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THE HOW-TO HOMEBREW BEER MAGAZINE

NOVEMBER 2019, VOL.25, NO.7

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NOVEMBER 2019, VOL. 25 NO.7

features

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Brew Your Own
THE HOW-TO HOMEBREW BEER MAGAZINE

departments

where to find it

RECIPE INDEX

RECIPE STANDARDIZATION

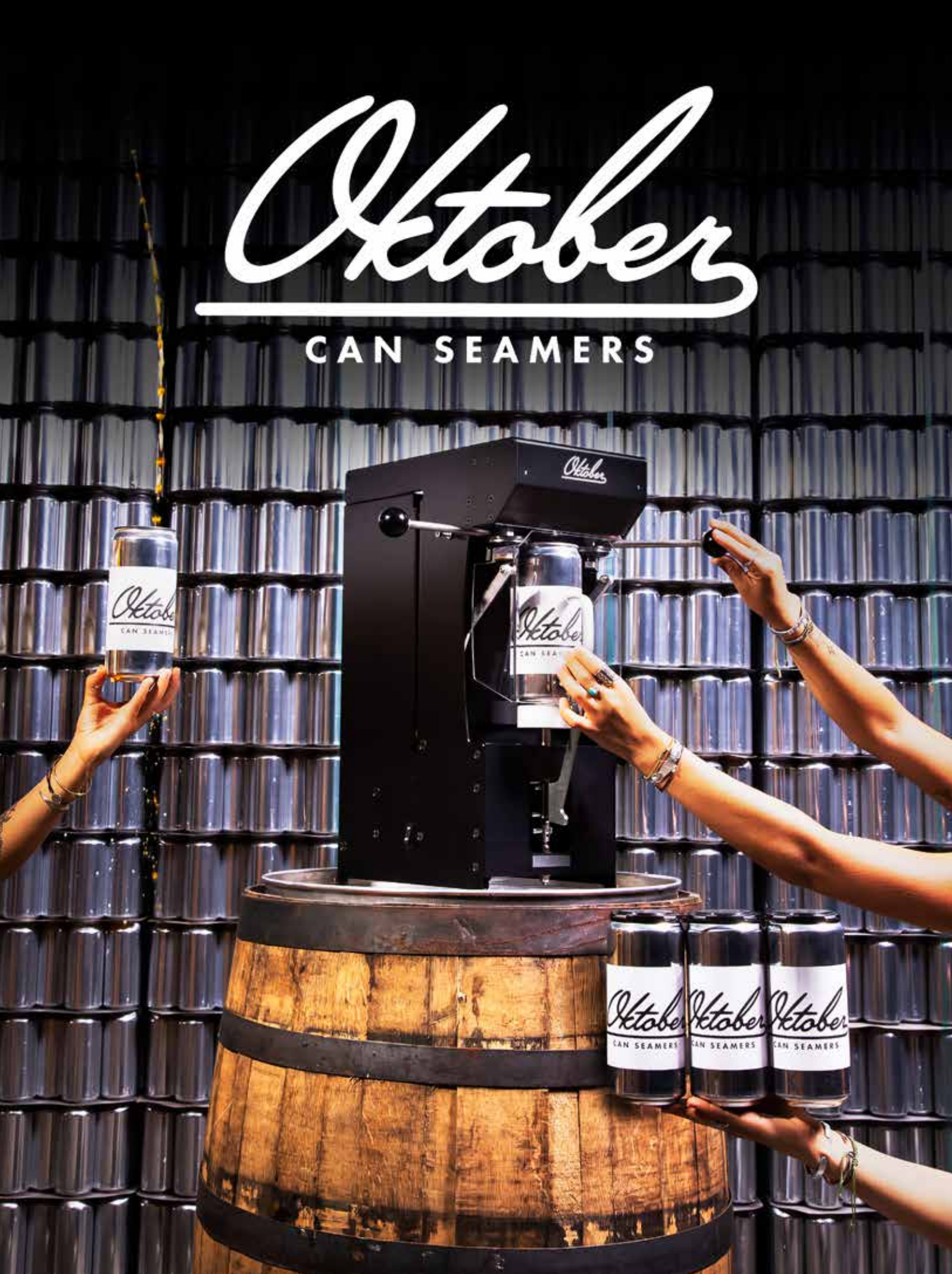
EXTRACT EFFICIENCY: 65%
(i.e. — 1 pound of 2-row malt, which has a potential extract value of 1.037 in one US gallon of water, would yield a wort of 1.024.)

EXTRACT VALUES FOR MALT EXTRACT:
liquid malt extract (LME) = 1.033–1.037
dried malt extract (DME) = 1.045

POTENTIAL EXTRACT FOR GRAINS:
2-row base malts = 1.037–1.038
wheat malt = 1.037
6-row base malts = 1.035
Munich malt = 1.035
Vienna malt = 1.035
crystal malts = 1.033–1.035
chocolate malts = 1.034
dark roasted grains = 1.024–1.026
flaked maize and rice = 1.037–1.038

HOPS:
We calculate IBUs based on 25% hop utilization for a one-hour boil of hop pellets at specific gravities less than 1.050. For post-boil hop stands, we calculate IBUs based on 10% hop utilization for 30-minute hop stands at specific gravities less than 1.050. Increase hop dosage 10% if using whole leaf hops.

Gallons:
We use US gallons whenever gallons are mentioned.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What beer destination/ region is at the top of your list to visit?

I'm a big fan of many Belgian beer styles. I was fortunate enough to go to Belgium in the summer of 2011 for a week-long beer adventure. In lieu of a trip back to Belgium, I would like to spend some time visiting breweries in Québec where many brewers have Belgian-style beers in their line-up. There are over 150 breweries in the province and I've only had beers from a handful . . . so far!

My fantasy beer destination would be either Belgium or northern Germany during the time period that the Gose style was being popularized/ perfected.

I just made reservations to go to Edinburgh — Glasgow — Speyside to combine beer AND whiskey. One of my favorite styles of beer is the very malty Scotch ale/ wee heavy. I hope to find a few with the signature smoky flavor of the region.

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suggested pairings at BYO.COM

Master The Spice

With holiday season approaching fast, now seems like the appropriate time to brew a spiced beer. While mixing beer with spices offers an unlimited array of options, the approach to spicing beer can be handled in stride using a few key guidelines. https://byo.com/article/master-the-spice-options-and-approaches-to-additions/

MEMBERS ONLY

Balance Your Draft System

Homebrewers that go to the length of building their own bar often will include a draft system with it. But draft systems can be a source of frustration if things are not done right. Learn how to properly set up and maintain your draft system. https://byo.com/article/balancing-your-draft-system-advanced-brewing/

Build A Tap Cleaning System

Clean multiple beer lines in a fraction of the time. The best technique for cleaning beer lines utilizes a submersible pump to push the cleaning fluid through your taps and beer lines. While this project is designed for a specific draft tubing design, it can be adapted for all draft types with some ingenuity. https://byo.com/project/tap-cleaning-system/

MEMBERS ONLY

Take Me To Your Liter

One of the things that makes drinking beer in Germany unique from North America is that depending where in the country you are, the beer style you find will be different. Take a beer-style tour of Germany to discover some of the most notable current German beer styles (plus recipes) and the regions they come from. https://byo.com/article/take-me-to-your-liter/

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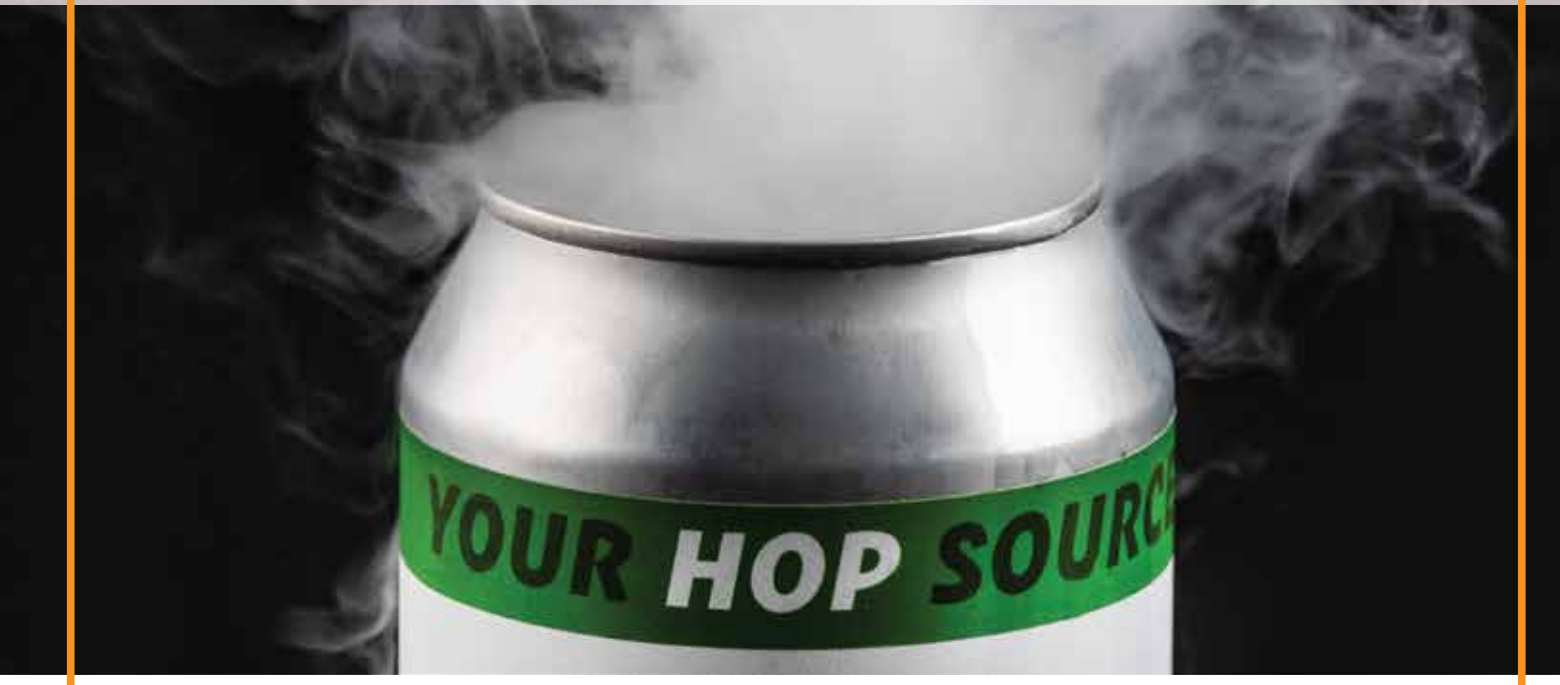

stay connected!

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MAIL

WHAT TO DO WITH A SPARE BEDROOM?

Daughter left for college. Used her bedroom for hop drying.

Keith Lietha • *via Facebook*

LAUNCH PAD BREWERY'S KEY LIME SAISON CLONE

I saw a recipe in the November 2017 issue of *BYO* for Launch Pad Brewery's Cape Canaveral Key Lime Saison. It sounds delicious! I'm hoping you can help me out with a question. The recipe calls for 2 lbs. (0.9 kg) of fresh key limes, peeled and juiced. The peel is added with 10 minutes left in the boil — but how much is used? It would seem to be a lot if you used all the peels from 2 lbs. (0.9 kg) of limes. I appreciate any information or other hints you can provide! I'm really looking forward to tasting this!

Dary Stewart • *San Diego, California*

We had to circle back to Launch Pad Brewery for this answer, and according to Owner and Brewmaster David Levesque, he suggests

contributors

Bill Jablonski is a Co-Owner of Draftnauts LLC, an independent installer of draft systems located in the Finger Lakes region of New York. After studying music and history in college, Bill became well-equipped for a life of working Wall Street, contaminated soil and groundwater investigation, and engineering inspection. Armed with a bunch of licenses and certifications in health and safety, construction, and asbestos, Bill set out to understand the dark arts of draft beer. Turns out the beer industry is a lot more interesting than all the rest.

In this issue, Bill details what homeowners should take into consideration when designing a home bar, beginning on page 48. He also shares his tips for cleaning draft systems in "Tips from the Pros" on page 18.

Horst Dornbusch is a consultant in the international brewing industry. Over the past quarter-century he has published hundreds of articles, as well as many books about the technical, sensory, and economic aspects of beer and beer-making. His books include *PROST! The Story of German Beer* (1997); *Altbier* (1998); *Bavarian Helles* (2000); *Die Großen Biersorten der BRAUWELT®* (2014); *Beer Styles from around the World* (2015); *Das Große BRAUWELT® Lexikon der Biersorten* (2017); and, together with co-author Thomas Kraus-Weyermann, *Dark Lagers — History, Mystery, Brewing Techniques, Recipes* (2018). In addition, he was the Associate Editor of and a major contributor to the 900-page reference work, *The Oxford Companion to Beer* (2011).

In this issue, Horst sets out to revive some of the many extinct German beer styles from hundreds of years ago, beginning on page 66.

Cameron Johnson owns and operates Incubator Brewery in Spokane, Washington, a collaborative brewing space featuring multiple, separately-licensed breweries sharing a seven-barrel brewhouse, that assists developing brewers in everything from initial business planning to moving out to their own premises. Additionally, he works as part of the engineering team at Marks Design and Metalworks, a custom brewery equipment designer and manufacturer in Vancouver, Washington.

Beginning on page 101 in this issue's "Nanobrewing" column, Cameron shares the knowledge he's acquired at Incubator Brewery on different business models for nanobreweries.

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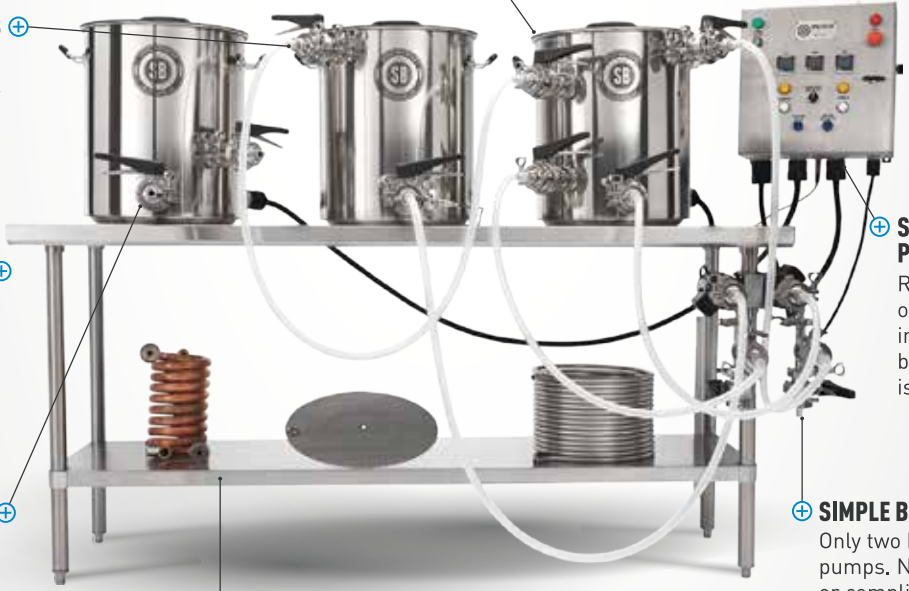

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PURSUE WHAT'S POSSIBLE

MAIL

2 oz. (56 g) of key lime peel, chopped up in a food processor to smaller pieces to provide more surface area. If you haven't brewed this recipe I hope you give it a try, as it sounds mighty tasty and would hit the spot in San Diego's summer heat. (OK, maybe a little late for that, but keep this recipe handy when next spring rolls around!) Let us know how the beer comes out!

CARBONATING THROUGH DOSAGE

I would like to brew the clone recipe for Brouwerij Bosteels' DeuS from the *250 Classic Clone Recipes* special issue. My question is about the last line of the recipe: 1.5 lbs. (0.68 kg) light dried malt extract (for dosage). I don't understand what I have to do with the light dried malt extract. For *dosage*? What does that mean?

Giampiero Galgani • *via email*

BYO *Recipe Editor Dave Green responds: "That's a good question and one that does not often come up on the homebrew side (that I've seen), but is more common among readers of our sister publication* WineMaker *magazine. However, this beer is described as 'Bière de Champagne,' also known as a Bière Brut, so it makes sense it would take some notes from Champagne winemakers. Dosage is something that is performed in the* méthode Champenoise *style of making sparkling wines, after the wine has been aged "on the lees" (yeast) for up to seven years, which in the wine world is considered a good thing. After this aging on the lees, the wine is riddled, disgorged, and a dosage is added to top the bottles back up. The dosage will add sweetness to the wine, so dosage sweetness levels will vary depending on the desired goal. This recipe ran with a story from the May-June 2004 issue that goes into detail about how to do the dosage. That story is available for free at https://byo.com/article/deus-brut-des-flandres/.*

The question is, are you ready to go all-in with the méthode Champenoise*? The alternative is the Italian* Charmat *method of producing sparkling wines (like Prosecco) . . . it's closer to the forced carbonation method most homebrewers utilize. If you want to learn more about dosage, you will find many details about it through wine-making resources, including a couple of links from* WineMaker *that are accessible to everyone at: https://winemakermag.com/technique/sparkling-wines-tips and https://winemakermag.com/wine-wizard/358-how-can-i-make-homemade-sparkling-wine.*

WRITE TO *BYO*

Have a question about something you've seen in *BYO*? Want to show off your latest DIY homebrewing gear or recipe? Write to us at: edit@byo.com, find us on Facebook: www. facebook.com/BrewYourOwn, Instagram: @brewyourownmag, or reach out to us on Twitter: @BrewYourOwn.

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BEGINNER'S BLOCK

BY DAVE GREEN

10 TIPS FOR BEGINNERS

For all of us brewers that have been brewing for many years, what advice would we have for ourselves when we were nascent homebrewers? If my current self were in my dorm room when I was creating my game plan for brewing, executing those first batches of beer twenty years ago, and finally packaging the beer . . . what would I tell myself? Well here are the Cliff's Notes:

1. Always have backup yeast sachets
This is one that is the clear leader in my mind . . . always have an extra sachet or two of dried yeast that can be pitched on a moment's notice if the first pitch of yeast for some reason fails on you. If you are not seeing any signs of yeast activity within 48 hours of the initial pitch of yeast, it's time to go to the backup. It's easy — just keep a favorite strain and keep the backup rotating through at regular intervals.

2. Keep it simple to start
Do your research and find a solid lineup of recipes you would like to brew. But keep the recipes simple. In my trajectory of homebrewing, I wish I had read Ray Daniel's *Designing Great Beer Styles* before I read Randy Mosher's *Radical Brewing*. I ended up putting the cart before the horse when it came to my homebrewing learning curve. Nowadays it's pastry stouts and mango creamsicle IPAs leading the charge in this department. I implore you to learn to master a few key beer styles before expanding into the more exploratory recipes.

3. More isn't always better
Just because that bag of crystal 60L comes in a 1 lb. (0.45 kg) bag, it doesn't mean you should use all 1 lb. (0.45 kg) in the recipe. This goes back to the previous point, find some good recipes and stick with them to start. Jamil Zainasheff's collection of homebrew recipes found in *Brewing Classic Styles* is a great jumping off point for dialing your recipe design. Once you establish a baseline for the style, you can then tweak these recipes to fit your preferred tastes.

4. Don't neglect your water
While simplifying the process is key to having fun homebrewing . . . there is nothing that can ruin a batch of beer faster than not identifying potential problems with your water. If your water is in question, start with reverse osmosis or distilled water. If you are brewing with municipal water, you need to make sure your water is free of chlorine/chloramines, which can be done with the simple addition of one half Campden tablet per 10 gallons (38 L) of brewing water or slowly filtering through a carbon block filter. A little research into your city's water department or sending a water sample off to a laboratory for brewing-specific water testing can save a lot of grief down the line.

5. Go to a homebrew shop
This may be a bit of a luxury for some, but when it's time to make purchases, whether it is equipment or ingredients, find your closest shop and pay a visit. Don't be afraid to talk and elicit advice from them . . . tell them you're green in the hobby and leave your ego at the door. You may be a great taster, but that doesn't make you a great homebrewer.

6. Don't sweat mash temperature
For all-grain and partial-mash brewers, mash temperature is a key step in the process, but don't get sucked into knee-jerk reactions if your mash temperature doesn't land where you intended. Keep a calm head and don't over compensate. But do make sure you have a good thermometer and keep it calibrated so you're confident about your temperature readings.

