices. Crossfire, Box 530W, Somersville, CT 06072. (203) 623-6537.

Beverage Makers
Free list, wide selections, fast too.
Haupt Barrel, Dept. Z0,
1432 S. First St., Milwaukee, WI 53204.
(414) 645-7274.

WRITE FOR FREE CATALOG of brewing supplies. Home Sweet Homebrew, 2008 Sansom St., Philadelphia, PA 19103.

BEERMAKERS—WINEMAKERS
Free Catalog — Valuable coupons! Homebrew International, 1126 S. Federal Highway, Z-182, Ft. Lauderdale, FL 33316.

Service Selection
Satisfaction Savings

FREE CATALOG

Alternative Beverage
800-365-BREW

SERIOUS BREWERS in Midwest take note—lowest bulk prices on varietal extracts, malts and hops. Free catalog. Green Acres, 216 Vork Road, Esko, MN 55733. (218) 879-2465.

BOTTLE CAPS—Seven gross–$7.00 postpaid. Hayes' Homebrewing Supply, Suite 117Z, 311 S. Allen St., State College, PA 16801.

BEERMAKERS—WINEMAKERS—
Free Illustrated Catalog—Fast Service—Large Selection—Kraus, Box 7850-Z, Independence, MO 64053. (816) 254-0242.

BEER AND WINEMAKERS
For free catalog call (612) 522-0500. Semplex, Box 11476Z, Minneapolis, MN 55411.

WILLIAM'S BREWING
features an extensive selection of unique supplies including: home breweries, draft systems, all-malt brewing kits, temperature controllers, bottling aids, and our own line of fresh malt extracts and liquid yeast. Free 32-page Catalog/Newsletter. William's Brewing, Box 2195-Y9, San Leandro, CA 94577. (415) 895-2739.

BREWER'S CATALOG. Stainless-steel draft systems, all-malt kits, fresh quality supplies. Koeppl's Master Brewer, 2311 George St., Rolling Meadows, IL 60008.

BARLEYMALT AND VINE
A complete beer and winemaking shop. Catalogs and instructions—recipes and personal service. For supplies or to ask a question contact us at 4 Corey St., Boston, MA 02132. (617) 327-0089.

AUSTRALIAN HOME BREW KIT makes 22.5 litres, $8.50 + $2.00 P&H. Free Australian coaster set with every order. (800) 366-3317 voice or FAX. Exclusive U.S. Distributors: Kanga Brew, PO Box 360742, Milpitas, CA 95036-0742.

BREWERS AND WINEMAKERS—
large selection, low prices, prompt service. Free catalog, S & R Homebrewing and Winemaking, PO Box 544, Union Station, Endicott, NY 13760. (607) 748-1877.

The Beverage People
We wrote the book on homebrewing. **Free Catalog. Free Newsletters.** Discounts on quantity supplies from America's most respected dealer. **Great Fermentations of Santa Rosa. See our display ad, page 52.**

Fall Special—Buy 1 case malt/kits—40 quart SS stock pot (U.S. made) only $1.00 plus shipping. Frozen Wort, PO Box 947, Greenfield, MA 01302 (413) 773-5920 anytime.

FREE CATALOG!
SEBASTIAN BREWERS SUPPLY
1762 Sunrise Lane
Sebastian, Florida 32958
1-407-589-6563

BREW-OF-THE-MONTH CLUB For more information call our toll free number: 1-800-TAP-BREW **THE HOMEBREWER'S STORE,** P.O. Box 82736, Kenmore, WA 98028.

Try to find
A BETTER SOURCE

Liquid malt extract	$1.49/lb.
Dry malt extract	$2.30/lb.
50 lb. 2-row pale malt	$30.00
Hops:	
Saaz	$1.95/2oz.
Hallertauer	$1.95/2oz.
Spalter	$1.95/2oz.
Tettnenger	$1.95/2oz.
Whitbred ale yeast	$1.50/10gr.
Liquid yeast	$3.85/pack
Complete Keg System	$225.00

OAK BARREL WINECRAFT INC.
1443 San Pablo Ave.
Berkeley, CA 94702
415-849-0400

BEERMAKERS—WINEMAKERS Free catalog. Large selection malt extracts, grains, fresh hop flowers compressed in 1/2 oz. discs, Yeast Bank™, equipment, accessories. Country Wines, 3333Y Babcock Blvd., Pittsburgh, PA 14237.