7. Size matters
Whenever you get new vessels, whether they're fermenters, boil kettles, or anything else that will hold the wort or beer, be sure you are able to measure the volume. A wooden dowel with etchings is a great tool to measure boiling wort volume. Markings on the outside of carboys or other fermenters can assure you that you are getting the volume you were expecting, which can go a long way in solving inconsistencies in your brewing process.

8. Sweat the fermentation temperature
While I used to freak out if my mash temperature was not spot-on, my early homebrewing self could barely muster a cursory glance at the fermentation temperature. Don't be like me. Do your research, adjusting fermentation temperature can be done on the cheap, but if there is one area I recommend investing a little more at the outset, this should be your focus.

9. Learn to taste critically
We receive tons of troubleshooting questions stating, "something just tastes off." This is one of the hardest problems to troubleshoot. How does it taste off? Is it plastic-y, medicinal tasting, or tasting like a rotten vegetable, or have the aroma of green apple Jolly Rancher? When you can hone in on potential sources of off-flavors, you can start to troubleshoot things you are doing wrong in your process.

10. Get informed from reviewed sources
A lot of homebrewers get too much information from some random person(s) on the internet. While there may be some great knowledge to be found out there in the web ether, start with learning from experts whose writings have been technically reviewed — like in books and certain magazines.

HOMEBREW DROOL SETUP

MATHIEU AUDETTE • BELLEFEUILLE, QUÉBEC

I named my brewery Garage 12 Brewing because I am also a garage guy and my racing number has always been 12. As a race car driver/mechanic I found the same characteristics that guide my brewing passion are also found in my racing passion: It takes good organization, you need to be well prepared, you need to know your tools, and it takes good friends to help you reach your goals!

I have been brewing for about six years now. Like most everyone else, I started with two buckets and a kit that came out of a cardboard box. I remember how nervous I was the first time I brewed. When I first opened the bucket lid to see what was going on during the fermentation I was shocked by the look of the yeast cake floating . . . "what is that?!" I thought it was ruined. But once the beer was in the secondary it started to look better and when I drank my first bottle . . . I was hooked. It was one of my favorite beers I ever had!

After I brewed a few kits and got some confidence, a friend and I started to look to go all-grain. I found a mash tun and we tried to make a sparging setup. It wasn't perfect but the first beer we made was a double IPA and I must say that it turned out really well. So we brewed using the same mash tun setup and my propane burner for about a year.

With my passion growing, I then got a gift from my brother-in-law to go into a beer brewing class put on by a well-known Québec brewer. I was quite curious to see he was using a brewing "machine" in the class. Turns out it was a Braumeister system and one of the beautiful things was that it's easy to transport. Impressed by the system's performance, I ordered my own Braumeister 20L brew kit after the class.

Just like many using this 20-L (5-gallon) setup, it quickly became too small so I ordered up a complete Braumeister kit with chiller, two conical fermenters with temperature control, and the bigger 50L Braumeister unit. I also now use the Braumeister pumps to transfer the wort into the fermenters so I don't need to clean a secondary pump. I find that the risk of infection is minimal and also I can get a complete brewing day done in about five hours. I do still dream of the next size up because this setup is limited to about 28 lbs. (13 kg) of grain. So my maximum OG is about 1.065 if I use the full water volume of 55 L (14.5 gallons) and get about 48 L (12.7 gallons) of wort in the fermenter. Still the convenience of the system is a big pro.

WHAT'S NEW

ANVIL BOTTLE CAPPER

The new bottle capper from Anvil Brewing Equipment features several key elements engineered to make it safe, durable, and easy to use. Some of the specialty designs include a broad free-standing base to prevent tipping and one hand operation allowing your other hand to stabilize the bottle. A magnetic head frame holds the cap in place prior to capping and the metal capping jaws provide consistent performance for years. The mast is foldable for convenient storage when not in use, it actually has a wall hanger for storage as well. The unit is adjustable for bottles up to 14 inches tall (36 cm) and an optional 29 mm (European) capping bell is available. www.anvilbrewing.com/-p/anv-bottle-capper.htm

THE GUIDE TO CRAFT BEER

As of early 2019, more than 7,000 breweries are active in the United States. In *The Guide to Craft Beer*, the Brewers Association has broken the book into four sections, the first section covers 80+ beer styles to provide framework for the style, the second section reflects on pairing beer and food, the third section celebrates the independent craft beer community, and the fourth section is a tasting log where the reader can record 75+ tasting experiences. For more information or to purchase, visit: www.brewerspublications.com/products/the-guide-to-craft-beer

SPIKE BREWING REDESIGNED 2-IN. SIGHT GLASS

The engineers at Spike Brewing went back to the drawing board to build their new sight glass from the ground up. The new design removes the long lag bolts, which at times need adjustments to prevent leaking and are often comprised of 26 parts. The new Spike Sight Glass has only 5 parts and no tools are required to disassemble the piece. Simply twist off the knurled end. The extra thick Pyrex®glass is protected from breakage by a 304 stainless steel guard. Total length is 6-in. (15 cm) and is 25% lighter than previous sight glasses. The new sight glass retails at $60 (USD). To learn more, check out: spikebrewing.com/collections/conical-accessories/products/2-tc-sight-glass

BREWERIES OFFER DISASTER HELP

Last year we covered Sierra Nevada's disaster relief effort after several neighboring towns were destroyed by the Camp Fire. During production of this issue, Hurricane Dorian had just leveled two heavily populated islands in the Bahamas. Just as when Hurricane Harvey unleashed its wrath on the Houston, Texas area, local craft breweries in Florida opened their doors for locals to fill their water jugs from their water system. Over 63 breweries in Florida alone offered free water fills to anyone preparing for the hurricane to strike. Just another way craft brewers are helping make a difference. http://floridabeernews.com/2019/08/29/florida-craft-breweries-filling-water-for-hurricane-preparation/

2020 BYO BOOT CAMP

The site for the 2020 BYO Boot Camp was announced along with a revamped schedule of events. The upcoming Boot Camp will be held in downtown Denver, Colorado from March 26–28 at the Embassy Suites. It is the perfect location within walking distance to easily explore much of Denver's vibrant craft beer scene. New this year: The Boot Camp will be three days total, two days being small-scale, full-day workshops plus a full day of brewing talks featuring many of the expert speakers. Two- or three-day options include lunch, one full day of back-to-back brewing seminars from our experts, and a post-Boot Camp Denver-Area Craft Beer Reception Thursday and Saturday. If you have not attended a BYO Boot Camp before, hopefully this will be your year. Mark your calendars for March or sign up today at byo.com/byo-boot-camps/

Upcoming Events

NOVEMBER 1 & 2
NanoCon 2019
comes to Vancouver, Washington, just across the bridge from Portland, Oregon. Join Nanobreweries (and Nanos in-planning) for two days packed with over 30 seminars, workshops, and events geared just for the small-scale commercial brewery. Attendees will learn from experts and fellow Nano colleagues about actionable ways to improve – or launch – your brewery with ideas targeted just for your small-scale size and business direction. https://byo.com/nanocon/2019-nanocon/

NOVEMBER 2
Entry Deadline —
The 8th annual Beer For Boobs competition organized by the Scioto Olentangy Darby Zymurgists (SODZ) is open to any amateur homebrewer age 21 or older. All net proceeds go to benefit Beer for Boobs breast cancer research, a non-profit organization started by White Labs founder and Vice President Lisa White. To date, SODZ has raised over $6,000 for the charity. Judging takes place November 16. For more information or to register, visit http://beerforboobs.sodz.org/

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REPLICATOR

BY MICHAEL BURY

DEAR REPLICATOR, When I tried Drop-In Brewing's Heart of Lothian for the first time, I found exactly what I have been looking for in a malty beer. The Middlebury, Vermont brewery has created the perfectly balanced Scottish ale. The hops are definitely there but they marry the malt exquisitely and with the right amount of sweetness. The 5.6% ABV is the ideal place for this beer to land.

Drinking this beer definitely gave me some brewing goals. This is the beer that I've spent years trying to brew. My malty beers tend to be unbalanced; I can't seem to get hoppiness, sweetness, and ABV to land at the right place. I would love to get some insight on how Drop-In does it.

Michael Burdick
Burlington, Vermont

Thanks for the request Michael! Although I'm sorry that your previous attempts have been less successful than you would've hoped. As you've found out, Scottish ales appear simple on the surface but are finely-tuned beers with multiple aspects in perfect harmony. Here's to hoping this column sheds a wee bit of light on your and other's endeavors

One can't mention Drop-In Brewing without uttering the name of Steve Parkes. That said, Drop-In is the culmination of Steve's dreams. After graduating with a BSc in Brewing Science from the prestigious Heriot-Watt University in Edinburgh, Scotland, Steve became responsible for brewing, selling, and delivering cask-conditioned ale at Berrow Brewery in Somerset, England. He later honed his skills as a Head Brewer at several other breweries (Berrow, Tisbury, and Wiltshire) in Great Britain all the while crafting delicious cask ales. From this success, individuals noticed his proclivity for quality and he was subsequently pulled away to the United States in 1988. There, he partnered with two others to found the British Brewing Company in Baltimore, Maryland; the first microbrewery in Maryland since Prohibition. Steve remained Head Brewer there until 1992 when he departed for California.

Over the next 20 years, a common theme weaved its way through Steve's career: An application of innovative techniques with a just-do-it attitude — systematize, but don't cut quality. This resulted in the growth of the next several breweries where Steve took the helm such as Humboldt Brewing Company and Otter Creek Brewery. This earned him multiple Great American Beer Festival (GABF) awards and additional opportunities.

His knowledge and willingness to teach about brewing and its practices including molecular biology, biochemistry, chemical engineering, off-flavors, and food pairings is what really shines. After a single semester teaching at the American Brewers Guild in California, Steve was offered a full-time teaching position at this prestigious institute. He went on to become a lead instructor until 1999 at which point he was offered the chance to purchase the rights to the Guild. He did and has been the owner for 20 years now.

But why mention the American Brewers Guild in the first place? Simply put, its home location is now Drop-In Brewing Co. There, you can take classes such as "Beer Appreciation," "Grain to Glass," or "Lab Practices for the Small Brewery," and even more importantly for many reading this, "Brewing Science for Advanced Homebrewers." It is a 2-day, intensive course that incorporates "the nation's only full-scale brewing facility dedicated to brewing education," Drop-In Brewing Company.

Just like a phoenix, Drop-In Brewing did indeed rise from the proverbial ashes of an old plumbing supply company in Middlebury, Vermont. With Steve's extensive knowledge, the task of rehabilitating the area into a brewhouse was as fluid as anyone can get with a remodeling project. The result was a Newlands 15-BBL brewhouse that turns out straight forward, approachable beers that still are innovative. They shipped their first beer in June 2012. Many of the beer names also use pop culture as inspiration like Red Dwarf (an American amber with the twist of a British sci-fi comedy), 6 Holes in My Freezer (a key lime pie beer that even Jimmy Buffett would approve of), and River Song (Doctor Who would do best to stay out of the shadows).

Drop-In Brewing brews several year-round offerings, one of which is the Heart of Lothian. It's named for the city of Edinburgh, where Steve acquired his brewing degree and is also a song title from the band Marillion. In terms of style, the beer is considered a Scottish 90/- or wee heavy and uses, "Scottish Golden Promise barley malt, British floor-malted crystal, and chocolate malts, Fuggle and Kent Golding hops, and British yeast." You'll probably notice several unique attributes about the recipe included. First off, is the use of an English ale yeast, which at 68 °F (20 °C) will probably give you a bit of fruity esters. The other deviation from common practice for the series of modern Scottish ales is the hopping rate of 3 oz. per 5 gallons (85 g per 19 L) of beer. However, this provides a balancing counterpart to the malt and esters. And at 5.6% ABV, Heart of Lothian becomes very drinkable yet boasts loads of flavor and character.

DROP-IN BREWING CO.'S HEART OF LOTHIAN CLONE

(5 gallons/19 L, all-grain)
OG = 1.055 FG = 1.012
IBU = 23 SRM = 22 ABV = 5.6%

INGREDIENTS

9 lbs. (4.08 kg) Golden Promise malt
0.75 lb. (0.34 kg) crystal malt (70 °L)
0.75 lb. (0.34 kg) Simpsons DRC™ malt (110 °L)
0.75 lb. (0.34 kg) Weyermann Carafoam® malt
0.2 lb. (0.09 kg) English chocolate malt (450 °L)
3.7 AAU Fuggle hops (60 min.) (0.75 oz./21 g at 4.9% alpha acids)
3.5 AAU East Kent Golding hops (30 min.) (0.75 oz./21 g at 4.6% alpha acids)
6.9 AAU East Kent Golding hops (0 min.) (1.5 oz./43 g at 4.6% alpha acids)
Wyeast 1968 (London ESB Ale) or White Labs WLP002 (English Ale) or SafAle S-04 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Mill the grains, then mix with 3.6 gallons (13.5 L) of 164 °F (73 °C) strike water to achieve a single infusion rest temperature of 149 °F (65 °C). Hold at this temperature for 60 minutes. Mashout to 170 °F (77 °C) if desired.

Vorlauf until your runnings are clear before directing them to your boil kettle. Batch or fly sparge the mash and run-off to obtain 6.5 gallons (25 L) of wort. Sparging for this beer takes 2 hours on scale but may be quicker at home. Boil for 60 minutes, adding hops at the times indicated above left in the boil. At 15 minutes left in boil, you may want to add either Irish moss or Whirlfloc as fining agents.

After the boil, add the whirlpool hops indicated and whirlpool for 15 minutes before rapidly chilling the wort to 66 °F (19 °C). Pitch yeast and aerate the wort. Maintain fermentation temperature of 68 °F (20 °C) for this beer.

Once primary fermentation is complete, and the beer has settled, bottle or keg the beer and carbonate to approximately 2.5 volumes.

DROP-IN BREWING CO.'S HEART OF LOTHIAN CLONE

(5 gallons/19 L, extract with grains)
OG = 1.055 FG = 1.012
IBU = 23 SRM = 22 ABV = 5.6%

INGREDIENTS

5 lbs. (2.27 kg) light dried malt extract
0.75 lb. (0.34 kg) crystal malt (70 °L)
0.75 lb. (0.34 kg) Simpsons DRC™ malt (110 °L)
0.75 lb. (0.34 kg) Weyermann Carafoam® malt
0.2 lb. (0.09 kg) English chocolate malt (450 °L)
3.7 AAU Fuggle hops (60 min.) (0.75 oz./21 g at 4.9% alpha acids)
3.5 AAU East Kent Golding hops (30 min.) (0.75 oz./21 g at 4.6% alpha acids)
6.9 AAU East Kent Golding hops (0 min.) (1.5 oz./43 g at 4.6% alpha acids)
Wyeast 1968 (London ESB Ale) or White Labs WLP002 (English Ale) or SafAle S-04 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Bring 6.5 gallons (25 L) of water to roughly 150 °F (66 °C). Steep all the specialty malts 15 minutes before removing and draining. Add the extract, while stirring, before heating to a boil. Boil for 60 minutes, adding hops at the indicated times left in the boil. At 15 minutes left in boil, you may want to add either Irish moss or Whirlfloc as fining agents.

After the boil, add the whirlpool hops indicated and whirlpool for 15 minutes before rapidly chilling the wort to 66 °F (19 °C). Pitch yeast and aerate the wort. Maintain fermentation temperature of 68 °F (20 °C) for this beer.

Once primary fermentation is complete, and the beer has settled, bottle or keg the beer and carbonate to approximately 2.5 volumes.

TIPS FOR SUCCESS:

First off, use high-quality, fresh ingredients with an emphasis on UK-based malts and hops if possible. Consider Crisp, Thomas Fawcett, and/or Simpsons as your maltsters of choice.

Next, focus on your fermentation. Ensure your pitch is appropriately sized and healthy; the easiest way is to either repitch yeast from a previous batch of beer or create a starter in whatever way you're most comfortable. This yeast strain has been known to struggle to attenuate to this extent, so be sure to provide an ideal environment with proper temperature control to ensure a strong fermentation.

Finally, focus on water chemistry for a malt-forward beer. To this end, ensure you have at least 40 ppm of calcium in the brewing water but more importantly your ratio of chloride-to-sulfate should be in the range of 1:1 to 2:1. With great base ingredients that are well-attenuated and flavored appropriately with the right amount of ions, you should have no trouble brewing an amazing Scottish 90/-. BYO

BY DAWSON RASPUZZI

DRAFT CARE

Cleaning & maintaining your draft system

Pouring a beer with a perfect head of foam from your draft system is a thing of beauty, but without proper maintenance the experience can be spoiled. Keep things from going off the rails with maintenance advice from two draft experts.

Effective cleaning is more important than cleaning frequency. Just don't let your cleaning schedule get ahead of you.

Bill Jablonski is a Co-Owner of Draftnauts LLC, an independent installer of draft systems located in the Finger Lakes region of New York. After studying music and history in college, Bill became well-equipped for a life of working Wall Street, contaminated soil and groundwater investigation, and engineering inspection. Armed with a bunch of licenses and certifications in health and safety, construction, and asbestos, Bill set out to understand the dark arts of draft beer. Turns out the beer industry is a lot more interesting than all the rest.

Beer is food. Proper sanitation is necessary and as homebrewers we are well-informed about the importance of appropriate cleaning procedures. Draft beer presents many of the same sanitation issues we encounter in our brewhouse along with a few other unique challenges.

When cleaning draft lines, simply allowing the cleaning solution to remain in contact with the line (static cleaning) is usually adequate. The entire system, quick disconnects, faucets, all can be cleaned at the same time as the line cleaning. Fill up a keg with 2–3 gallons (8–11 L) of cleaning solution and then push it through the kegerator with CO_2. Let the solution sit for 15 minutes and then push the remainder of the cleaning solution from the keg. Rinse it all with a full keg of water. If you have a pH meter you can confirm when the pH is acceptable. You really want to be abundantly cautious and rinse thoroughly. Consider purchasing strips of pH paper if you aren't ready to buy a pH meter.

There are numerous cleaning solutions, each claiming their own particular benefit. An industry standard is Beer Line Cleaner (BLC) and it works quite well. Whether organically-based, color-enhanced, low-foam, or extra strength, line cleaning solutions work because they are caustic. The solution kills bacteria, removes biofilm, scrubs hop oil, and eliminates protein deposits. It is potent stuff. The concentration of caustic in the solution is the primary cost consideration.

Alkaline cleaners have an extremely high pH. A widely available cleaner sold retail has a pH value of 13.5 prior to dilution. Bleach is typically in the pH range of 12. So line cleaner is over 10 times more caustic than bleach. These are serious chemicals, folks! Wear rubber gloves and eye protection. Read and follow the safety precautions.

Cleaning beer lines once a month is plenty, and once every two months is probably adequate. Effective cleaning is more important than cleaning frequency. Just don't let your cleaning schedule get ahead of you. Your homebrew is swimming with live yeast and undoubtedly has a lot of hop debris as well, all of which are sanitation issues that require attention. Yeast in your draft system will go rogue just as readily as they will in your fermenter, especially if you let your rig sit warm. Hops are antiseptic but they also provide a fine harbor for beer spoiling bugs to take hold.

Every time you clean your lines you should be cleaning your liquid quick disconnect (QD) and faucet, either with the clean-in-place method or manually disassembling. The gas QD does not need to be cleaned unless you managed to force it onto the liquid out post (and we have all done it). Faucets and QDs have crevices that harbor all sorts of gunk, hop debris, and yeast. In fact, these two items are more likely to be fouled than the beer line. Unscrew the top of the QD, put all the innards into a soapy hot water solution for a few minutes, then rinse. Your faucet does require particular attention as it contains some room-temperature beer. Disassemble on a towel and rinse the body thoroughly in hot water. Be sure the vent holes are cleaned of gunk. If you have a ventless faucet and maintain a cleaning schedule you probably don't need to disassemble every time.

The only tool I consider a requirement for the cleaning process is a faucet wrench. If you need a faucet brush you probably aren't cleaning your system frequently enough, though we all need some help now and again.

Christian Lavender is an Austin, Texas-area homebrewer and the founder of HomeBrewing.com, a website that helps brewers find the best prices on homebrewing kits and homebrew supplies. He also runs Kegerators.com, a website for those looking for home draft equipment. You can ask him questions at the site's "ask an expert" section.

My regular draft cleaning procedure is broken into four steps: **Step 1 - Turn Off and Unplug.** Start by unplugging the kegerator. I also turn the CO_2 tank off, close off the regulator, and disengage the keg tap and remove the keg.

Step 2 - Clean Inside and Outside. I clean all interior surfaces of the kegerator — this includes the CO_2 tank, regulator, keg tap, beer lines, any drip tray collection, the inside of the cooling unit, and the outside. I do this because bacteria and yeast can live in sticky puddles of spilled beer and find their way into the beer faucet and cause contamination.

Step 3 - Flush Beer Lines with Cleaner. Using a gravity-fed cleaning kit or one pressurized with a hand pump, I flush beer line cleaner through the lines to clean all the liquid-side beer line components. I usually take about 10 minutes to recirculate the cleaner through the beer lines.

Step 4 - Clean Faucets and Couplers. I disassemble the faucet by unscrewing it to the right with a faucet wrench and let the various faucet and coupler parts soak in a mixture of cleaning solution (like PBW) and hot water in a bowl for 10–15 minutes.

Over a period of time kegerator lines can become brittle, making it easier for bacteria, wild yeast, and molds to take hold in cracks and small scratches in the line material. They should last about a year if regular surface and deep cleanings are performed.

Depending on the beverage you are dispensing, you might find that your lines become stained or discolored. This can occur even after the first dispensing of a darker colored beer, wine, coffee, or even soda. Discoloration usually does not affect how the lines perform as long as they are fairly new lines and after recirculation of line cleaner there are no remaining odors. If you notice beer stone or other materials in the line after cleaning then it is time to replace. BYO

For more advice from Bill and Christian, see an extended version of this article at https://byo.com/article/draft-care/

HELP ME, MR. WIZARD

BY ASHTON LEWIS

THE NOT-SO-GREAT HOP FADE

Also: Step mashing and frozen fruit

Q I TYPICALLY PURCHASE HOPS A POUND (0.45 KG) AT A TIME AND USUALLY A YEAR OLD TO GET A BARGAIN. THEREFORE, THE BULK OF MY HOPS ARE ABOUT 2 YEARS OLD. WHEN I OPEN THE HOPS I BREAK THEM DOWN INTO 1-OZ. (28-G) BAGS THAT I THEN VACUUM SEAL.

I LIKE MAKING NEW ENGLAND IPAS WITH THE USUAL SUSPECTS: CITRA®, SIMCOE®, MOSAIC®, ETC. I HAVE NOTICED THAT OVER MY PAST HANDFUL OF BATCHES THAT THE INITIAL HUGE AROMA BLAST I GET WHEN KEGGING THE BEER HAS USUALLY SUBSIDED BY THE TIME IT FINISHES CARBONATING (~1 WEEK TO CARBONATE). NO MATTER WHICH HOPS, NO MATTER WHICH COMBINATION OF HOPS, THEY ALL FADE TO A "BERRY" AROMA (TROPICAL NO LONGER EXISTS) BEFORE BECOMING WHAT I DESCRIBE AS A MUTED, LACK-LUSTER MESS. I DON'T DRINK THEM AS THEY AREN'T WHAT I AM EXPECTING. THE BEER ITSELF DOESN'T SEEM TO HAVE FLAWS.

I HAVE BEEN SCRATCHING MY HEAD AND CAN ONLY THINK IT IS DUE TO THE AGE OF THE HOPS. ON BREW DAY THE HOPS SMELL WONDERFUL PRIOR TO PUTTING IN THE BEER. WHEN KEGGING, THEY TYPICALLY SMELL GREAT. BUT A WEEK AFTER BEING IN THE KEG … DONE! I HAVE SUCCESSFULLY MADE MANY NEW ENGLAND IPAS IN THE PAST AND I HAVE BEEN BREWING FOR 10+ YEARS, SO I THINK MY OVERALL PROCESS IS GOOD. I HAVE BEEN COLD CRASHING BY PLACING THE CARBOY IN THE FREEZER FOR 24–48 HOURS PRIOR TO KEGGING.

SCOT
CHICAGO, ILLINOIS

Repackaging hops into smaller sizes is a good idea when buying hops in larger quantities because oxygen in the package does cause storage problems.

Homebrewers who purchase hops in bulk should look to repackage open hops bags using a vacuum sealer. Be sure to label them though!

A Question and answer columns can be really frustrating for the writer when a question seems totally answerable until details within the question get in the way of the answer. Pesky details! This question contains a few of those gems. There are a few ways around this problem. One sneaky way is to carefully edit the question so that certain details don't interfere with the answer the columnist wants to write, but I am not a big fan of this technique. Another option is to avoid questions that cannot be answered! After all, what is the use of replying to a question with a failing answer? And perhaps the most common stylistic choice is to use a very thin slice of the question as a launching point into something more interesting to the author than the actual question. Zinnng, off on a wild tangent!

And here I sit, looking at a question that has shut down all of the obvious answers. Scot, I see that you and your friend Rich are the two dudes behind the website called, uh, Two Beer Dudes, and that you have been brewing for 10+ years, have successfully brewed many New England IPAs in the past, and seem to have your brewing game on. It seems to me that you may not actually have a brewing problem! This brings me to the wild tangent option of

the Q&A columnist, but in your case I am going to turn the mirror perpendicular to the question and review some of the things that may help others brewing this style and just hope that I stumble onto something that may also help you!

So let's get this party started. Repackaging hops into smaller sizes is a good idea when buying hops in larger quantities because oxygen in the package does cause storage problems. The polymers used to make food-packaging materials may or may not have gas barrier properties that slow or essentially prevent the movement of oxygen molecules across the liner. Just because a vacuum packaged bag of hops feels rigid does not mean the packaging film is impervious to oxygen diffusion. Probably not a likely cause, but perhaps you changed the packaging materials and your hops are being oxidized during storage. I know, the hops smell wonderful, so this cannot be the problem.

Another possibility is that your hops are not as great as you think they are. Properly packaged and stored hop pellets can maintain high brewing value for a several years. The fact that you are buying year-old, or perhaps older, hops is not a big red flag. And you firmly shut down that avenue by describing the hop aroma as "wonderful" on brew day and as "typically great" when kegging. I am assuming that brews from atypical kegging days, you know the ones when your hops smelled like yesterday's running socks, are not the same brews that you are not loving.

Call me Mr. Obvious here, but you are brewing really hoppy beers and don't like the way hops are expressed. Humor yourself and brew the same beer with the same hop varieties from another source than your hop locker. Just because these hops smell great doesn't mean that your finished beer will meet your expectations.

It's impossible for me to make any assessment about the quality of your hops from the comforts of my home office, but hop quality is a likely candidate to your displeasure. Brewers hear and speak about how *terroir* affects hop aroma and how hops are expressed in beer, but most hops that brewers buy only have 3–4 pieces of information on the label: Variety, harvest alpha, crop year, and total oil. Commercial brewers can obtain more information than this, but usually only after requesting the information.

My point is: Don't assume that all "Crop year 2016 variety X" hops are the same because they probably are not the same. Different farms, even within a single valley, can yield different hops simply due to *terroir*. Add agricultural practice, harvest date, kilning method, pellet processing method, and packaging technology to the mix and it is easy to see why "Crop year 2016 variety X" is an extremely vague way of viewing what is in the bag. And this is all before the hops ever get close to your re-packaging operation. How were these hops stored between the time of packaging in the fall of 2016 and when you purchased them? And how were the hops handled during shipping? Did the hops leave the warehouse on July 3, a Wednesday this year, and deliver to your home on Monday, July 8? That shipping scenario means that your hops were probably baking in a shipping warehouse or in the trailer of a truck for a total of 5–6 days. Not saying that this is the problem, but brewers should always suspect hops when the brewing problem is hop aroma.

Moving onto some other ideas; have you changed yeast strains or sources? Since much of the "juicy" notes attributed to this style are intertwined with biotransformation, it could be that you have done something related to fermentation. Make sure you are using a yeast strain that is reported to biotransform hop terpenes and that you are adding your hops during, or shortly after, peak fermentation.

My last thought about your dilemma has nothing to do with brewing and has to do with the mirror I mentioned earlier. Perhaps the problem is that your expectations of the beers you have been brewing have become separated from what you are actually brewing. I have been in this spot before where I have had some abstract target in my head that I should be nailing but for some reason my darts are not even landing on the board. Tweak this, tweak that, and add a pinch more of the theme ingredient. It all comes up short. In times like these, the best thing to try is a total reset. Look forward, not behind, and start from scratch. If that doesn't work, find a commercially-brewed beer that lives up to the flavor in your head and learn everything you can about that beer. Your problem really may be misalignment of expectations . . . or it may not. If your goal was to stump the chump with your question, you succeeded!

Q WHENEVER I'VE SOUGHT ONLINE ADVICE FOR ADDING FRESH FRUIT INTO A SECONDARY, PEOPLE CONSISTENTLY RECOMMEND USING FROZEN FRUIT. I'VE USED PASTEURIZED PUREES, VODKA-INFUSED TINCTURES, AND ARTIFICIAL FLAVORING, BUT THOSE METHODS ALTER THE FLAVORS. I UNDERSTAND LOWERING THE TEMPERATURE WILL SLOW YEAST GROWTH. BUT DOES IT ACTUALLY KILL OFF THE BADDIES? HOLLYWOOD HAS TAUGHT ME THAT FREEZING AN ORGANISM, EVEN FOR THOUSANDS OF YEARS, AND THAWING THEM OUT WILL RESULT IN DISASTROUS MONSTERS. I'D LIKE TO KNOW THE SCIENTIFIC ANSWER, IS THERE A CHANCE ANYTHING WOULD SURVIVE FREEZING?

BRAD CARPENTER
RALEIGH, NORTH CAROLINA

A Hollywood movies generously apply dramatic license in all matters of the world. But when it comes to portraying the resurrection of frozen life forms, there is not much exaggeration when the organism is something like a bacterial or yeast cell. And most of us kind of know, perhaps without really knowing it, that freezing is not a form of sterilization. Let me give you an example. A pound of ground chicken is popped in the deep freeze and stored for 30 days at -40 °F/-40 °C; are you feeling eager to try some chicken tartare when this package is thawed?

OK, this is not an answer to your question, but you get my point. Freezing food may reduce microbial populations, but it is certainly not a substitute for pasteurization. In fact, freezing is a really great way to preserve cell viability as long as the cells or tissue being frozen are protected from the damaging effects of ice crystals with a cryoprotective compound, like glycerol, that interferes with the formation of ice crystals. So freezing yeast cells can actually be used to prevent cell death.

When it comes to brewing with fruit, today's homebrewer really has quite the array of options. Many brewers find it hard to resist going *au naturale* and simply adding clean, damage-free fruit to beer. Fruit additions are usually made after primary fermentation is complete; not sure why this is, but the fact that the concentration of fermentable sugars is low is certainly a help when it comes to minimizing the growth of wild yeast. Spoilage bacteria are still able to grow in beer, but if the fruit is added to a sour beer, the bacteria and yeast on the surface may not be a problem. Clean beers, however, may be contaminated by this process and brewers wanting to use fresh fruit can use sulfite to knock back wild populations.

While going *au naturale* is attractive to brewers who like the romance of using fresh fruit or who simply want to use locally-grown fruits, many brewers either don't have access to the right types of locally-grown fruits or don't want to risk ruining beer with a potential source of spoilage organisms. This is where products like aseptically-processed purees, fruit extracts, and even crystallized fruit juices come in handy. While thermal processing can certainly change the flavor and color of fruit juices, it is also possible, and quite common, to thermally process fruit juices without negatively altering flavor. Single-strength citrus juice is a great example of how gentle pasteurization can be on juice flavor; seriously, few consumers are even aware that these products are pasteurized. Another option is to simply add the fruit at the time of serving. Lots of options, indeed.

There was a time when many US craft brewers were living life on the lunatic fringe and throwing caution to the wind. After several brewers had very costly, barrel-aged beer recalls due to spoilage in the market, a good chunk of craft brewers adopted a more conservative and reasoned approach to packaging beers that potentially could cause problems months after leaving the brewery. Flash-pasteurization prior to bottling is no longer an unusual method, nor is it frowned upon by "cool brewers," and the polymerase chain reaction (PCR) method of DNA amplification is now routinely used in brewing labs of all sizes as a rapid method to detect the presence of a wide range of beer spoilers before aged beers get anywhere close to being packaged.

Brewing with fruit opens up another chapter of flavor opportunities to an already impossible number of ingredient permutations. The risk of contamination is real but also realistically managed through fruit selection, time of addition, and brewing technique. Thank you for the great question and *viva la fruta*!

Q STEP MASH RECIPES USUALLY HAVE DETAILS ABOUT STEP TEMPERATURES AND TIMES, LIKE THE FOLLOWING EXAMPLE. USE A MASH SCHEDULE WITH A 15-MINUTE ACID REST AT 113 °F (45 °C), A 15-MINUTE PROTEIN REST AT 126 °F (52 °C), A 20-MINUTE BETA-AMYLASE REST AT 145 °F (63 °C), A 20-MINUTE CONVERSION REST AT 158 °F (70 °C), AND A 10 MINUTE MASH-OUT REST AT 167 °F (75 °C).

1. IN A SYSTEM WITH A HEATED MASH TUN, DO WE COUNT THE TIME IT TAKES TO GET FROM ONE TEMPERATURE TO THE NEXT?

2. IN A BREW-IN-A-BAG (BIAB) SYSTEM, ADDING HOT WATER CAN JUMP THE TEMPERATURE QUICKER, BUT WOULD LEAD TO SHORTER OVERALL MASH TIME. ISN'T THAT GOING TO AFFECT THE RESULT?

MIKE BOESEN
FORT COLLINS, COLORADO

A Let's start out with two quick answers to your questions. Heating time is definitely an important part of the mash and it most certainly should be counted. In fact, control over the heating rate is often overlooked as a tool in the brewer's arsenal of methods to wrangle the enzymatic changes that occur during mashing. This means that quickly heating any mash using hot water aliquots, whether BIAB or an unrestrained mash in a pot, may result in a different wort compared to slower heating using an external heat source (yes, this is difficult in the BIAB system). The question that this all begs to be answered is what mashing profile should be used and how do practical brewers select their mashing method and/or temperature profile when formulating a new brew?

The answer to this question really begins with the Snickers bar story and the concept of malt modification. When pondering mashing, keep in mind that mashing is an extension of malt modification plus the totally separate enterprise of starch conversion. For practical brewing purposes, starch conversion falls under the purview of the brewer, while malt modification can be a shared responsibility between maltster and brewer. Onto the Snickers bar story . . .

Professor Michael Lewis, the venerable and now retired brewing scientist from UC-Davis who mentored so many brewers, likened the cross-section of barley kernels to Snickers bars. The chocolate of a Snickers bar is the husk of barley, nougat is the protein, beta-glucan, and arabinoxylan matrix of the endosperm, and of course the peanuts are akin to starch granules. During malt modification, enzymatic degradation of the nougat exposes the peanuts and makes the endosperm of the malted barley easier to bring into solution during mashing, and also makes wort separation

easier during wort collection. As it so happens, proteolytic and cytolytic enzymes, the enzyme types responsible for the digestion of barley's nougat-equivalent, are more heat labile than amylolytic enzymes — responsible for peanut digestion.

What this means in practical terms is that the job of digesting the nougat is best performed by the maltster. This is why a majority of the lab analyses performed on malted barley relate to modification; soluble protein, the Kolbach index (soluble protein/total protein ration), total beta-glucan, friability, fine-coarse difference, and acrospire length are all indices of malt modification. Brewers using under-modified malts need to pick up where the maltster left off. Not all brewers have a problem with this deal and there are some brewers who prefer using lightly modified malt because of the control they retain over wort composition.

Most base malts these days, even a large percentage from continental Europe, are being malted from barley varieties that produce evenly- and well-modified malts that function admirably when infusion mashed. This is especially true of malts produced with the craft brewer in mind because a large proportion, probably the majority, of craft brewers have infusion brewhouses. Even breweries with the ability to perform multi-temperature step mashes have empirically determined that mashing method does not make much of a difference to finished beer when well-modified malts are used to brew all-malt brews. I do want to clarify for all you step- and decoction-mash devotees that I am not arguing that mashing method is irrelevant. I am just making this point for modern, well-modified malts.

Going back to the question I posed earlier; how does a practical brewer choose mash technique? This decision has been made much easier over the last 20 years or so as malts have become progressively better suited for infusion mashing. Many brewers today simply use the infusion method for every brew, and don't vary mash thickness, mashing time, or mash temperature from brew-to-brew. Other brewers hang onto step mashing methods even when using modern malts because these brewers have "always" used these mash methods. I confess to being one of these brewers until about 2002 when I started questioning why I was doing things a certain way and began simplifying and shortening mashes. Then there are brewers who really go about matching mash method with their raw material. These brewers brew the most beer by volume, but they fall into the minority of brewers because of the lab methods required to really align mashing, raw materials, and wort/beer properties.

It's taken a lot of words to provide a little contextual argument to the real message; don't get too hung up on matching another brewer's mash profile if you know how to deal with a variety of grist bills in your set up. To paraphrase Charlie Papazian, take a chill pill, sip on a chilled Pils, and don't sweat the details! BYO

STYLE PROFILE

BY GORDON STRONG

KELLERBIER

The Real Lager of Germany

Some will say it's more of a process than a style, but I would go a step further — it's more of a lifestyle.

KELLERBIER
BY THE NUMBERS

OG:	1.045–1.051
FG:	1.008–1.012
SRM:	3–7
IBU:	20–35
ABV:	4.7–5.4%

Photo courtesy of Wikimedia Commons

Real Lager? What am I talking about? Is this some Reinheitsgebot joke? No, I'm just trying to point out that kellerbier is in Germany what Real Ale (cask ale) is in the UK. They have no common origin or linkage, other than they are natural, gentle handling of young beer. In the beer gardens of southern Germany, this is a very popular summer style.

Kellerbier (literally, "cellar beer") is not well understood in the United States and elsewhere, yet its popularity seems to be growing. Some will say it's more of a process than a style, but I would go a step further — it's more of a lifestyle. While it is proper to think of it as a process applied to existing styles, the resulting beers are different enough that they can be thought of as unique styles in their own right. From a sensory perspective, there is certainly a difference between a kellerbier and a German helles.

To be honest, I never really thought too much of this style. I had tried some commercial examples, and they seemed to be an excuse to rush out lagers too quickly, or a way to slap a style label on a faulted beer. I remember one that caused me to exclaim, "That tastes like my lagers before they are ready." Kind of like the old joke, "If it's infected, just call it Belgian." I wasn't ready to accept yet another faulty beer as a legit excuse for a style.

However, I was wrong. I had just tried poor examples. Recently, I had several beers that were very nice, and helped me understand how to differentiate a kellerbier from related styles. While it is correct to say that a pale kellerbier is an unfiltered, cask-conditioned helles, that really doesn't do the style justice. The style actually has a somewhat broader range, too.

I tried a kellerbier from Port City Brewing Co. in Alexandria, Virginia that was quite bitter at 35 IBUs but still well balanced since the malt and yeast character were higher than in a helles (the Spalt hops were nice, too). While in Quito, Ecuador for the Copa Mitad del Mundo competition, I loved the Mut Lager from Cervecería Mut, a gold-medal winner in that competition. Brewer Dora Durán was kind enough to share her recipe with me, which I've scaled to homebrew systems (see page 27).

The Beer Judge Certification Program (BJCP) categorizes kellerbier as Style 7C in the Amber Bitter European Lager category, and calls out two variations: The pale kellerbier and the amber kellerbier. The pale is based on helles and the amber is based on Märzen; this article will primarily discuss the pale version.

HISTORY

Kellerbier is popular in Franconia, a region of Germany in the north part of Bavaria. But that is just the administrative region of Franconia; there is a broader region where the Franconian people live that touches upon several bordering German states. The Franks were a Germanic tribe that settled around the Main River in the German Central Uplands, and who still maintain their cultural identity and dialect.

Franconia also happens to be one of the most densely populated brewing regions of the world. Some of the larger cities in the region are Nuremburg, Bamberg, and Würzburg. Several traditional styles are made in the region, including the well-known rauchbier of Bamberg (see "Style Profile" in the September 2019 issue on rauchbier).