TBA - New beer/wine making supply company. One day we'll be your supplier. Send for free catalog. TERRAPIN BREWERS ASSOCIATION, PO Box 943, College Park, MD 20740.

MISCELLANEOUS

Address labels for over 400 homebrew supply retailers. Market your ideas. Anthem Ent., Box 1209, Manhattan Beach, CA 90266.

FINALLY!

A professional record keeping system for Homebrewers!

- Classic vinyl covered three ring binders feature gold corner protectors and edge sewn construction.
- Includes over 200 pages with headings for recipes, results and more!
- Makes a Great Gift!

BREWLOGGER
P.O. Box 301122, Escondido, CA 92030-1122

Send $29.95 plus $3.50 shipping and handling. Continental U.S. only. Allow 4-6 weeks delivery.

The Homebrew Connection

These fine retail shops across North America offer homebrewing ingredients and supplies. Plan to visit them when you are in the area.

Alabama

Birmingham Homebrew
1917 29th Ave. S
Birmingham, AL 35209-2617
Ph# 205-871-BEER/800-BUY-MALT

Pearly Gates
2308 Memorial Parkway SW
Huntsville, AL 35801
Ph# 205-534-6233

Alaska

Alaska Mill & Feed Co.
1501 E 1st Ave.
Anchorage, AK 99510
Ph# 907-276-6016

California

Barley And Wine
Home Fermentation Supply
1907 Central Ave.
Ceres, CA 95307
Ph# 209-538-BREW

Great Fermentations of Marin
87M Larkspur
San Rafael, CA 94901
Ph# 415-459-2520/800-542-2520

Great Fermentations of Santa Rosa
840 Piner Road #14
Santa Rosa, CA 95403
Ph# 707-544-2520/800-544-1867

Napa Fermentation Supplies
724 California Blvd.
Napa, CA 94559
Ph# 707-255-6372

Portable Potables
1011 41st Ave.
Santa Cruz, CA 95062
Ph# 408-476-5444

Colorado

The Brew-It Company
129 Remington Ave.
Fort Collins, CO 80524
Ph# 800-748-2226

Liquor Mart Inc.
1750 15th St.
Boulder, CO 80302
Ph# 303-449-3374

North Denver Cellar
4370 Tennyson St.
Denver, CO 80212
Ph# 303-433-5998

Connecticut

Crossfire Brewing Supply
PO Box 530
Somersville, CT 06072
Ph# 203-623-6537

Wine Art of Smith-Tompkins
1501 E Main St., Rt 202
Torrington, CT 06790
Ph# 203-489-7137

Delaware

Wine Hobby USA–Delaware
2306 W Newport Pike
Stanton, DE 19804
Ph# 302-998-8303

Florida

Sebastian Brewers Supply
1762 Sunrise Lane
Sebastian, FL 32958
Ph# 800-780-SUDS

Georgia

Wine Craft of Atlanta
3400 Woodhale Drive NE
Atlanta, GA 30326
Ph# 404-266-0793

Illinois

Chicago Indoor Garden Supply
297 N Barrington Road
Streamwood, IL 60107
Ph# 708-885-8282/800-444-2837

The Cooper Shop
One Vineyard Lane
PO Box 130
Monee, IL 60449-0130
Ph# 708-534-8570

Lil' Olde Winemaking Shoppe
4 S 245 Wiltshire Lane
Sugar Grove, IL 60554
Ph# 708-557-2523

Iowa

Biederman Brewing Supply
PO Box 164
Elkader, IA 52043

Kentucky

Winemakers Supply & Pipe Shop
9477 Westport Road
Westport Plaza
Louisville, KY 40222
Ph# 502-425-1692

Maine

The Purple Foot Downeast
116 Maine St., Dept. Z
Waldoboro, ME 04572
Ph# 207-832-6286

R.S.V.P. Discount Beverage & Redemption Center Inc.
887 Forest Ave.
Portland, ME 04103
Ph# 207-773-8808

Maryland

Brew Masters Ltd.
12266 Wilkins Ave.
Rockville, MD 20852
Ph# 301-984-9557

The Flying Barrel
111 S Carrol St.
Fredrick, MD 21701
Ph# 301-663-4491

Massachusetts

Beer And Wine Hobby
180 New Boston St.
Woburn, MA 01801
Ph# 617-933-8818/800-523-5423

The Witches Brew
25 Baker St.
Foxborough, MA 02035
Ph# 508-543-2950

Michigan

The Barrel Shop
41 Courtland St.
Rockford, MI 49341
Ph# 616-866-3327/800-648-9860

Missouri

E.C. Kraus Sales
PO 7850
9001 E 24 Hwy
Independence, MO 64054
Ph# 816-254-7448

Winemakers Market
4349 N Essex Ave.
Springfield, MO 65803
Ph# 417-833-4145

Nebraska

Homebrewing Supply Co.
2805 N 97th Ave.
Omaha, NE 68134
Ph# 402-391-0649

New Hampshire

Orfordville Home Brew Supplies
Rt 25A RR1 Box 106A
Orford, NH 03777
Ph# 603-353-4564

Salisbury Brewing Supply Co.
114 Garvins Falls Road
Concord, NH 03301
Ph# 603-224-8270

New York

The Brewery
18 Main St.
Potsdam, NY 13676
Ph# 315-265-0422/800-762-2560

Fall Bright
9750 Hyatt Hill
Dundee, NY 14837
Ph# 607-292-3995/607-292-6908

Hennessy Homebrew, Inc.
470 N. Greenbush Road
Rensselaer, NY 12144
Ph# 518-283-7094

Milan Malt Shoppe
RD 1, Box 196
Red Hook, NY 12571
Ph# 914-756-2741

Milan Wine & Beer Brewing Lab.
57 Spring St.
New York, NY 10012
Ph# 212-226-4780/800-BEER-KEG

Party Creations
RD 2 Box 35
Red Hook, NY 12571
Ph# 914-758-0661

North Carolina

Alternative Beverage
114-0 Freeland Lane
Charlotte, NC 28217
Ph# 800-365-BREW

Oregon

Home Fermenter Center
123 Monroe
Eugene, OR 97404
Ph# 503-485-6238

Pennsylvania

Ambler Woodstove & Fireplace
Butler & Bethlehem Pikes
Ambler, PA 19002
Ph# 215-643-3565

Bryant Brewing
RD 1, Box 262
Austin, PA 16720
Ph# 814-647-8526

Rhode Island

East Coast Homebrew Supply
199 Austin Farm Road
Exeter, RI 02822
Ph# 401-392-0522

Hobby Winemakers Supply
1270 Post Road
Warwick, RI 02888
Ph# 401-461-0780

Tennessee

Allen Biermakens
4111 Martin Mill Pike
Knoxville, TN 37920
Ph# 615-577-2430

Squash Blossom Market
5101 Sanderlin, Suite 124
Memphis, TN 38117
Ph# 901-685-2293/901-324-BREW

The Winery and Brew Shop
605 Cooper St.
Memphis, TN 38104
Ph# 901-278-2682

Utah

Art's Brewing Supplies
640 S 250 W
Salt Lake City, UT 84101
Ph# 801-533-8029

Virginia

The Compleat Gourmet Inc.
3030 W Cary St.
Richmond, VA 23221-3502
Ph# 804-353-9606/800-777-9606

Heartwood Crafts/Brew Supplies
PO Box 2501
Lebanon, VA 24266
Ph# 703-889-2741

Washington

The Cellar Home Brew
14411 Greenwood N.
Seattle, WA 98133
Ph# 206-365-7660/800-342-1871

Jim's 5¢ Home Brew Supply & Traditional Beer Emporium
N 2619 Division St.
Spokane, WA 99207
Ph# 509-328-4850

West Virginia

Tent Church Vineyard
RD 1, Box 218
Colliers, WV 26035
Ph# 304-527-3916

Wisconsin

Haupt Barrel & Cooperage Co.
1432 S First St.
Milwaukee, WI 53204
Ph# 414-645-7274

Hedtke's IGA Market
308 Clark St.
Hatley, WI 54440
Ph# 715-446-3262

Life Tools
401 N Clay St.
Green Bay, WI 54301
Ph# 414-432-7399

Canada

Pacific Coast Vintners and Brewers Ltd.
3419 Kingsway
Vancouver, BC V5R 5L3
Canada
Ph# 604-433-8918

Marcon Filters
40 Beverly Hills Drive
Downsview, ON M3L 1A1
Canada
Ph# 416-248-8484

If you are interested in having your shop listed, please call Linda Starck, (303) 447-0816, for all the details.