Kellerbier is best thought of as a home and artisanal craft beer that represents the traditional way of brewing in the area. The standard pale lager of the area (helles) is brewed normally but then conditioned in casks for service. Served unfiltered and naturally carbonated, the beer is best enjoyed fresh and young. The natural carbonation is often in an unbunged cask, so the carbonation

level is gentler (yet isn't still, since the carbonation isn't driven off).

Locally, the beer is served from the cask in beer gardens. This isn't really unique to Franconia (or Bavaria, for that matter). Anyone who has gone to Düsseldorf to sample altbier has seen beer served from casks. The Oktoberfest celebrations begin with the tapping of the first cask, and other festivals (like those that celebrate the spring with bockbier) follow the same tradition.

As the beer is young, unfiltered, and often lightly carbonated, sometimes the beer is served in stoneware mugs or steins, which was the traditional way of serving beer in Germany before glassware began to be used to display the new sparkling, bright, and clear lagers in the mid-1800s. So the kellerbier tradition draws upon an older tradition of beer, which has a nice feel in the hilly country land of Franconia.

When discussing kellerbier, several similar or related styles are often brought up – for instance, lagerbier, landbier, zwickelbier, and zoiglbier. Mostly these are synonymous but sometimes indicate more narrow or broad interpretations. Landbier is basically country-style beer (things that may have been called farmhouse in Belgium?), lagerbier is an outdated term for that new lager style back in the ale-only days. Zwickelbier and zoiglbier tend to be narrower, and can be applied to younger beer or beer that is allowed to naturally carbonate in a closed container.

SENSORY PROFILE

Remember that we're only talking about the pale kellerbier now, so don't expect richer malt flavors of the amber version. The pale version does have more character than a helles, and the malt often takes on a freshly-baked bread or crackery malt character. It doesn't have a raw doughy flavor, but does have clean, fresh flavors derived from proper German Pilsner malt.

The malt profile can have a little more character than a helles, in that the beer is typically served fresh and the malt hasn't had time to fade or oxidize. A bit more richness in malt character than a helles can be expected, so the intensity is a little higher. And because

KELLERBIER

(5 gallons/19 L, all-grain)
OG = 1.051 FG = 1.013
IBU = 18 SRM = 5 ABV = 5%

This recipe is based on the gold-medal winner kellerbier Mut Lager from Cervecería Mut out of Quito, Ecuador. Special thanks to the Brewer Dora Durán for her help pulling this recipe together for the homebrew scale.

INGREDIENTS

7.75 lbs. (3.5 kg) German Pilsner malt
1.2 lbs. (544 g) German Vienna malt
1.2 lbs. (544 g) Bestmalz caramel Pils malt (2 °L)
7 oz. (198 g) biscuit malt
1.6 AAU Perle hops (first wort hop) (0.2 oz./6 g at 8% alpha acids)
3.2 AAU Perle hops (80 min.) (0.4 oz./11 g at 8% alpha acids)
0.4 oz. (11 g) Saaz hops (0 min.)
SafLager W34/70, Wyeast 2124 (Bohemian Lager), or White Labs WLP830 (German Lager) yeast
¾ cup corn sugar (if priming)

STEP BY STEP

This recipe uses reverse osmosis (RO) water. Adjust all brewing water to a pH of 5.5 using phosphoric acid. Add 1 tsp. calcium chloride to the mash.

Mash the malts at 126 °F (52 °C) for 10 minutes. Raise the temperature to 145 °F (63 °C) and mash for 40 minutes. Raise the temperature to 162 °F (72 °C) and mash for 20 minutes. Start recirculating wort. Raise the temperature to 172 °F (78 °C) for 10 minutes to mash out.

Add the first wort hops to the kettle. Sparge slowly and collect 6.5 gallons (24.5 L) of wort. Boil the wort for 90 minutes, adding hops at the times indicated in the recipe.

Chill the wort to 48 °F (9 °C), pitch the yeast, and ferment until complete (typically, two weeks). Cool to 36 °F (2 °C) and lager for five weeks at this temperature.

Rack the beer, prime and bottle condition, or keg and force carbonate. If traditional cask-conditioning, don't prime the beer. Leave it "open" (in the fermenter), then bung it "closed" just prior to service.

KELLERBIER

(5 gallons/19 L, extract with grains)
OG = 1.051 FG = 1.013
IBU = 18 SRM = 5 ABV = 5%

INGREDIENTS

4.5 lbs. (2 kg) Pilsen dried malt extract
0.5 lb. (0.23 kg) Goldpils® Vienna dried malt extract
1.2 lbs. (544 g) Bestmalz caramel Pils malt (2 °L)
7 oz. (198 g) biscuit malt
1.6 AAU Perle hops (first wort hop) (0.2 oz./6 g at 8% alpha acids)
3.2 AAU Perle hops (80 min.) (0.4 oz./11 g at 8% alpha acids)
0.4 oz. (11 g) Saaz hops (0 min.)
SafLager W34/70, Wyeast 2124 (Bohemian Lager), or White Labs WLP830 (German Lager) yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Use 6.5 gallons (24.5 L) of water in the brew kettle; heat to 158 °F (70 °C). Steep the crushed malts in a mesh bag for 30 minutes, then remove, allowing to drip back into the kettle.

Turn off the heat. Add the malt extracts and stir thoroughly to dissolve completely. Turn the heat back on and bring to a boil. Add the first wort hops while raising to a boil.

Boil the wort for 90 minutes, adding hops at the times indicated.

Chill the wort to 48 °F (9 °C), pitch the yeast, and ferment until complete (typically, two weeks). Cool to 36 °F (2 °C) and lager for five weeks at this temperature.

Rack the beer, prime, and bottle condition, or keg and force carbonate. If traditional cask-conditioning, don't prime the beer. Leave it "open" (in the fermenter), then bung it "closed" just prior to service.

of this, the hop and yeast character also is stronger.

I find the balance of the pale kellerbier to be nearing that of a Vienna lager, where the malt and bitterness intensity is nearly equal. It's OK for the kellerbier to retain some more of its helles lineage by being tilted slightly to the malt side, but the age of the beer should allow more of the hop character to come through.

The hop flavor and aroma can be higher in a kellerbier to better balance the fresh malt. It doesn't really approach the level of a Pilsner, but it is often higher than in a classic helles where the malt is king. The hops should be very fresh, and reflect the character of noble Saazer-type hops, which often have a floral, spicy, or herbal character.

The yeast character is where I want to spend the most time discussing the profile, as I think this is what tends to get misunderstood. Let me start by saying what the beer isn't. It shouldn't be an unlagered, yeasty mess – excessive sulfur, eggy flavors, diacetyl, and acetaldehyde fermentation byproducts, and similar flaws should not be prominent. When a lot of yeast is present in the beer, the perceived bitterness can seem higher (this is known as "yeast bite"), and it can take on a nutty, bready flavor similar to a good Champagne. This character shouldn't be excessive, though; remember that brewing faults are still faults. They don't suddenly become acceptable in this style. It just doesn't need to be as squeaky-clean as a helles.

> **Cool fermentation for a proper bottom-fermented beer should not produce esters, so don't try to rush this with a warm fermentation.**

Kellerbier is a lager, and should be lagered. This process shouldn't be rushed, but doesn't have to completely reduce all fermentation byproducts. Cool fermentation for a proper bottom-fermented beer should not produce esters, so don't try to rush this with a warm fermentation. Lagering reduces sulfur compounds and other fermentation byproducts, so give the yeast some time to work. If you brew lagers, it shouldn't taste like one where lagering is only half done – you know what I mean if you taste your beers during the process. It still needs to have lager smoothness, but perhaps a touch more rustic.

So I've talked about what it isn't or what it shouldn't be, but do you understand what fermentation character it needs to have? A good lager should be clean and smooth, without fermentation byproducts, and be ready to drink. A kellerbier is that as well, but might be just very fresh. All the flavors should "pop," and the yeast might seem a little young. But it still should be clean, smooth, and highly drinkable.

Kellerbier is basically a fest-type beer, made for drinking in beer gardens. So it can be a bit stronger than an average lager. Typically, it is at least 5% ABV but could be stronger. However, I tend to like them at that level since they are more conducive to day drinking. It is a fully attenuated beer, so it shouldn't seem sweet (especially with the added bitterness and yeast character to balance). The body is typically moderate, and may seem a touch heavier than a helles, but it still should be quaffable one liter at a time.

As kellerbiers are described as unfiltered, this means they don't have to be crystal clear. That doesn't mean they should be murky, hazy messes that are confused with yeast pitches. Many lager yeasts are powdery so they tend not to naturally flocculate quickly. So like an unfiltered Kölsch, the beer can have a little shine to it. It's not necessarily desirable to seek a hazy beer, so don't do anything special to achieve it — it's just not a fault if present.

The pale color and reflectance from some suspended yeast can make the beer a touch darker than a helles. But it should still be in the gold range. Just think about the type of color that you can get from a gold beer with a bit of haze to it — that's about right for this style. Since the beer is traditionally naturally carbonated in open containers, the head can be low. However, when packaged, the head can seem normal — remember that like the UK cask ales, the bottled versions make some compromises. As a judge, be lenient with the appearance and especially the fresh beer characteristics when the beer is bottled.

Sometimes the style is based on a different style such as Pilsners, so the beer can have a slightly different balance. Those that are produced this way are often described as a keller Pils, and sometimes the keller word is used to describe the process. So again, don't be hyper-critical when it's clear the process-based technique is being applied to a different base style. Expect a slightly richer, hoppier, fresher, and yeastier version of the base style.

One final note — some people see "cask-conditioned" and expect that to be the same as "barrel-aged." That's not correct; conditioning is just the maturation phase rather than explicit aging to develop additional character, including oak and/or barrel character. The casks used here are often wood, yes, but they are neutral in this usage. The final beer should not have a woody/oaky character.

BREWING INGREDIENTS AND METHODS

Brewing a kellerbier is pretty much like brewing a helles — normal German brewing ingredients, procedures, and techniques apply. German Pilsner malt should be the bulk of the grist, but this style could have a bit of character grain to boost the maltiness, breadiness, and richness. Using traditional German maltsters such as Weyermann, Bestmalz, Durst, and the like, should produce good results.

German brewers use step mashes in modern times, but traditionally could be using decoction mashes. In pale beer styles, decoction mashing could produce more color and flavor than desired. When decocting, brewers might want to avoid additional character malts as they are gaining additional flavors through the decoction process.

Step mashes help with attenuation and body (mouthfeel) development in German lagers, enabling them to have malty flavors without being sweet, and dryness and high drinkability without being watery and thin. If using a hybrid (single-step) infusion process, aim for converting on the low end of the range to promote attenuation.

German and Czech noble Saaz-er-type hops are typical in Bavarian lagers, so they are also good to use here. Hallertauer, Tettnanger, Spalt, and Saaz are good choices, or American equivalents. Freshness matters, so try to choose the freshest hops possible. Having some flavor and aroma hops noticeable is more traditional than in helles. The bitterness level can be higher than helles, typically in the 20-35 IBU range. That allows a wide range of interpretations for brewers.

German lager yeast is a must, and strains that don't produce excessive sulfur are desirable since the beer will be served young and could have more yeast character. I like the Weihenstephan 34/70 strain, a true workhorse of German lagers, but others can also be used. Try to pick ones that favor maltiness, and ones that don't throw much sulfur, diacetyl, or other fermentation byproducts.

Fermenting cool is traditional for German lager yeasts, so don't try to rush this with warm fermentations that could produce esters. After fermentation, lagering near freezing temperatures is required to properly reduce fermentation byproducts and other green beer flavors.

HOMEBREW EXAMPLE

As I said, I'm indebted to Dora Durán of Ecuador for this recipe. I drank more of this beer in Quito than any other of the outstanding beers there.

Dora uses Bestmalz in her beers, so the ingredients reflect that choice. She brews on a 200-L (1.7-BBL) system, which is about 10 times the size of a typical homebrewer systems — fairly small by American craft beer standards but not unusual for craft brewers in South America. I've converted her recipe to fit *BYO* recipe standards.

She is using Pilsner malt for the bulk of the grist, and adding character through the addition of Vienna malt, caramel Pilsner (a honey-like flavor), and a touch of biscuit malt to increase the graininess. The beer is step-mashed to get attenuation and body.

German and Czech hops provide the traditional flavors, and as is typical for South America, she uses dry yeast. In my own trials, I've had outstanding results with the SafLager W34/70 dry yeast so I can endorse this product, but similar liquid strains could be substituted. She ferments cool and then lagers for five weeks (which is more similar to how I produce my Kölsch and altbier; I normally go eight weeks for my lagers).

I tried her beers bottled and on draft, both were outstanding. I think freshness matters, so try to drink them like hefeweizens – young and fresh. I think I'll be adding this to my normal summer rotation of beers. I hope you enjoy it as much as I did. BYO

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WHAT IS BREWART?

Think of BrewArt as your personal home brewery, allowing you to brew and dispense your own quality beer from home. In its simplest form it's a two-part system comprising of the BeerDroid; a temperature-controlled fermenter, and the BrewFlo; a chilled dispensing system that doesn't require CO_2.

Developed by Coopers Brewery, Australia's largest independent brewery, BrewArt benefits from more than 150 years of brewing knowledge, a world class brewhouse and internationally acclaimed Maltings with a complete grain to glass approach to brewing at home.

BEERDROID

TEMPERATURE CONTROLLED BREWING

With the BeerDroid crafting your own, quality beer has never been easier. The 2.6-gallon (10-L) fermenter independently controls temperature using pre-programmed Ale, Lager and BrewPrint profiles or by using the Custom function, allowing the brewer to customize the temperature settings during 'PROPAGATION', 'FERMENTATION', 'STORE' and 'KEG' modes.

Not only is temperature controlled by the BeerDroid, but the tech is smart enough to automatically detect various stages of fermentation and then transition through temperature zones as is required.

AUTOMATIC END OF FERMENTATION DETECTION

Say goodbye to your hydrometer! End of Fermentation (EOF) is automatically detected without manual gravity testing using patented technology, which . . . actually, if we told you, we'd have to kill you.

BUSY? NO NEED TO WORRY

If EOF is detected and no kegging action is taken after 48 hours the BeerDroid will transition your brew into storage mode, dropping the temperature to 39 °F (4 °C) to avoid infection and maintain brew quality.

CRYSTAL CLEAR HOME BREW

The BeerDroid has a preprogramed Diacetyl Rest for low temperature fermentations, which raises fermentation temperature in a staged process as your brew approaches EOF resulting in a much cleaner flavored beer.

To further improve beer clarity Cold Crashing can be achieved in the BeerDroid using the 'STORE' mode after fermentation; dropping the temperature causes yeast to flocculate, dropping any remaining particles out of solution.

These capabilities are perfect for creating crisp, clean Lagers which in the past have been difficult to achieve at home.

EVERY HOUSE HAS A BLUEPRINT, EVERY BEER HAS A BREWPRINT

BrewPrints are BrewArt recipe packs – the range continues to grow with more than 50 styles available today. Whether you're into light bright Lagers, hopped up IPAs or smooth Stouts and Porters there is a BrewPrint for you. Each BrewPrint contains specific ingredients; Elements, Enhancers, Hops, Dry Hops and Yeast, as created by our Master Brewers. At our 150-year-old brewery we mash and boil a variety of base worts (Elements) which are then naturally spray dried at low temperature for stability and shipped to you with other natural ingredients to make the perfect . . . IPA, Saison, Blonde, Porter, and on and on it goes!

As brewers you'll know that ingredients are just one part of the brewing puzzle, that's why each BrewPrint has its own preprogramed brewing profile which when started using the BrewArt App is downloaded to the BeerDroid at the touch of a button.

BrewPrints are completely customisable, or you can buy BrewArt ingredients individually to create your own brew; play with your base hopped malts (Elements), enhance alcohol content, head retention, and mouthfeel with adjuncts (Enhancers) or go crazy with aromatic hop oils (Hops) and dry hop (Dry Hop) additions.

CAN OTHER INGREDIENTS BE USED IN THE BEERDROID?

Absolutely yes! The BeerDroid can be used for any fermentation. Create your own all-grain wort, use specialty fermentables or even make your own craft ciders from juice. Focus on your creativity and let the BeerDroid do the admin! The smart EOF will automatically adjust to whatever you are fermenting and detect end of fermentation as it does with the BrewArt ingredients.

APP CONTROLLED, SMART BREWING

The BrewArt App allows you to monitor and control the BeerDroid. When you start a brew using the app the specific brewing profile for that BrewPrint will be downloaded to your BeerDroid, controlling and changing temperatures through each stage of brewing.

If you're creating your own recipes and using the 'CUSTOM' function you can individually set temperatures for propagation, fermentation, kegging and storage zones using the app.

With notifications turned on you'll receive progress updates on your brew and notifications of milestones, no matter where you are – what's better than sitting at work knowing that your beer is at home underway in fermentation mode?! Or how about getting a notification that your beer is ready to drink while you're out with your buddies (bragging rights)!

Let's say your BeerDroid detects End of Fermentation but you are out of state on vacation and can't get home to keg, simply open your app and send your beer into storage mode, then as you get on the plane to return home use your app to switch to keg mode so you can keg when you arrive.

STAY CURRENT WITH UPGRADEABLE FIRMWARE

With upgradeable firmware this machine is designed for years of brewing, as features are developed you can add these to your hardware – just like you would a smartphone. When new software is available, you'll be notified by the app and upgrading is as simple as hitting "update now" on the app.

Our customer service is like something out of a sci-fi movie as, with the brewer's permission, BeerDroid data can be accessed remotely by BrewArt staff; should you have any issues we can dial in and check your fermentation stats and advise what might have gone wrong.

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Allowing you to pour your beer on tap, the BrewFlo is a temperature-controlled beer dispenser that doesn't require CO_2 – so there's no need to continually be buying gas. The 2.6 gallons (10 L) of beer you brew in the BeerDroid is transferred into disposable liners (did somebody say no cleaning?!) within two 1.3-gallon (5-L) kegs, then liquid priming sugar is added to naturally condition and create carbonation. When it comes time to serve, the BrewFlo chills your beer to your preferred temperature, then using air pressure around the liner expels the contents through a patented helix system to pour cold beers with great carbonation and a faultless head.

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Holiday GIFT GUIDE

This holiday season give the gift of beer! Check out all of the great beer gear on the next few pages for some gift ideas for friends and family or make your own homebrew holiday wishlist...

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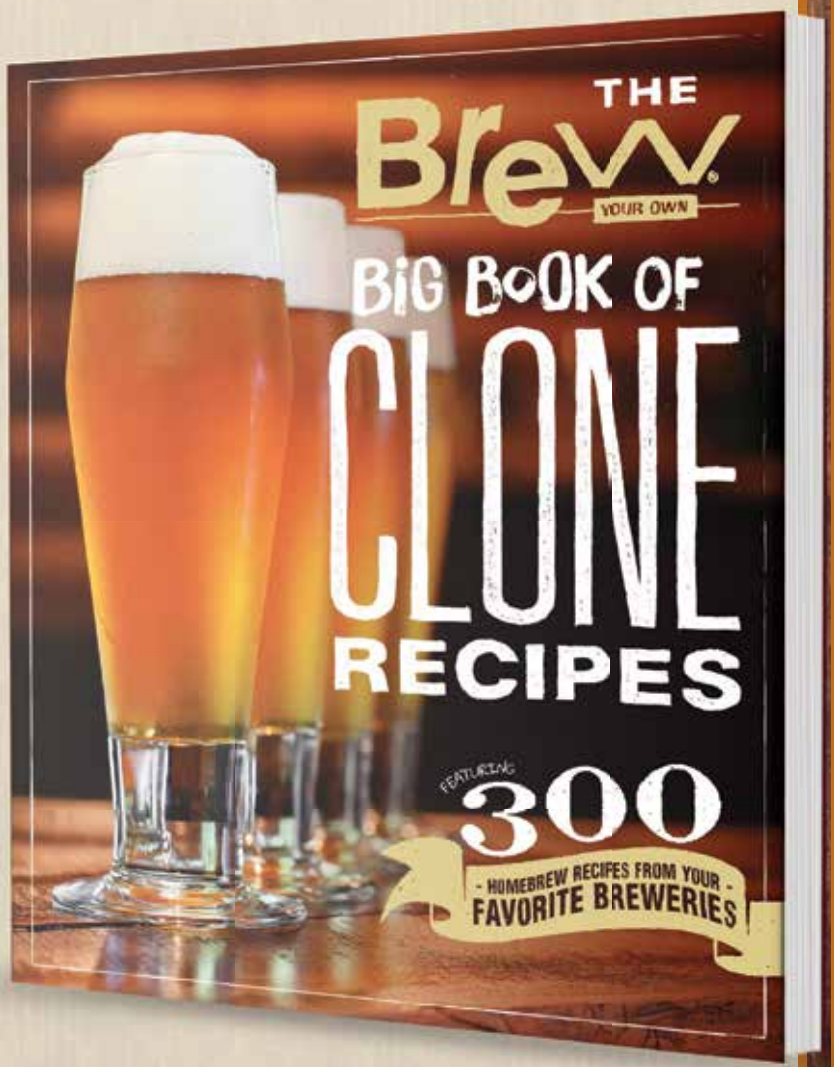

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Winter Warmers

Brewing for the cold

by Dave Clark

People have many unique ways of keeping warm when the weather gets cold. Sitting by the fireplace, getting close to a special someone, or wearing three sweaters are just a few approaches to combat the frigid season. For many, a great sipping beer, widely referred to as a "winter warmer," serves the purpose of keeping us warm when the weather does not.