Contributors

David Edgar is club news editor for ***zymurgy***, news editor for ***The New Brewer*** and administrative assistant for the Institute for Brewing Studies. In addition, he is the author of "New Brewing," a new consumer-oriented syndicated column from the Association of Brewers. He has been homebrewing for two years.

Dan Fink is assistant systems operator of the CompuServe Beer Forum, judging director of club competitions and merchandise assistant for the AHA. He is an avid homebrewer—brewing half-barrel batches, growing hops, culturing yeast and enjoying draft homebrew at his White Pine Brewery high in the Colorado mountains.

Stephen Foster was born in England on a hop farm. He met his American-born wife on an English hop farm and attempts to continue the tradition by filling the house with the smell of hops whenever possible. He lives in Ft. Collins, Colo., with his wife and two children, Fiona and Hamilton, who aren't old enough to brew, but help out whenever they get close enough!

Bert Grant, born in Scotland and raised in Canada, started with Canadian Breweries Ltd. in 1945. His positions there included analytical chemist, microbiologist, pilot plant supervisor and assistant research director. Currently, he is a consultant to SS Steiner Hop Co. as well as brewmaster and president of the Yakima Brewery in Washington.

J. "Gus" Guzinski, Ph.D., is senior chemist at Kalsec Inc., in Kalamazoo, Mich., where he is responsible for research on hop extracts and hop oils, and serves as a consultant to the brewing industry in the practical aspects of modifying equipment to use Kalsec's hop products. Recently he has been testing various spice blends to create beers with novel flavors.

Alfred Haunold, Ph.D., is a research geneticist specializing in hops with the U.S. Department of Agriculture. He is a professor at Oregon State University, Corvallis, in the department of crop science. A native of Austria, Haunold is also a member of the Master Brewers Association of America.

Michael Jackson is known worldwide for his love of all things good, and especially good beer. He is author of *The New World Guide to Beer* and the *Simon and Shuster Pocket Guide to Beer*, among other books. He has a television series for the Discovery Channel. Jackson lives in London and consults for Restaurants Unlimited of Seattle. He is a member of the American Homebrewers Association Board of Advisers.

Ralph Olson is director of hop purchasing and material services for Hopunion, USA Inc., a hop brokerage firm that is part of a worldwide organization established in 1809.

Jackie Rager has been a serious homebrewer for 10 years. He is a charter member of the Kansas City Bier Meisters and is treasurer of the Homebrewers Alliance. Rager is one of the managing partners of Bacchus & Barleycorn Ltd. of Merriam, Kan., and has conducted homebrewing classes for the last five years. He is also a recognized beer judge and vice president of the Free State Brewing Co., a brewpub in Lawrence, Kan. When asked what his favorite beer is, he replied, "The one in my stein."

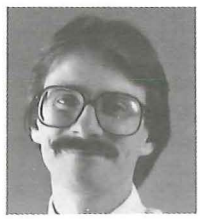
Pierre Rajotte has been brewing for more than 10 years. A mechanical engineer, he also serves as a brewing consultant to *Le Cheval Blanc* (the White Horse) brewpub in Montreal, Quebec. He designed a one-barrel pilot brewery for sale to the public. He is writing *Belgian Ales* for the *Classic Beer Style Series*, published by Brewers Publications.

Michael Ramsey, brewmaster for John Butler, a new microbrewery near Toronto, Ontario, is a graduate of the University of California at Davis fermentation sciences program. He is a longtime homebrewer.

Lloyd Rigby received a Ph.D. from McGill University in Montreal. He then joined the research division of Canadian Breweries Ltd., in Toronto as senior research chemist and later became director of research.
In 1965, Rigby joined John I. Haas Inc., as technical director assigned to establish a hop processing division for both extract and pellets. He is now executive vice president of John I. Haas Inc. Rigby has written many papers and holds several patents, particularly in hop chemistry. His memberships have included the American Society of Brewing Chemists, the Master Brewers Association of the Americas, the American Chemical Society and the Institute of Brewing.

Quentin B. Smith is an accountant working toward a Ph.D. in business management. He has played professional golf since 1964 and won a few events in Michigan and California. The owner of more than 30 different kinds of businesses, Smith is writing a book on beer and one on golf. He has won an award in every brewing competition entered with his all-grain beers.

Dave Wills received his bachelor's degree in agriculture from Oregon State University and has been a homebrewer since 1980. He started growing fresh organic hops in 1983 and is the operator of Freshops and vice president of Oregon Trail Brewery in Corvallis, Ore.