Winter warmer is not a beer style, it is a term used to describe beers that have certain characteristics and are often brewed for winter consumption. It does not get its own designation by the Beer Judge Certification Program (BJCP), but is a term that comes up as an example of the English strong ale style in the 2015 BJCP Style Guidelines. In the previous BJCP guidelines from 2008 it was included as an example in the old ale category, in which a loose definition was given: "Winter warmers are a more modern style that are maltier, fuller-bodied, often darker beers that may be a brewery's winter seasonal special offering."

Photo courtesy of Shutterstock.com

CHARACTERISTICS AND STYLES OF WINTER WARMERS

While every brewer has their own unique interpretation of what "winter warmer" means to them, there are two distinct variations of the style that fall under the winter warmer umbrella. The classic version of the style is based around the British old ale/strong ale styles. The more modern versions are usually spiced, often employing the same spices used in holiday desserts. While these two takes have differences, there are a few important characteristics that can be found in just about any version of this highly interpretable beer style.

Common among most winter warmers is the general range of color, alcohol strength, and heavy lean to the maltier side of the continuum. Many winter warmers start somewhere in the 6% ABV range and get stronger from there; regularly in excess of 10% ABV. Typically, the malt-forward brew will range in color from the darker side of amber to the lighter side of brown (but never as dark as a stout or porter), with darker, toasted, and mildly sweet malt flavors prevailing.

Most winter warmers feature only enough hops to provide proper balance and drinkability — certainly a far cry from the hoppy styles so prevalent in today's beer scene. While not a hard and fast rule, most warmers will have a body of substance, ranging from medium to full. It's rare to find a light-bodied winter warmer.

SPICED WINTER WARMERS

Christmas or holiday beers can be considered a subcategory of the larger term encompassing winter warmers. Not all winter warmers are spiced, but those that are often fall into the Christmas/holiday subcategory. For all intents and purposes, most winter warmers are ales, many of which originate from the British old or strong ale beer styles.

Since old ales pack a punch, are malty sweet, and usually provide a pleasant "warming" sensation due to the higher alcohol levels, this beer style makes a great base style for these spiced variations. Creating a grist with just the right character malts (see the "tips" section later), and implementing relatively high mash temperatures, can help produce the desired outcome.

CHRISTMAS IN AMERICA

American brewers, as they often do, reinterpreted the old ale style, adding their own unique qualities and nuances to the beer. Spices were added, such as cinnamon, nutmeg, allspice, ginger, and countless others, sometimes alongside character-adding sugars such as molasses, maple syrup, and honey, to create a hearty, cold-weather beverage that wonderfully complements the foods of the holiday season. Taking the traditional old ale and reimagining it with an American twist, a popular new beer style was born.

Beer revolutionary Fritz Maytag is credited by many with creating America's first Christmas ale in 1975 when Anchor released its inaugural holiday season offering, called Our Special Ale. Originally crafted as a dry-hopped English Ale, Anchor wanted to craft a special holiday beer for its loyal followers. In 1987, Anchor introduced a spiced version of the ale for the first time, a style they continue to brew annually, likely making Anchor Christmas Ale America's longest running seasonal craft beer. The spices in Anchor Christmas Ale change year to year, but the essence of the beer has remained the same for over three decades.

Anchor may have been the first, but as the number of American breweries grew, it didn't take long for others to follow suit. Tröegs' Mad Elf, Great Lakes Brewing's Christmas Ale, and upstart Collision Bend Brewing's 8 Crazy Nights are all fine examples of American brewers' interpretations of this popular style of spiced Christmas beer (all of which I've worked with the brewers to provide clone recipes for later in this story).

As an aside, I am particularly drawn to this style as in my original hometown of Cleveland, Ohio, Christmas Ale is not just a beer style; it is a celebration. When Cleveland's largest brewery, Great Lakes Brewing, releases Christmas Ale each year, it is welcomed citywide with lines at grocery stores as well as a kickoff party at the brewery. Signifying the start of the season, people who often shun craft beers flock to Christmas Ale, which can take a toll on the unprepared with its sneaky 7.5% ABV. With its success, all of the other craft breweries in the city have released their own variations on the style as well, many to critical acclaim.

INTERNATIONAL CLASSICS

Winter Welcome, created in 1990 by Samuel Smith Brewmaster Steve Barrett, sets the standard for traditional winter warmers, leaning heavily on the traditional, malt-forward tenden-

cies of British old ale. Charles Finkel, founder of Merchant du Vin, the importers of Samuel Smith, had a vision that American consumers would embrace the idea of a specially-brewed "winter beer." Although certainly not America's first holiday beer, it may be the first with wide distribution throughout the United States.

The full-bodied Winter Welcome is made using the proprietary, flocculent Sam Smith's ale yeast, unchanged since at least 1900, along with the brewery's famous "Yorkshire Squares," two-compartment, open-topped fermenting vessels made of slate panels (i.e. stone fermenters). The Sam Smith brewers believe the yeast has adapted to these vessels over many generations, and that the stone provides trace nutrients. All Sam Smith ales are fermented in these vessels. So, if your homebrewed version of Winter Welcome (a clone recipe is on page 45) isn't quite like the original, these non-replicable factors may be a leading reason why.

Another very unique Christmas beer, Samichlaus, translates to "Santa Claus" in Swiss German. One of the strongest lagers on the market at 14% ABV, this complex, flavorful doppelbock is brewed only one day each year — on December 6, St. Nicholas Day — making it the ultimate winter warmer.

Originally brewed in 1979 for release the following year by Hürlimann Brewery of Zurich, Switzerland, the brewery produced this seasonal classic until 1997 when the brewery closed. The beer returned in 2000, this time brewed by Schloss Eggenberg in Vorchdorf, Austria, using the original recipe from Hürlimann. Samichlaus is lagered for ten months to produce the rich, clean, and memorable flavors that make this beer a perfect holiday sipper around a fireplace.

TIPS FOR BREWING WINTER WARMERS

Whether you're looking to brew a traditional winter warmer or a spiced Christmas ale, the approach will be relatively similar. It all starts with creating a hearty base beer, with a fair amount of character malts to produce the rich, sweet, nutty, fruity, and toffee-like character that showcases the style.

The rich, malty flavors typically come from creating grists designed to produce high gravity beers, often utilizing any combination of character malts including Victory®, honey, brown, or various degrees of crystal and/or Munich malts, to go along with a base of 2-row English or American pale malt. A mash regimen focusing more on alpha amylase conversion, rather than beta, is often employed, resulting in a wort containing larger-chain sugars that will leave just the right amount of sweetness and body in the finished beer.

Spicing a winter warmer can occur by adding spices to the boil, at flameout, during fermentation, or post-fermentation. Spicing can be approached similar to hopping, with each method creating different final outcomes. The later in the process the spices are added to the beer, the more the aromatics stay intact. The key is to have a restrained hand. Most spices used in Christmas ales can impact the overall impression of the beer in very small doses. It's always better to under spice than to over spice — make that the guiding mantra when brewing your first Christmas ale.

HOW TO SERVE

Due to the presumed higher alcohol content, a snifter or tulip is a great choice for serving a winter warmer, especially if the ABV approaches or surpasses the 8% range. The style is best served between 45–55 °F (7–13 °C) so the aromas can be fully enjoyed.

While many winter warmers can be a meal in and of itself (certainly a dessert), some people enjoy these beers with rich meats such as pork or turkey, or complementing desserts that share similar spices to tie the flavor and aroma characteristics together between the food and the beer.

THE PROS DESCRIBE THEIR WINTER WARMERS

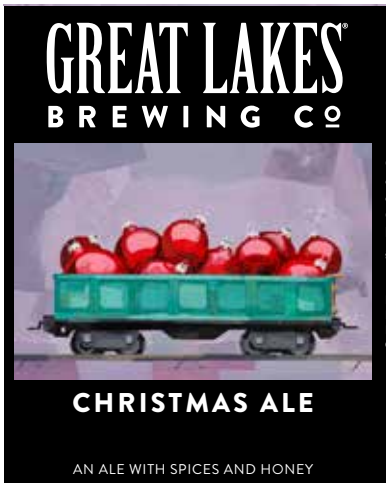
Each brewer has their own way to approach creating a winter warmer. Tomme Arthur, Brewmaster/Co-Owner of The Lost Abbey, one of the country's finest brewers of Belgian-style beers, takes a blending approach when it comes to his prized Gnoel de Abbey. Brewing both an imperial stout and a blonde, the two beers are blended to create the end resulting masterpiece (find clone recipes for The Lost Abbey's Gnoel de Abbey on pages 46–47).

Great Lakes Christmas Ale, according to Brewmaster Mark Hunger, gets most of its needed sugars from the malt bill (2-row, crystal 45, and unmalted white wheat, with character additions of Briess Special Roast and roasted barley), with an extra boost from a generous addition of honey that adds an additional 2 °Plato (8 gravity points) to the beer, while augmenting the mouthfeel, smoothness and the overall character. By no means an inexpensive addition, it's the special ingredient that turns a very good beer into a world-class Christmas ale (find a clone recipe for Great Lakes Christmas Ale on page 42).

Brothers John and Chris Trogner of Tröegs in Hershey, Pennsylvania, wanted to brew a special beer to commemorate the holidays. When they dreamed up Mad Elf, they had no idea how impactful the beer would be to the brewery. Meant originally to be part of a seasonal multi-pack, the beer gained a loyal following and demand dictated this one-off become a yearly staple. The original version of this Belgian-influenced winter warmer has spawned offspring, creating an entire line extension of various Mad Elf varieties, including a barrel-aged version, a sour version, and the "director's cut" known as Mad Elf Grand Cru, brewed to celebrate the brewery's 20th anniversary (a clone recipe of the original Mad Elf can be found on page 44).

BREW YOUR OWN

Whether you're looking to brew a traditional old ale warmer or a spiced holiday classic, the possibilities are endless. Think about your favorite holiday dessert and the characteristics that the dessert showcases, and then build a beer that would wonderfully complement that dessert. Or, try one of the following clone recipes. Either approach is a great place to start!



GREAT LAKES BREWING CO.'S CHRISTMAS ALE CLONE

(5 gallons/19 L, all-grain)
OG = 1.070 FG = 1.012
IBU = 30 SRM = 19 ABV = 7.5%

By Cleveland tradition, the annual release of Christmas Ale effectively marks the official start of the holiday season in The Forest City.

INGREDIENTS

10.5 lbs. (4.76 kg) American Pilsner malt
1 lb. (0.45 kg) crystal malt (45 °L)
1 lb. (0.45 kg) unmalted white wheat
0.5 lb. (0.23 kg) Briess Special Roast (50 °L) malt
0.25 lb. (0.11 kg) roasted barley
1 lb. (0.45 kg) honey (0 min.)
4.9 AAU Mt. Hood hops (60 min.)
(0.75 oz./21 g at 6.5% alpha acids)
3.25 AAU Mt. Hood hops (30 min.)
(0.5 oz./14 g at 6.5% alpha acids)
5.75 AAU Cascade hops (5 min.)
(1 oz./28 g at 5.75% alpha acids)
0.05 oz. (1.4 g) fresh cut ginger root (crushed or finely cut)
(0 min.)
0.05 oz. (1.4 g) cinnamon stick (0 min.)
Wyeast 1098 (British Ale) or White Labs WLP007
(English Dry Ale) or LalBrew Nottingham yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Using a 1.2 qts. to lbs. grist ratio, start the mash at 150 °F (66 °C) for at least 30 minutes to ensure beta amylase conversion. Once fully converted, increase temperature to 160 °F (71 °C) for 15 minutes to encourage alpha amylase conversion, before raising it once again to 170 °F (77 °C) for 2 minutes to end conversion. Recirculate at least 10 minutes or until clear, then sparge using water at 170 °F (77 °C) water until you collect 6.5 gallons (24.5 L) of wort.

Boil for 60 minutes, adding the hops according to the schedule. Add the honey and spices at the end of the boil to preserve as much aromatic quality as possible. Cut the fresh ginger into small pieces to maximize flavor and aroma.

Chill rapidly to 66 °F (19 °C) and pitch the yeast. Oxygenate thoroughly. When fermentation is fully complete after 14 days, drop the temperature about 6 °F (3 °C) per day for four days to help clear the beer. Keg and carbonate to 2.5 volumes or prime and bottle condition.

GREAT LAKES BREWING CO.'S CHRISTMAS ALE CLONE

(5 gallons/19 L, extract with grains)
OG = 1.070 FG = 1.012
IBU = 30 SRM = 19 ABV = 7.5%

INGREDIENTS

6 lbs. (2.7 kg) Briess Pilsen dried malt extract
1 lb. (0.45 kg) crystal malt (45 °L)
1 lb. (0.45 kg) unmalted white wheat
0.5 lbs. (0.23 kg) Briess Special Roast (50 °L) malt
0.25 lbs. (0.11 kg) roasted barley
1 lb. (0.45 kg) honey (0 min.)
4.9 AAU Mt. Hood hops (60 min.)
(0.75 oz./21 g at 6.5% alpha acids)
3.25 AAU Mt. Hood hops (30 min.)
(0.5 oz./14 g at 6.5% alpha acids)
5.75 AAU Cascade hops (5 min.)
(1 oz./28 g at 5.75% alpha acids)
0.05 oz. (1.4 g) fresh cut ginger root (crushed or finely cut)
(0 min.)
0.05 oz. (1.4 g) cinnamon stick (0 min.)
Wyeast 1098 (British Ale) or White Labs WLP007
(English Dry Ale) or LalBrew Nottingham yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Using a 5-gallon (19-L) kettle, start by steeping just the unmalted wheat (placed in a muslin bag) in 2 gallons (7.6 L) of water at 152 °F (67 °C) for 30 minutes. Then, introduce the rest of the specialty grains into the bag and steep for another 10–15 minutes. Remove grain bag then increase kettle volume with water to about 4 gallons (15 L). Bring liquid to or near a boil. Turn off the flame and slowly add half the malt extract, stirring to avoid clumping or scorching. Adding just half of the extract here maximizes hop isomerization. Turn flame back on and bring to boil. Add remaining malt extract with 15 minutes until knockout. Follow the remainder of the all-grain recipe for boil, fermenting, and packaging instructions. After chilling the beer, but before pitching your yeast, remember to top up with water to 5 gallons (19 L).

Winter Warmer CLONES

COLLISION BEND BREWING CO.'S 8 CRAZY NIGHTS CLONE

(5 gallons/19 L, all-grain)
OG = 1.078 FG = 1.018
IBU = 25 SRM = 13 ABV= 8.2%

8 Crazy nights is a full-bodied spiced winter ale brewed with cinnamon, honey, and apples.

INGREDIENTS

13 lbs. (5.9 kg) 2-row pale malt
1 lb. (0.45 kg) Munich malt (8 °L)
13.5 oz. (0.38 kg) Gambrinus honey malt
5 oz. (0.14 kg) crystal malt (45 °L)
5 oz. (0.14 kg) Briess Victory® malt
2 oz. (0.06 kg) chocolate malt
8.5 oz. (0.24 kg) honey
0.5 lb. (0.23 kg) crushed apples
(or 1 pint/0.5 L apple cider) (60 min.)
5.4 AAU Simcoe® hops (60 min.)
(0.4 oz./11.3 g at 13.5% alpha acids)
4.6 AAU Tradition hops (15 min.)
(0.7 oz./20 g at 6.2% alpha acids)
0.02 oz. (0.57 g) cinnamon stick (60 min.)
Wyeast 1028 (London Ale) or White Labs WLP0013
(London Ale) or SafAle S-04 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

With a somewhat thick mash, and a fairly hard water profile featuring at least 50 ppm of calcium, target a mash temperature of 148 °F (64 °C) and mash for 90 minutes or until conversion is complete. Recirculate (vorlauf) 2 gallons (7.6 L) of wort from the bottom to the top of your mash tun to set the grain bed, then sparge with 5 gallons (19 L) of water at 170 °F (77 °C) and collect about 7 gallons (26 L) of runoff to your boil kettle.

Boil for 90 minutes and add the hops, apples (in a muslin bag if using fresh apples), and spices at the times indicated in the ingredients list. At flameout, rapidly chill the wort to 60 °F (16 °C) and transfer the wort to your fermenter.

Pitch the yeast, oxygenate thoroughly, and ferment at about 65 °F (18 °C). Once fermentation is near completion after two weeks, raise the temperature to 70 °F (21 °C) to perform a diacetyl rest for two days. Then cool the beer about 6 °F (3 °C) per day for four days to help clear the beer. Rack the beer into a keg and force carbonate to 2.5 volumes (or prime and bottle condition). If bottle conditioning, leave the beer at 70–75 °F (21–24 °C) for a week or two. Lager at 35 °F (2 °C) for two weeks to a month. Serve at 40–45 °F (4–7 °C).

COLLISION BEND BREWING CO.'S 8 CRAZY NIGHTS CLONE

(5 gallons/19 L, partial mash)
OG = 1.077 FG = 1.018
IBU = 25 SRM = 13 ABV= 8.2%

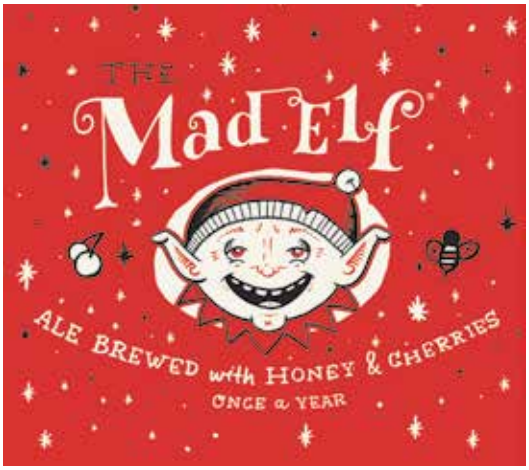
INGREDIENTS

7 lbs. (3.18 kg) extra light dried malt extract
1 lb. (0.45 kg) Munich malt (8 °L)
13.5 oz. (0.38 kg) Gambrinus honey malt
5 oz. (0.14 kg) crystal malt (45 °L)
5 oz. (0.14 kg) Briess Victory® malt
2 oz. (0.06 kg) chocolate malt
8.5 oz. (0.24 kg) honey
0.5 lb. (0.23 kg) crushed apples
(or 1 pint/0.5 L apple cider) (60 min.)
5.4 AAU Simcoe® hops (60 min.)
(0.4 oz./11.3 g at 13.5% alpha acids)
4.6 AAU Tradition hops (15 min.)
(0.7 oz./20 g at 6.2% alpha acids)
0.02 oz. (0.57 g) cinnamon stick (60 min.)
Wyeast 1028 (London Ale) or White Labs WLP0013
(London Ale) or SafAle S-04 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Using a 5-gallon (19-L) kettle, start by raising about 2 gallons (7.6 L) of water to 148 °F (64 °C). In a muslin bag, mash the Munich, honey, and Victory® malts for at least 60 minutes or until converted. Once mash is complete, add the crystal and chocolate malts to the bag and allow to steep for another 10 minutes. Remove grain bag then add more water to your boil kettle to bring it to about 4 gallons (15 L). Once liquid is at or near boil, turn off the flame and slowly add half of the malt extract, stirring to avoid clumping or scorching. Turn flame back on and bring to boil, adding the rest of the malt extract with 15 minutes left in the boil.

Follow the remainder of the all-grain recipe. Remember to top up with water to 5 gallons (19 L) before pitching yeast.



TRÖEGS BREWING CO.'S MAD ELF CLONE

(5 gallons/19 L, all-grain)
OG = 1.092 FG = 1.015
IBU = 13 SRM = 17 ABV = 11%

Back in 2002, Owners Chris and John Trogner decided to brew a special beer — a big Belgian-style ale with cherries and honey — for the holidays, and thus, a superstar named Mad Elf was born. The calculated SRM is the color prior to the cherry puree addition. The final color of the beer will be ruby red.

INGREDIENTS

12.5 lbs. (5.67 kg) Pilsner malt
2.63 lbs. (1.19 kg) Munich malt (8-10 °L)
0.75 lb. (0.34 kg) dark Munich malt (20 °L)
0.31 lb. (0.14 kg) caramel malt (80 °L)
0.13 lb. (0.06 kg) chocolate malt
0.31 lb. (0.14 kg) Special B malt
1 lb. (0.45 kg) cane sugar (sucrose) (0 min.)
0.25 lb. (11 g) (0.11 kg) honey (0 min.)
1.25 lbs. (0.57 kg) tart cherry puree
0.9 lb. (0.41 kg) sweet cherry puree
2.7 AAU Galena hops (90 min.)
(0.2 oz./6 g at 13.6% alpha acids)
2.3 AAU Hersbrucker hops (10 min.)
(0.5 oz./6 g at 4.6% alpha acids)
White Labs WLP530 (Abbey Ale) or Wyeast 3787
(Trappist Style High Gravity) or LalBrew Abbaye yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Using 1.3 qts. per pound of grain, mash in at 146 °F (63 °C), rest for 10 minutes, then raise temperature to 152 °F (67 °C) and hold for 40 minutes. Increase temperature to 162 °F (72 °C) for final 10 minutes. Recirculate about 10 minutes to set the grain bed then sparge and collect 7 gallons (26 L).

Boil 90 minutes, adding the hops per the instructions. Add the cane sugar and honey at knockout, stirring well to dissolve. Chill rapidly to 65 °F (18 °C), pitch plenty of yeast (at least two packs with a starter), and oxygenate thoroughly. After 24 hours of fermentation, add the cherry purees. After 12–14 days, drop the beer about 6 °F (3 °C) per day for four days to help the beer clear. Rack the beer into a keg and force carbonate to 2.7 volumes, or prime and bottle condition. If bottle conditioning, leave the beer at 70–75 °F (21–24 °C) for at least two weeks.

TRÖEGS BREWING CO.'S MAD ELF CLONE

(5 gallons/19 L, extract with grains)
OG = 1.092 FG = 1.015
IBU = 13 SRM = 17 ABV = 11%

INGREDIENTS

7 lbs. (3.2 kg) Briess Pilsen dried malt extract
1.5 lbs. (0.68 kg) Munich or Vienna dried malt extract
0.75 lb. (0.34 kg) dark Munich malt (20 °L)
0.31 lb. (0.14 kg) caramel malt (80 °L)
0.13 lb. (0.06 kg) chocolate malt
0.31 lb. (0.14 kg) Special B malt
1 lb. (0.45 kg) cane sugar (sucrose) (0 min.)
0.25 lb. (11 g) (0.11 kg) honey (0 min.)
1.25 lbs. (0.57 kg) tart cherry puree
0.9 lb. (0.41 kg) sweet cherry puree
2.7 AAU Galena hops (90 min.)
(0.2 oz./6 g at 13.6% alpha acids)
2.3 AAU Hersbrucker hops (10 min.)
(0.5 oz./6 g at 4.6% alpha acids)
White Labs WLP530 (Abbey Ale) or Wyeast 3787
(Trappist Style High Gravity) or LalBrew Abbaye yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Using a 5-gallon (19-L) kettle, start by steeping all the specialty grains (placed in a muslin bag) in about 2 gallons (7.5 L) of water at 152 °F (67 °C) for 15 minutes. Remove grain bag then add water bringing total volume in kettle to about 4 gallons (15 L). Bring liquid to or near a boil. Turn off the flame and slowly add half of the malt extract, stirring to avoid clumping or scorching. Adding just half of the extract maximizes hop isomerization. Turn flame back on and bring to boil. With 15 minutes left in the boil, add the remaining malt extract.

Follow the remainder of the all-grain recipe for boil, fermenting, and packaging instructions. After chilling the beer, but before pitching your yeast, remember to top up with water to 5 gallons (19 L).

WEEKEND WELCOME (SAMUEL SMITH'S WINTER WELCOME HOMAGE BREW)

(5 gallons/19 L, all-grain)
OG = 1.056 FG = 1.010
IBU = 32 SRM = 16 ABV = 6%

Samuel Smith's Brewery holds the recipe for Winter Welcome — a beer first brewed over 30 years ago by retired Head Brewer Steve Barrett — close to the chest. This recipe for Weekend Welcome was created by Craig Hartinger, homebrewer and long-time employee of the importer of Sam Smith's, Merchant du Vin, and is based on many years of Winter Welcome sampling and a little insider knowledge of the brewery. If not an exact clone, this recipe will get you most of the way there. Brew this recipe, then grab a bottle of Winter Welcome and compare.

INGREDIENTS

9 lbs. (4.08 kg) English Maris Otter pale ale malt
1.5 lbs. (0.68 kg) crystal malt (80 °L)
1.13 lbs. (0.51 kg) crystal malt (20 °L)
7.5 AAU Fuggle whole leaf hops (60 min.)
(1.15 oz./33 g at 6.5% alpha acids)
2.4 AAU Goldings whole leaf hops (5 min.)
(0.5 oz./14 g at 4.75 % alpha acids)
Wyeast 1098 (British Ale) or White Labs WLP007
(Dry English Ale) or LalBrew Nottingham yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Using a fairly thick mash of 1 lb. of grain per 1 qt. of water, with calcium chloride additions to achieve at least 50 ppm calcium, mash for 45 minutes at 158 °F (70 °C) or until conversion is complete. Recirculate for about ten minutes to set the grain bed, then sparge with 5 gallons (19 L) of water at 170 °F (77 °C) and collect about 6.5 gallons (24.5 L) in your boil kettle. Boil for 60 minutes, adding the hops as indicated.

At flameout, rapidly chill the wort to 65 °F (18 °C) and pitch yeast, oxygenate thoroughly. Primary fermentation at 65 °F (18 °C) should complete in about four days, but let the beer sit for at least two weeks to fully absorb all fermentation byproducts. Rack beer and force carbonate to 2.1 volumes or prime and bottle condition.

WEEKEND WELCOME (SAMUEL SMITH'S WINTER WELCOME HOMAGE BREW)

(5 gallons/19 L, extract with grains)
OG = 1.056 FG = 1.010
IBU = 32 SRM = 16 ABV = 6%

INGREDIENTS

5 lbs. (2.3 kg) extra light dried malt extract
1.5 lbs. (0.68 kg) crystal malt (80 °L)
1.13 lbs. (0.51 kg) crystal malt (20 °L)
7.5 AAU Fuggle whole leaf hops (60 min.)
(1.15 oz./33 g at 6.5% alpha acids)
2.4 AAU Goldings whole leaf hops (5 min.)
(0.5 oz./14 g at 4.75 % alpha acids)
Wyeast 1098 (British Ale) or White Labs WLP007
(Dry English Ale) or LalBrew Nottingham yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Using a 5-gallon (19-L) kettle, start by steeping only the crystal malt additions (placed in a muslin bag) in about 1 gallon (4 L) of water at 155 °F (68 °C) for 15 minutes. Remove grain bag then add more water to your boil kettle to bring it to 4 gallons (15 L). Once liquid is at or near boil, turn off the flame and slowly add half of the malt extract, stirring to avoid clumping or scorching. Adding just half of the extract at this time will help increase hop isomerization. Turn flame back on, bring to boil, and add bittering hops. With 15 minutes left in the boil, add the rest of the malt extract. At flameout, rapidly chill the wort to 65 °F (18 °C), top up to 5 gallons (19 L). Pitch yeast, oxygenate thoroughly. Primary fermentation at 65 °F (18 °C) should complete in about four days, but let the beer sit for at least two weeks to fully absorb all fermentation byproducts. Rack beer and force carbonate to 2.1 volumes or prime and bottle condition.

The Lost Abbey Brewing Co.'s Gnoel de Abbey clone

Gnoel de Abbey is a blend of two different beers. To re-create Gnoel de Abbey at home, brew both base beer styles, then blend in a 70/30 blonde-to-stout ratio. Bottle or keg what you don't blend as standalone beers.

GNOEL DE ABBEY BLONDE BLENDING BEER

(5 gallons/19 L, all-grain)
OG = 1.048 FG = 1.008
IBU = 26 SRM = 4 ABV = 5.2%

INGREDIENTS

9.75 lbs. (4.4 kg) American 2-row pale malt
5 oz. (0.23 kg) German Vienna malt
6.3 AAU US Magnum hops (90 min.)
(0.45 oz./12.8 g at 14% alpha acids)
0.07 oz. (2 g) freshly ground coriander (15 min.)
½ tsp. Irish moss (15 min.)
White Labs WLP830 (German Lager) or Wyeast 2124 (Bohemian Lager) or Mangrove Jack's M84 (Bohemian Lager) yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Achieve a mash temperature of 148 °F (64 °C) and mash for at least 60 minutes or until conversion is complete. Recirculate enough wort to achieve wort clarity and set the grain bed for sparging. Target a sparge water temperature of 170 °F (77 °C) and collect 7 gallons (26 L) of wort.

Boil wort for 90 minutes adding hops after hot break has ensued. Add Irish moss and coriander 15 minutes before flameout. Whirlpool and chill to 56 °F (13 °C) for fermentation. Ferment at 56 °F (13 °C) until 70–75% of the attenuation is reached. Allow fermentation to free rise to 64 °F (18 °C) for diacetyl rest.

After fermentation and diacetyl rest, cold condition the beer by dropping temperature from 64 to 59 °F (18 to 15 °C) on day one and 10 °F (5 °C) per day thereafter until reaching 32 °F (0 °C). Hold for one week and ensure all yeast and trub has been removed from the beer. When both beers are ready, rack into blending vessel and marry with the imperial stout portion of the brew in a 70/30 blonde-to-stout ratio.

GNOEL DE ABBEY BLONDE BLENDING BEER

(5 gallons/19 L, extract with grains)
OG = 1.048 FG = 1.008
IBU = 26 SRM = 4 ABV = 5.2%

INGREDIENTS

5.25 lbs. (2.4 kg) extra light dried malt extract
5 oz. (0.23 kg) German Vienna malt
6.3 AAU US Magnum hops (90 min.)
(0.45 oz./12.8 g at 14% alpha acids)
0.07 oz. (2 g) freshly ground coriander (15 min.)
½ tsp. Irish moss (15 min.)
White Labs WLP830 (German Lager) or Wyeast 2124 (Bohemian Lager) or Mangrove Jack's M84 (Bohemian Lager) yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Using a 5-gallon (19-L) kettle, start by steeping only the Vienna malt addition (placed in a muslin bag) in about 1 gallon (3.8 L) of water at 148 °F (64 °C) for 30 minutes. Remove grain bag then add more water to your boil kettle to bring it to 4 gallons (15 L). Once liquid is at or near boil, turn off the flame and slowly add half of the malt extract, stirring to avoid clumping or scorching, followed immediately after with the bittering hops. Turn flame back on, bring to boil, and with 15 minutes left in the boil, add the remaining malt extract. Follow the remainder of the all-grain recipe. After chilling the beer, but before pitching your yeast, remember to top up with water to 5 gallons (19 L).

Winter Warmer CLONES

GNOEL DE ABBEY IMPERIAL STOUT BLENDING BEER

(5 gallons/19 L, all-grain)
OG = 1.094 FG= 1.015
IBU = 65 SRM = 52 ABV = 10.5%

INGREDIENTS

13.4 lbs. (6.08 kg) American 2-row malt
0.4 lb. (0.18 kg) Gambrinus honey malt
0.4 lb. (0.18 kg) crystal malt (70–80 °L)
0.4 lb. (0.18 kg) crystal malt (120 °L)
0.4 lb. (0.18 kg) crystal malt (165 °L)
0.4 lb. (0.18 kg) chocolate malt
0.4 lb. (0.18 kg) Weyerman Carafa® II malt
0.8 lb. (0.36 kg) roasted barley
0.8 lb. (0.36 kg) flaked barley
1.75 lbs. (0.79 kg) dextrose
16.4 AAU US Magnum hops (90 min.)
(1.1 oz./31 g at 14.9% alpha acids)
4.9 AAU Cascade hops (15 min.)
(0.65 oz./18 g at 7.6% alpha acids)
½ tsp. Irish moss
4 oz. (113 g) Bourbon-soaked oak chips
White Labs WLP001 (California Ale) or Wyeast 1056
(American Ale) or SafAle US-05 yeast
Wyeast 1098 (British Ale) or White Labs WLP007
(English Dry Ale) or LalBrew Nottingham yeast
¾ cup corn sugar (if priming)

STEP BY STEP

On brew day, target a mash temperature of 148 °F (64 °C) and mash for at least 60 minutes or until conversion is complete. Recirculate enough wort to achieve wort clarity and set the grain bed for sparging. Target a sparge water temperature of 170 °F (77 °C) and collect 7 gallons (26 L) of wort. Boil the wort for 90 minutes, adding hops after hot break has ensued. Add Irish moss and Cascade hops 15 minutes before flameout. Whirlpool and chill to 68 °F (20 °C) for fermentation.

Ferment using both yeast strains at 68 °F (20 °C) until 70–75% of the attenuation is reached, then allow to free rise to 72 °F (22 °C) to ensure beer finishes fermentation. (The English strain should produce some esters and enhance the malt in a way that the American ale strain cannot.) Add Bourbon-soaked oak chips or cubes to beer. Cold condition the beer by dropping temperature from 72 to 67 °F (22 to 19 °C) on day one and 10 °F (5 °C) per day thereafter until reaching 32 °F (0 °C). Hold for one week and ensure all yeast and trub has been removed from the beer.

Once both beers are complete, rack into a 70/30 blonde-to-stout ratio. Package beer to your preferred methods targeting carbonation levels between 2.5–2.7 volumes of CO_2.

GNOEL DE ABBEY IMPERIAL STOUT BLENDING BEER

(5 gallons/19 L, extract with grains)
OG = 1.094 FG= 1.012
IBU = 65 SRM = 53 ABV = 10.5%

INGREDIENTS

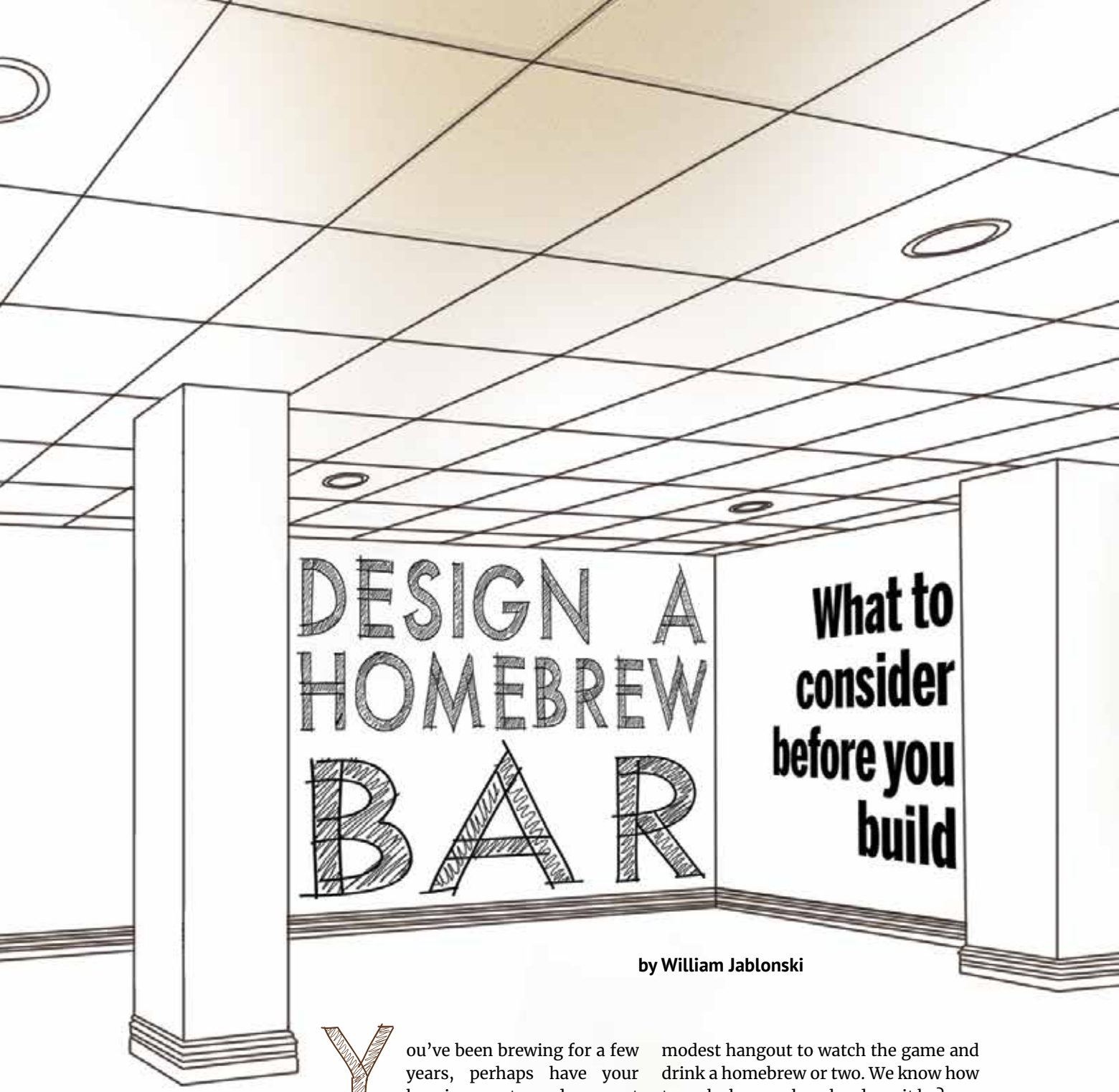
7 lbs. (3.2 kg) extra light dried malt extract
0.4 lb. (0.18 kg) Gambrinus honey malt
0.4 lb. (0.18 kg) crystal malt (70–80 °L)
0.4 lb. (0.18 kg) crystal malt (120 °L)
0.4 lb. (0.18 kg) crystal malt (165 °L)
0.4 lb. (0.18 kg) chocolate malt
0.4 lb. (0.18 kg) Weyerman Carafa® II malt
0.8 lb. (0.36 kg) roasted barley
0.8 lb. (0.36 kg) flaked barley
1.75 lbs. (0.79 kg) dextrose
16.4 AAU US Magnum hops (90 min.)
(1.1 oz./31 g at 14.9% alpha acids)
4.9 AAU Cascade hops (15 min.)
(0.65 oz./18 g at 7.6% alpha acids)
½ tsp. Irish moss
4 oz. (113 g) Bourbon-soaked oak chips
White Labs WLP001 (California Ale) or Wyeast 1056
(American Ale) or SafAle US-05 yeast
Wyeast 1098 (British Ale) or White Labs WLP007
(English Dry Ale) or LalBrew Nottingham yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Using a 5-gallon (19-L) kettle, start by steeping all the specialty grains (placed in a muslin bag) in about 4 gallons (15 L) of water at 148 °F (64 °C) for 15 minutes. Remove grain bag then bring liquid to or near a boil. Turn off the flame and slowly add half of the malt extract, stirring to avoid clumping or scorching. Turn flame back on, bring to boil and immediately add bittering hops. With 15 minutes until knockout, add the remaining malt extract. Follow the remainder of the all-grain recipe for boil, fermenting, and packaging instructions. After chilling the beer, but before pitching your yeast, remember to top up with water to 5 gallons (19 L).