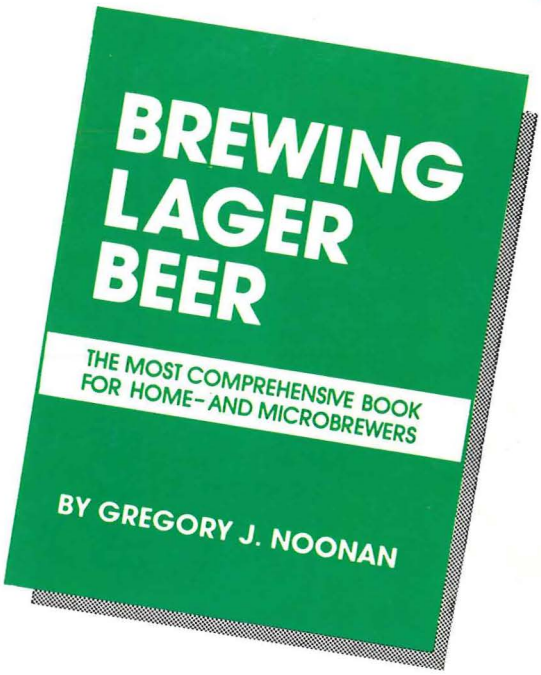
Kihm Winship is a student of beer and brewing with a special interest in the effects of history and changing technology on the brewing process and the resulting beers. He has written often for ***zymurgy***, including articles on black patent malt and the evolution of porter, the holiday beer tradition and H.L. Mencken's homebrewing. By day, to pay for his books and beers, he writes advertising copy and produces television and radio spots for Signet Advertising in Syracuse, N.Y. He adds that he is "married to a beautiful woman and has a beautiful daughter."

NOW IN ITS FOURTH PRINTING

A Complete Look at Lager Brewing and Decoction Mashing

Brewing Lager Beer

By Gregory J. Noonan



'Tis the season for brewing lager beer. And if you're planning to do some serious beer-making, you'll want this comprehensive guide to brewing at your side.

Since we first published *Brewing Lager Beer* in 1986, it has become a classic reference for brewers nationwide. To understand why we've sold out three times you have only to scan its contents:

Part 1: Brewing Constituents

First Greg Noonan gives readers an in-depth look at beer ingredients and the part they play in brewing.

Chapters include Barley; Malted Barley (Evaluation, Carbohydrates, Sugars and Protein); Water (Analysis, pH, Hardness, Alkalinity, Cations, Anions and Treatment); Hops; Yeast (Culturing Pure Strains, Storage and Washing); Bacteria; and Enzymes.

Part 2: The Brewing Process

Next, Greg guides you through the entire brewing process from planning to bottling the beer.

Chapters include Malting (Steeping, Germination and Kilning); Crushing the Malt; Mashing (a complete discussion and directions for decoction mashing); Boiling the Wort (Boiling Hops, Hops Rates, Hot and Cold Breaks, Finishing Hops and Straining and Cooling the Wort); Primary Fermentation (Kraeusening, Pitching the Yeast, Temperature Control, Balling, Real and Apparent Attenuation and Racking); Secondary Fermentation (Lagering, Fining, Real Terminal Extract); Bottling; and Imbibing. A special section also discusses Cleaning and Sterilizing Equipment.

Appendices

Here are over 30 pages of invaluable data handily organized in tables and charts for easy reference. Topics include Homebrewing from Malt-Extract Syrup; Infusion Mashing; Step (Modified Infusion) Mashing; Weights and Measures; Density References; Expected Alcohol Percentage; Hydrometer Correction; Water Hardness Calculations; Brewers Glossary; and others too numerous to list here.

Complete with illustrations and 320 pages.

Still At Our Same Low 1986 Price
Only $12.95 ($14.95 Non-members)

Yes, I want _____ copy(ies) of *Brewing Lager Beer* at $12.95 ($14.95 non-members) each. Enclose $2.50 for Postage and Handling plus 50 cents for each additional book.

___Check Enclosed ___Credit Card Order

Name_____

Address_____

City_____State_____Zip_____

Phone_____

Charge my ___Visa ___Mastercard

Exp. Date_____Acct. No._____

Name on Card_____

Signature_____

Or Call (303) 447-0816 with your Credit Card Order.

Make check payable to Association of Brewers, Box 287, Boulder, Colorado, 80306-0287, USA, (303) 447-0816.

L13-1