Tips for Success: While The Lost Abbey may have the luxury of using oak barrels for their barrel aging, most homebrewers need to find a more efficient way to replicate the process. About two weeks before your brew day, soak 4 oz. (113 g) of oak chips or cubes in Bourbon so the chips have time to absorb the Bourbon character. Using American oak may provide the closest replication to The Lost Abbey's beer, but any origin of oak is acceptable, depending on what specific character the brewer is seeking to achieve. BYO

Photo by Shutterstock.com



by William Jablonski

You've been brewing for a few years, perhaps have your kegging system down pat and are confident in your ability to nail beer styles. What's next? If you have time, some spare change, and perhaps most importantly friends to entertain, now is when you may be thinking of building your home bar. Installing a personal beer drinking space is a natural extension of the hobby, whether you plan to build an elaborate "man cave" worthy of HGTV or a more modest hangout to watch the game and drink a homebrew or two. We know how to make beer . . . how hard can it be?

Like every other home project the answer is, *it depends.* As homebrewers we can appreciate the DIY nature of things so this article will focus on the decisions to be made during planning and construction of your personal bar space. With a good understanding of your options you can determine appropriate construction methods based on your budget, skills, and time.

Starting with a blank slate, the design options for your bar area are endless. Moods can be set with colors, decorations, lighting, and activities available in the area. Seating, how beer is served, and whether other beverages will be available are some of the many choices to consider up front.

Regardless of complexity, size, and cost considerations, every home bar must have a few key items. These include a space to hold chilled beer (and possibly other beverages), storage for glassware, horizontal space to place your drinks, and space to relax. Beyond that the possibilities expand quickly. Bottles, draft, or both? Commercial beer? Wine and liquor? Perhaps you really want nitro draft beers available. Music, video, and other electronics can be incorporated with more investment and time, or you may purposefully choose to eliminate electronics to make the bar area a place for conversation.

PLANNING YOUR SPACE

Before you start tearing down walls you will want to have a clear idea of what the space will look like and how you can go about making your vision a reality. If you have a theme in mind take account of all of the specific items you'll have on display and where they will go. Be realistic with your budget and time, and then add 25% to each. Professional remodelers are careful to examine the space prior to construction because they know even the most detailed plans are often changed due to unforeseen issues.

Your first task should be to make a sketch of the space. It does not need to be architectural quality but the sketch must include dimensions. Start by measuring all dimensions of the area. Plotting the measurements on graph paper allows for a starting point. As you start to refine your vision for the space keep the measurements handy for reference. It is helpful to make photocopies of the basic sketch; allowing you to plot changes as you refine your layout.

A large space is not a requirement for a home bar area, and oftentimes a small space is better suited to a cozy atmosphere more conducive to relaxing with friends and family. A large room can feel sterile if there are only a few people hanging out while smaller spaces promote conversation and camaraderie. Think of a Munich beer hall vs. a neighborhood bar in Tokyo or corner bar from the 1950s. Both are great places to enjoy beer but an empty beer hall does not have tremendous appeal. At a minimum you'll need to have seating and space for each person, and if your plans include a large screen TV with plenty of guests then a bigger room will give you more options.

The space behind the bar is something mystical and you may find people are hesitant to enter that world. The bar is the stage and we naturally don't break the fourth wall. If you envision yourself as the bartender in your home bar you will have the space all to yourself. Remember that your homebrew frequently requires an ambassador and your guests will look to you for guidance. This can be a satisfying experience or it may become a bit of a burden. Providing all the service or inviting people to help themselves will establish the house rules. Plan to have enough room to move around and don't forget to allow space for any doors to swing open.

Now is a good time to consider

building code requirements. Building codes are local, and your local code enforcement official can tell you if you need to pull permits and what specific items will require inspection. Some codes are more lenient while others are strict, but all building codes are there for everyone's safety. The best thing to do is to ask the code enforcement official. Having your sketch and list of planned construction activity will go a long way towards making friends. Code enforcement is not responsible for educating you (or your contractor) but they will reference each specific code requirement and may offer some basic advice to make everything go smoothly. Remember, if you neglect to meet building code or skip required inspections it will eventually catch up to you. Think about ripping out your tiles or drywall so the completed work can be inspected in 10 years when you are selling your home. You may also find that your planned construction does not require any permits or inspection, but you will have to ask first!

Standard bar height is 42 inches (107 cm) and a standard bar stool is 30 inches (76 cm). Fortunately this allows for a good deal of space beneath the bar. A well-designed bar utilizes all of the available space for efficiency. The space behind the bar is a good place to hide necessary but not always display-worthy items. This could include a dirty glass storage bin, garbage can, or a sink. If you plan to have wine and liquor available but don't have the shelf space for those items, they go here.

Though free beer does bring out all of your friends and acquaintances, your home bar is presumably not intended for fast service and you won't be three deep with customers. It is not so much of a concern to have things like speed rails and cocktail mixing stations. You can incorporate cabinetry for storage as you like and the furnishings will go a long ways towards setting the atmosphere. Dark woods tend to create a more reserved space while bright colors can lend a festive atmosphere. Tile, wallpaper, and mirrors provide contrast and will really make the space unique.

BARTOP

Selection of material for your bartop is probably the most significant design element choice you will make. Wood is the most popular choice, and for good reason: Wood is elegant, easy to work with, can be stained for a variety of looks, and it is timeless. For as long as people have been gathering to drink beer there have been wooden bartops. Wood has the advantage of being DIY-friendly and readily available too. Wood can also be refinished relatively easily.

A protective layer of epoxy can be applied, though if you're not familiar with its application it is probably best left to a pro or an experienced friend as it is messy and unforgiving. At the very least, you will want to do a trial with the epoxy on another surface if you have never used it before. The superior protection offered is probably not as great a concern in your home bar as it is at a commercial establishment. Wax or polyurethane are very good alternatives to wood bartops.

Other bartop materials include granite, concrete, tile, and synthetics

Photos by Christian Lavender

A graphic bar top design (left) is another option, like this one in which Christian Lavender had brewing images printed on an adhesive vinyl banner, which he then poured epoxy (right) over to protect and provide a nice shine to.

Photo by Christian Lavender

A chalkboard listing the available beverages is a nice touch to make your space feel more like a bar. This can be as fancy as you'd like to make it.

such as Corian. These materials may require a contractor and each offers a unique look with advantages and disadvantages. These surfaces are promoted as being extremely durable, which is true, but it also means maintenance can be difficult. Drilling into these surfaces is a chore so your layout needs to be final before you commit. Hard surfaces and glassware are not always a good mix either.

PLUMBING AND ELECTRICAL

Hot and cold water along with electrical service will increase your home bar options. They may already be present if you're lucky, and you should try to incorporate existing services into your layout if possible. If you are not comfortable working with either, hire a professional, because floods and fires seem like a bad idea.

You will need an available power source for refrigeration along with any lamps, lighted signs, etc. If you plan to have your offerings held in a nearby remote location then the refrigeration can be kept there. Otherwise you'll need to account for each appliance's space and required electric service. A small dorm fridge will fit under the bar and can hold your bottles and perhaps wine or soft drinks. A refrigerator is a heat removal device, and that heat must have someplace to go, so be sure to allow some room around the compressor for ventilation. Refrigeration units designed for built-in applications, which exhaust through the front, are available but fairly expensive. If you have a kegerator or keezer there are special considerations for a built in application, which we will get to.

Having cold water available allows for a glass rinser. If you decide to go with a rinser in your drip tray you are also going to need to drain the rinse water to the sewer/septic system. This may get quite involved, especially if you are in a basement space and can't use gravity. Installing pumps and all of the necessary pipes and check valves, not to mention electrical requirements, will add cost, time, and complexity. A glass rinser is a fancy addition but pretty far down on the list of needs.

Commercial bars use a three-bay sink to wash, rinse, and sanitize their glassware. It is unlikely any home bar needs to be so involved. If you have hot and cold water available you can install a sink and clean your glassware right at the bar. An under-bar drying rack is ideal for glass storage. Another option is to skip all of that plumbing and just haul the dirties to the kitchen.

SERVING YOUR BEER

Now that you have a pretty good idea of how this home bar of yours is going to look, it's time to get to the reason you started this project in the first place. Homebrew! If you are strictly a bottle person it is fairly easy to incorporate your homebrew into the home bar. Cold storage, glassware, a place for empty bottles, and you are on your way. The addition of a mounted bottle opener with a cap can is an easy upgrade that will lend a little bit of flair to your space.

Brewers that are kegging their beer have plenty of flexibility in the placement of the kegs and faucets. A chalkboard listing the available beverages is not required but useful whether you keg or bottle, and does

make the space seem more like a bar.

There are three basic types of draft systems. In order of increased complexity they are direct draw, kegerator, and remote draw. Direct draw incorporates the faucets against a wall of the refrigeration unit, typically a walk-in cooler. Since we don't likely have a walk-in available in our homes, that leaves us with the kegerator or remote draw.

The vast majority of homebrewers who keg are going to be modifying a kegerator or keezer for use in their bar. Remote draw systems are an option we will discuss but because these systems are more complex and require more equipment, space, expense, and time, remote draw is an option best left to the confident and committed. The easiest and most cost-effective solution is to put your kegerator or keezer into an available space behind the bar. Leave some space to open the kegerator door or keezer lid and off you go.

Having faucets on your bartop shows that you mean business. It also allows guests to see what's on tap and gives your home bar some real style. There is a wide choice of towers available. Column towers are common but are limited to a maximum of three faucets. Using multiple column towers presents a unique look and allows for more flavors to be served.

Pass-through towers are another option. A Pass-through is mounted to the bar top as an upside down "U" and the bartender passes the beer through the space beneath the tower. In reality, though, pass-through towers are often quite large and can really overtake your limited space on the bar top. Pass-throughs come in different heights and a shorter tower may be more appealing in the smaller space of a home bar. However, if you are pouring beer in a separate space from your bar (like in the picture below), this is a nice looking option that may fit well in most spaces.

A third option is a ceramic mushroom tower. Mushrooms and mini-mushrooms are relatively compact and offer a wide variety of colors and faucets. Mushrooms have a smaller footprint than pass-through towers have.

Finally, a home bar could incorporate an underbar mounted draft box. The box is fixed to the underside of the bar near the bartender. Faucet markers (tap handles) are visible across the bar and all of the barspace is left free. The actual pouring of the beer is not visible, however, reducing some of the fun of the presentation. Still, underbar units are well worth consideration. Take a look at the draft towers out there in the commercial world to get a feel for how each would fit into your home bar.

Your kegerator likely has a draft tower located directly above the appliance. The tower is insulated and exposed to the ambient temperature. A tower cooler is used to force cold air into the tower in an effort to keep the beer in the line chilled. If the temperature of the beer in the line increases even a few degrees the CO_2 gas will break out of solution and you'll be pouring a few ounces of foam until

Photo by JS Bull

Photo by Andre Viau

Pass-through (left) and mushroom (right) tower designs are two options when you require multiple taps. Both can add an elegance to your bar and accommodate many taps, depending on how large you want to make them.

POURING BEER FROM YOUR DRAFT

After all the effort you have put into making your homebrew and your homebar, you should be enjoying the perfect pour from your draft system. A well-presented pour is a thing of beauty and in my estimation never gets old. There is a special satisfaction to pouring your own homebrew, in your own bar. Cooler than the other side of the pillow, in fact.

Start with a beer-clean, room-temperature glass that is free of grease or detergent. Keep your beer at 38 °F (3 °C). You can enjoy your beer at any temperature warmer than 38 °F (3 °C), but foaming becomes a real headache as the liquid gets warmer. Place the glass at a 45-degree angle about one inch (2.5 cm) under the spout and begin by fully opening the faucet. Avoid allowing the beer to contact the spout as the glass fills. Try not to grab the handle at the top. One, it is a big lever and you risk looking like a Neanderthal, and two, it is a big lever that can snap while open, leaving you with no quick way to stop the flow of beer. As the glass fills up to about three quarters, straighten the glass and gradually drop it to create some velocity and foam. With a little practice you should be able to get a perfect collar of foam for a perfect presentation.

the keg beer gets to the glass. Keeping the beer cold from keg to glass is a basic draft system requirement.

A bar-mounted tower must also be cooled, either with forced air or glycol. With some planning it is possible to mount the tower separately from the kegerator. Remote systems use a glycol chiller and an insulated trunk line to keep the beer at the proper temperature. Commercial glycol chillers have a chilled bath of glycol solution and a pump to circulate the glycol through the trunk line and tower in an endless loop. The pump runs 24/7 and the chiller maintains the temperature of the glycol bath. A small chiller costs north of $700 while an insulated trunk line can have 2 to 12 lines and costs around $3 up to $14 per foot depending on the amount of lines. Installation of a glycol system is an order of magnitude more complex than other systems. The scope of this article does not go into all of the variables and considerations but it is an option you may want to pursue.

When selecting the location for your draft tower it should be no more than a few feet from the kegerator or keezer. That is because you will need to push cold air to the faucets and you are limited to the length of choker you are using while too many bends in the duct decreases airflow. The tubing can be extended a bit either by installing a longer choker or using a short length of poly tubing between the choker and the coupler. A typical installation uses flexible plastic duct and a small fan. Be careful not to use too large a fan, however, as it will inevitably push cold air out of the tower and kegerator. Thirty to 100 cubic feet per minute (CFM) (0.85 to 2.8 cubic meters) is plenty. Using flexible duct instead of rigid PVC will make placement of the equipment much easier and allows you to move the refrigeration unit a bit when needed. Be sure to insulate the duct, or better yet use 2- to 4-inch (5- to 10-cm) insulated duct intended for use in heating and cooling. You should insert a short piece of appropriately-sized PVC into the tower from under the bar as well as into the kegerator. This will give you a hard surface to tape the duct to. Even with careful attention to sealing the duct you'll find moisture inevitably collects in the kegerator. This is not a deal-breaker but removing the water every now and again or using DampRid moisture absorber should be part of your maintenance routine. All of this material requires some space, so referring to the layout drawing you did at the beginning will help you to plan the space.

FILLING OUT THE HOME BAR

Now that you've got the bar and the beer figured out, its time to consider all of the other things that belong in a proper tavern.

Liquor and wine increase your options if you are serious about entertaining. When planning your liquor purchases you want to consider space, what your guests will want to drink, and budget. If you need help here a good place to start is to visit a small commercial bar to see what bottles they are using frequently and what looks like it is collecting dust. Some mixers and citrus will increase your options as well. Wine is an easy addition and can be as inexpensive or extravagant as you like. Lockable cabinets as well as faucet locks will keep it all out of reach of the neighbor's kids and the baby sitter too.

Consider providing the appropriate glassware. Serving beer in unique glassware is certainly not necessary but sure is a lot of fun. Same for wine and liquor. Placing the glassware on display is an easy way to create an atmosphere and can be incorporated into your particular home bar theme. Online vendors have begun to sell small orders of custom glassware. Establishing a brand and logo for your home bar will make it fun and unique.

With proper consideration of space, budget, and time, your home bar can become a place of pride that enhances your appreciation of your homebrews as well as a cool space to enjoy with friends and family. BYO

Home BAR Builds

Readers share their bar designs

Background photo by Shutterstock.com

Dan Stocker ★ Red Deer, Alberta

When we purchased our house two years ago, one of the requirements was that there would be an area that I could use for a bar/homebrewing spot. We found a place with an undeveloped basement, got the basement finished, the plumbing roughed in, and got started on the bar. I really enjoy homebrewing and wanted to create a space that I could brew in, but also a space that I could hang out with friends and family while they drink my beer. I set to work on the most important part — the taps — drawing inspiration from a friend's tap setup that he has in his kitchen and random images that came up when I Googled "basement bar taps." I wanted to create an island big enough to enclose all of my draft equipment (CO_2 and nitro included) and serve as an aesthetically pleasing "sit-up" bar area.

The design was relatively simple; I built a box around a freezer, bought and stained the birch countertop, installed it with heavy duty hinges, drilled a hole for the tap tower, and finished the outside with faux rock. The cabinets I had done custom since that's a bit beyond my carpentry prowess, but I installed the wet bar sink and a utility sink with filtered water behind the scenes in the laundry room. After the main part of the build I filled the drawers and cabinets with all my homebrew gadgets (Erlenmeyer flasks, stir plates, etc.). I built some shelves to match the countertop along with the backsplash and added a few items that looked cool with some sentimental value as well.

I didn't originally have much of a vision for the bar; I was worried about having unrealistic expectations and then not finding a place that could live up to the hype. I wanted it to have a pub feel, function, and look, but also showcase a few items that mean a lot to me including:

- The shadow box with my Granddad's WWII memorabilia.
- The "Sword of Charlemagne" replica (also from my Granddad).
- Two long neck bottles from The Establishment Brewing Company, which is owned by the award-winning brewers (Mike and Brandon, among others) who taught me how to brew. These are from their very first barrel-aged batches of beer and their passion for brewing has been a huge inspiration to me.
- The German stein was a gift to my Dad for some engineering work he did in Germany.
- My first homebrew medal; a silver for an English extra strong bitter called "Bloody Well Right."

Now that the space is fully set up I can have coworkers over for team meetings and chat about beer with friends and family while pouring pints for them. Being able to have all my brewing equipment in one place has streamlined my brew days and made it more enjoyable to brew. I do have some plans for the future of the bar; I'd like to install a 240V plug and an exhaust fan so I can boil indoors (I use propane on my front deck right now). My fiancée, Christine, has done some wine kits that we have carbonated and put on tap, which were delicious, so I'd like to expand from beer and try some ciders and perhaps meads in the future also. I like to think of the bar as a constant project that's never really finished, always making tiny improvements either functionally or aesthetically.

William Blase ☆ Colorado Springs, Colorado

This is the bar that friendship built. Everything from the idea to the construction of it was all because of friendship. When the time came for us to search for a home, we desired to find a house that had enough space for entertaining. Our bar was going to be a focal point in our household, not just a table in a corner. I do not think there is a better idea than to have a room dedicated as a brewpub to showcase my homebrew. When we bought the house, I quickly set out researching designs that would maximize the space available.

It was going to be in a sunroom with a lot of natural light, and within a month I had a design. My brother-in-law, Keith, made plans to help me build it. We built it from scratch, with a custom-designed backside to fit a kegerator and mini fridge as well as giving me space to store my glass collection. I went with the dark stain and corrugated tin roof for the design; which complemented the existing farmhouse style décor of our home. For the tap tower I used steel to add an industrial look. Shortly after the bar was built, I saw the need for more. When friends would come over we would run out of fridge space and draft beer — it was time to expand! I then found a fridge and chest freezer online. My desire was to repurpose something old and give it new life. I cleaned and painted both with chalkboard paint to allow the current brew on tap to be displayed. My good friend came up with the brewery name "Role Model Brewing Co." and drew the hop on the fridge.

This home brewpub is used for good times. We play games, listen to music, and most importantly get away from the daily grind. To this day I have refused to put a TV in the brewpub as this is a place for laughter and good times with friends. I am a member of a fun beer group on Facebook that uses our pub to host beer shares. We sure can pack the place! I also use the bar to have tapping parties. What's homebrew without some friends to share it? That's where all the décor comes from. The stickers that cover my kegerator and mini fridge beneath the bar come from beers enjoyed with friends; every one of them holds a memory. The tin tackers are from breweries that we have been to that hold great times as well; each with its own story.

If I had to pick one aspect that I would call my favorite part of this brewpub, it would be the memories. Sure, there are many neat little things in here, but the memories that it has given me are next to none. I do love my tap tower, though. It was fun to build and does a great job keeping the beer cold with some good insulation inside.

The story of my brew pub continues to grow. I have some expansions planned in the near future. I am currently building a bigger keezer to start my sour tap and conceal some CO_2. I am also looking into dartboards to add another game to the pub. Lastly, I am going to be putting my new home-built electric brew system in the brewpub, but that will be moved when guests are here.

Will Swingle ★ Waconia, Minnesota

For years my wife and I have had a recurring conversation. It normally begins with something like, "wouldn't (fill in random name) be a cool name for a bar?" It then goes on to build upon a theme and design that we would love to hang out in and even own one day. Owning our own bar has always been a dream, but not one that would ever be feasible without making some huge life changes. So, instead we decided that we would put one in our home.

I picked up woodworking as a hobby a few years ago and mainly work on projects during the summer because I'm a teacher and that's when I have the time. Each year I have one big project that I spend a lot of time on and last summer it was the bar. We had just finished our basement and at that point knew exactly what it was missing so we decided to go for it. My wife and I spent about two weeks building and installing it.

The shape was chosen to fit and function in our space. We knew we wanted to be able to have at least six people sit at the bar at once and since it is in the middle of a large room, it needed it to be separate and not dominate the space. We also wanted to make sure we had enough room to allow use of the living space without it feeling cramped. With all this taken into account we came up with the design and it was perfect except our rough in for plumbing was about a foot too close to our back wall to accommodate what we had in mind. The solution to this problem would eventually be a small seat/shelf at the far end of the bar to allow space for the plumbing (shown in the middle picture).

The frame is made from 2x4s and was probably the easiest part of the build. The tops are made of 2x6s and gave us a bit of a headache when it came time to bring them downstairs. The stairs into the basement have a sharp turn in them and so the boards wouldn't fit around it. To solve this problem we had to bring them in through the window.

The front of the bar is shiplap and was designed to match the back wall of the basement, which we installed at the same time. This is one of my favorite parts and took the most time. Each piece of shiplap was unfinished to begin with. We stained each one then either white washed or distressed them to give us four different colors using three colors of stain, a white wash, and a brown glaze. My wife was the mastermind behind the color and pattern of the wall and front of the bar. She measured and cut nearly every piece and I hung them up. Like I said, this took a long time.

Next it was time to install the sink. I had never done this before but thanks to the internet and the directions that came with it, figured it couldn't be too difficult. I had already cut a hole in the top so the biggest challenge was deciding how tall we wanted the faucet to be. We went taller because the sink was small and we wanted to be able to fit tall glasses under it.

At this point we primarily use the space for hanging out as a family. We have a living space on each side — one for television (it gets a lot of use during football season) and the other for games, and the bar anchors down our basement.

Danny Allwood ✭ Sheffield, UK

The main consideration behind my bar was that I wanted to get into kegging my beer (rather than just bottling), so with future-proofing in mind, I wanted to be able to eventually run three keg lines in as small a space as possible. It's difficult to get a refrigerator large enough to hold three Cornelius kegs and a CO_2 tank, so I did a lot of research and found a chest freezer with the perfect dimensions and then bought one used on the internet. The kegs and tank fit nicely with a little space on the back shelf left over, which can be used for lagering beer in 1-gallon (4-L) fermenters. To run the freezer as a fridge, I used an external temperature-controlled power supply, which cuts power to the freezer when the internal temperature reaches 43 °F (6 °C) and turns it back on when it reaches 50 °F (10 °C). You can see the temperature probe cable in the top left photo as the probe is taped to the side of a cider can sitting on the back shelf.

Internally, the kegs are carbonated and beer delivered by CO_2 pressure from a 6.6-lb (3-kg) tank, with a single regulator and a 3-way gas splitter manifold providing gas to all three kegs. All the carbonation and delivery is done under the same 10 psi of pressure so that I don't have to mess around with changing the gas pressure and the carbonation only takes around a week.

The beer lines are run through a hole in the lid of the chest freezer into the "coffin box" on the top, where the three flow-control taps are mounted. There are three more holes between the lid and the coffin box, which have computer fans mounted in them to ensure the air circulates properly through the whole interior. This ensures the top section of beer lines stay reasonably cold (to stop out-gassing and foamy pours) and also to prevent any mold growth. All the lines/probe cables etc. run through the lid as the walls of the chest freezer are where the coolant pipes are housed, so drilling through them is a bit problematic.

Cosmetically, the freezer is just painted with blackboard paint, which allows us to use chalk pens on the front/sides. All the wood is reclaimed from our local wood recycling depot, so cost less than $25 in total and is just finished with stain and wax. The wooden frame around the front/sides of the freezer isn't fixed – it slides out in case the bar needs to be moved (as the chest freezer itself is on wheels). The top frame is bolted on to the freezer lid, so you can just lift the entire thing up on the pre-existing hinges to access the kegs.

There are RGB LED strips built into the underside of the coffin box and the under sides of all the front/side panels, providing downlighting that can essentially be set as an infinite number of colors or changing patterns as desired. A switch for the LEDs is mounted on the back of the freezer but they're also remote controlled, which is how you set the color, pattern etc.

All the electronics (LEDs, fans, temperature control unit, etc.) are plugged into a multi-way adaptor that is mounted onto the back of the freezer, so the entire bar only uses one plug in an electrical socket and it keeps the cables tidy!

Photos courtesy of Christopher Toms

Jeff Witte ★ Independence, Missouri

When I started brewing 10 years ago, I had no idea just how hard the bug would bite. I got this hobby kicked off with your typical starter system and a couple extract kits, and it has morphed into a half-barrel electric system that attempts to keep my 10-faucet-long draft system in my basement bar fed. The bar has been a work in progress over the last five years, slowly collecting pieces and building it out a little at a time. Picking up the tap tower here, the glycol chiller there, and eventually the cabinets and actual bar top, and it has finally evolved into something for my friends and I to enjoy my homebrew at.

I started the long decision-making process of trying to decide exactly how I wanted it to look and how it was going to be laid out by finding as many pictures of basement bars that I could, and using masking tape on the floor to lay out possible options that could fit. I went back and forth for quite a while as to whether I wanted a long traditional bar or a small wet bar style. In the end, I went for a blend of the two, and chose a small space that could still seat 5–6 people comfortably while also having a traditional feel, but not taking up as much space overall as a full-size bar.

Once I had the design and layout figured out, I had to decide what I was looking to use for materials. Again, I had several thoughts in my head for what to do based on the many examples I had been looking at. Eventually, I came to

my decisions based on ease of install, ease of future maintenance, and overall feel of how they worked together. I started with ceramic tile flooring that has the look of wood floors. I wanted something with good appearance and wear qualities, but more importantly, easy to clean and keep clean. Once that had been laid, I placed the back bar cabinets and painted them black to blend in with the wall paint scheme, and topped it off with a butcher block-style countertop finished in a neutral color with several coats of gloss polyurethane.

For the bar itself, I used another butcher block piece finished the same, and then wrapped the bar front with recycled pallet wood I had picked up from a local brewery and my homebrew supply shop. The pallet wood is then carried through to behind the back bar for a nice rustic feel that I think highlights the stars of the bar well, the 10-tap tower, and my lit up homebrewery logo sign. Being near plumbing was a big consideration of the location so that I could put a sink in the back bar and feed my glass rinser drip tray. Being in IT, I of course had to add computerization to the bar as well, using a monitor for a menu board and flowmeters to keep track of keg levels.

I wanted my basement bar to have plenty of keg space, but I also did not want any sort of refrigeration compressors in the bar itself. To accomplish this, I found a commercial-style three-door cooler and a glycol chiller to keep everything cold. I set all of this up in my garage with a 30-foot trunk line heading into the basement. With a 10-gallon (38-L) reservoir, the glycol chiller is also able to pull double duty and keeps my three conicals at fermentation temperature, and even cold crash, while still keeping the trunk line and tower chilled.

It's taken time to get it to where it's at now, but by working slowly I've been able to create it exactly how I envisioned, and been able to wait for the great deals along the way. Knowing that I built it all with my hands, and those of some great friends who have helped out, makes it all the more satisfying to sit down and have a beer at.

Richard Barnes ☆ Nottinghamshire, UK

To begin with, Bar-NES was a sad, empty square of decking on our back garden. It was rarely used and needed staining yearly, which took a great deal of effort and usually faded pretty quickly; leaving the whole area looking rather untidy. This was not helped by the recalcitrant herd of garden furniture scattered across the deck.

It was June 2017 that we decided to take action and bring the area to heel. The initial plan was to build a semi-permanent sheltered outdoor seating area that joined onto the back of the house, between the conservatory and the boundary fence, which means that we only would have to build one side, whilst also giving us easy access into the house. Yet as the seating area took shape we felt it was missing something. As August approached we decided to add a bar to the space . . . and so Bar-NES was born.

The result was a wonderful sanctuary protected from the unpredictable British weather by two retractable awning blinds and a set of sturdy French doors. As the summer reached its end we found we were able to sit outside later into the evenings, especially with the addition of the TV, which brings the homey feel of a living room outside. In the time since, we have had many enjoyable nights in almost all weather.

With the addition of the bar, alcohol came naturally and we stocked up on various beers, wines, and spirits. We have had a few parties, and Bar-NES has allowed for a great atmosphere with different lights and later additions of sofas, bar stools, and tables, which means that there is plenty of seating. Additionally we rescued an old bookcase, polished and painted it to match the color of the bar, and turned it into a shrine to Iron Maiden's "Trooper" complete with the flag and it's one of my favorite features of Bar-NES.

Another of my favorite parts is the bar itself. Not just because of the alcohol, but because of how we decorated it. After around four months of collecting bottle tops from a local bar, we set them into the top of the bar and covered them with resin, which is a great background for pitchers of cocktails.

As good as this was, the most recent change we made was to cover the visually offensive decking once and for all with artificial grass. This makes it much easier to walk on barefoot and easier to keep clean with the vacuum cleaner, and in my opinion really sets off the space, contrasting with the darker grey of the walls which is pleasing to the eye.

One of our favorite hobbies is to create cocktails and host family tasting sessions. We have made a wide variety of cocktails, which are all published on our Instagram page 'bar_nes_cocktails,' which add a burst of color to the bar and bring a flavor to our relaxing evenings.

As Bar-NES's second summer year up, we have plans to extend outwards for an area to barbecue and eat. BYO

REVIVING EXTINCT GERMAN BEER STYLES

RECREATE THESE 15 FORGOTTEN STYLES

by Horst Dornbusch

Lurking in the dark recesses of beer history are many formerly famous brews that are now all but forgotten. This is particularly true in countries with old beer cultures, such as Great Britain, Belgium, and especially Germany, where folks are known to have been brewing for almost three millennia, probably longer. The proof is a beer amphora discovered in 1934 in a Celtic chieftain's grave mound, near Kulmbach, in what is now the northeastern part of Bavaria. It has been dated to 800 BC, which makes it the oldest archeological evidence of brewing in central Europe.

These early brewers, however, were illiterate. Thus, the oldest written records of brewing on the European continent were compiled only at the beginning of the current epoch, when scribes accompanied the Roman legions on their conquests of the "barbaric" tribes across the Alps. Perhaps the most noteworthy of these documents is *De origine et situ Germanorum* (About the origin and location of the Germans), penned by the Roman senator and historian Gaius Cornelius Tacitus (c. 56–120 AD). In this work, Tacitus mused sarcastically about the fondness of the primitives along the rivers Rhône, Danube, Rhine, and Moselle for their *"umor ex hordeo aut frumento"* (fermented liquor from barley) that tasted much like *"vinus corruptus"* (rotten wine).

Photo by Shutterstock.com

Photo courtesy of Horst Dornbusch

This Celtic beer amphora from around 800 BC was found in a grave mound of the Celtic Hallstatt culture, in present-day northeastern Bavaria. It contained residues of a dark wheat ale flavored with oak leaves. The vessel is now in the Beer Museum of Kulmbach.

We do not know exactly how these tribes made their "rotten wine" back then, but by the High Middle Ages, around the turn of the first millennium, Benedictine monks in all of central Europe had clearly accumulated a great storehouse of knowledge about the art of making delicious beers from various grains. We know so from many documents, including the annals of the Abbey of Saint Gall, in present-day Switzerland, which were compiled roughly between the middle of the 10th and the 11th centuries, as well as an architectural floor plan from around 830. According to that plan, Saint Gall was equipped with a granary, a malting floor, a kiln, and three (!) brew houses, each dedicated to a different beer.

In the first brew house, the friars made Celia from the first runnings of a mash of barley and wheat malts. This was a privileged beverage reserved exclusively for the abbot and his lofty guests. In the second brew house, they made huge quantities of Cervisa from the first runnings of a mash of barley and oat malts. This was the daily beer of the ordinary monks, who also served it to visiting pilgrims. Finally, in the third brew house, they made Conventus. This was a "small" beer blended from the second runnings of the Celia and Cervisa mashes and often fortified with wort from a freshly mashed bed of malted oats. Conventus was doled out mostly to the abbey's lay workers and to beggars. At first, these three beers were spiced with herb mixtures called gruit, but eventually hops replaced herbs as the preferred flavoring agents.

We cannot be certain that the Abbey of St. Gall was actually built according to the 9th-century plan because there is no trace left of the original buildings. It is known, however, that European monks made variations of Celia, Cervisa, and Conventus throughout the Middle Ages and well into the Renaissance. Thus, one can argue that these three beers were the foundation from which virtually all regional brews in central Europe have since sprung. In other words, Celia, Cervisa, and Conventus were arguably the world's first true beer "styles." Eventually, just about every village and town had its own set of "*terroir*" brews, based on whatever raw materials would grow well around them.

Nowadays, we still find scattered references to such old beers in documents written in Latin or in antiquated German (think of old German as the equivalent of Chaucer's English). Initially, the authors of these documents were scholarly monks; but learned secular scribes also wrote about beer-making later on. (A select list of historical sources about German beers is in the sidebar on pages 79–80.) Old beer descriptions are invariably vague and cryptic, which is why they are also tantalizing. In interpreting and re-enacting old brewing instructions, we must remember that their measurements are often quite unspecific — such as a handful of this or two buckets of that. The intriguing part about old recipes is that we simply don't know for sure how these brews were made or how they tasted. This leaves modern brewers — accustomed to clear-cut, lab-generated analytics, as well as modern ingredients and equipment — with quite a reconstruction challenge.

There is also the issue of replicating old raw materials. Barley landraces of yore were obviously a far cry from today's thoroughbred brewing barleys, which are the result of sophisticated, genetic marker-guided breeding. In addition, the malts of beers that evolved before the advent of pneumatic malting in the second half of the 19th century were invariably floor malted and dried in smoky, direct-fired kilns, which often left them undermodified, with phenolic flavors, and of relatively low diastatic power. Malt colors were invariably some shade of brown, and pale malts tended to be rare and expensive because they had to be laboriously sun-dried in the open air. For all these reasons, old malt characteristics are difficult to imitate today. Finally, we must not forget that managed yeast strains became available only in the latter part of the 19th century, after Emil Christian Hansen, the head of the Carlsberg Brewery laboratory in Copenhagen, had isolated pure yeast cultures for the first time. Before Hansen, all brews were almost certainly fermented with a random mix of yeasts, as well as other ambient microbes of indeterminate character.

In spite of all these obstacles, the article here features descriptions of

"The intriguing part about old recipes is that we simply don't know for sure how these brews were made or how they tasted."

This work, entitled About the Origin and Location of the Germans*, by the Roman scribe Gaius Cornelius Tacitus contains one of the earliest descriptions of beer making in central Europe.*

a selection of 15 old, now "defunct" German beer styles — five of these with recipes — for adventurous brewers to use as inspiration for their own experimentation. Just put on your magic hat and take a stab at them.

If entering any of the following styles in competition, Beer Judge Certification Program (BJCP) President Gordon Strong suggests all should be entered in Category 27 Historical Beer, along with a brief description similar to those given in this article.

1. SCHÖPS

This beer is from the former German city of Breslau (now Wroclaw in Poland). It is a top-fermented wheat beer that was brewed in two color variations, white and black (sometimes also referred to as red). The mash is made up of 80% wheat malt, the rest is barley malt. In 1575, Dr. Heinrich Knaust, the author of the world's first beer style encyclopedia (see sidebar of sources at the end of this article), called schöps a "sweet and lovely beer." Recently, schöps has even become a Brewers Association competition category. See https://s3-us-west-2.amazonaws.com/brewersassoc/wp-content/uploads/2018/03/2018_BA_Beer_Style_Guidelines_Final.pdf for more on this style.

2. BROYHAN BEER

Allegedly "invented" in Hanover, in 1526, by brewer Cord Broyhan, this light-colored and apparently mildly sour ale became a Hanseatic League trading commodity. The League turned the Broyhan into one of the world's most popular beers. In spite of the brew's commercial significance at the time, however, there is much dispute in the brewing literature about its composition. It was made either from just barley malt or from a combination of both wheat and barley malts. Either way, it was mildly hopped and had a moderate ABV value. Its bouquet is said to have been viniferous; its finish, sour-sweet; and its color, that of white wine.

3. LICHTENHAINER

In the 17th and 18th centuries, this smoky ale from the Thuringian village of Lichtenhain just outside the city limits of Jena, was all the rage among students at the local university. Just as with Broyhan Beer, historical sources disagree about the brew's grain bill, which was made up either of just barley or of both barley and wheat. Regardless of the mash composition, according to several brewing books from the early 20th century, Lichtenhainer had an original gravity (OG) of roughly 1.032 (8 °Plato), an ABV of 2.5–3%, and a dry finish. The wort was mildly hopped and boiled only briefly — probably just long enough to coagulate proteins and dissipate Dimethyl Sulfide (DMS). It was fermented with yeast and *Lactobacillus*. All in all, this beer probably had a distant resemblance to a Berliner weisse.

This is the only style of the 15 highlighted in this story that is in the Beer Judge Certification Program Style Guidelines (included in the Historical Beer section).

4. GARDELEBISCHER OR GARDELEGENER GARLEY

For English-speakers, this ale from the Renaissance is surely hard to pronounce. It got its name from the city of Gardelegen in the German state of Saxony-Anhalt, where it was held in high esteem. The earlier-mentioned Dr. Knaust called this beer an "out-of-this world good beer" with "not too much hops." Johann Georg Krünitz (see sources) added that it must be "brewed from plenty of two-row barley," which gives it "a sweetish-pleasant taste, along with a translucent brown-yellow color." This suggests that the Garley might have been a malt-forward ale that we could now brew with a good portion of caramel malts.

5. KOTTBUSSER BIER

This old-fashioned ale from the city of Cottbus along the Spree River in the German state of Brandenburg, about 75 miles (125 kilometers) southeast of Berlin, was made from barley, wheat, and oat malts, as well as honey, molasses, and floral hops. It is described as nutty-sweet, which might remind modern brewers of an altbier. It was also slightly sour. It came in two strengths of about 3% and 6% ABV.

6. ZERBSTER BITTERBIER

This classic, barley-only ale is from the small town of Zerbst in Saxony-Anhalt, not far from the city of Magdeburg. It was first documented in 1369. As the name suggests, it was well-hopped and thus kept well. Part of its bitterness was phenolic and came not from hops but from malt that was smoke-dried in alder-fired kilns. Zerbster summer beers, brewed in March and drunk until September, were the most bitter, while Zerbster winter beers were less so. Zerbster mashes were batch-sparged three times in parti-gyle fashion to produce three separate brews of declining strength. These gyles were also blended in various permutations to create variety. Like the Broyhan, the strongest of the Zerbster bitterbiers were shipped overland to Hamburg, where they served as a Hanseatic League trading commodity.

7. DUCKSTEINER BIER

In the 18th and 19th centuries, this yellowish and slightly sweet brew was a mildly hopped wheat ale from the town of Königslutter, near Braun-

Photo courtesy of Horst Dornbusch

Beers #11 to #15 were test-brewed in a modern 66-gallon (2.5-hL) pilot system on the premises of the Weyermann Malting Company in Bamberg, Germany. Homebrew recipes for these styles are on pages 72–76.

schweig (Brunswick), in the German state of Lower Saxony. Not much is known about it, but, in 1773, Johann Georg Krünitz (see sources) praised the ducksteiner as "an excellent all-wheat beer." Today the designation Ducksteiner Original has survived as a brand name for a red-blond, altbier-like, all-barley ale that has only scant relation to the old Königslutter brew.

8. DANZIGER JOPENBIER

Danzig is the German spelling of the erstwhile Prussian and now Polish port city of Gdansk. The jopenbier from this region is a most peculiar brew! Its wort was heavily hopped, boiled for up to 10 hours or even longer, and then flavored with rosehips. The name jopen possibly derives from the Middle High German word *jope* or *kope* for a wooden ladle. Fermentation of this highly viscous wort was in open fermenters in cellars whose walls and ceilings were infested with mold and other microbes. This microflora initiated a year-long spontaneous fermentation, during which the brew also oxidized and acquired Port-like flavors. A greenish mold layer usually formed on the surface of the beer, which was occasionally skimmed off (with a *jope*?). Before being packaged in barrels, the finished beer was filtered through a sack to trap the mold. The resulting libation had unpredictable alcohol levels that, according to several sources, might have varied wildly between 2.5–7% ABV.

9. POMERANZENBIER

This is a wheat beer that distantly resembles a Belgian witbier. *Pomeranze* is the German word for bitter orange (*Citrus aurantium*), whose rasped peel is mixed with a little cinnamon and placed in a porous bag that is suspended into the fermenting beer for some "dry-spicing." For a treatise of this and similarly spiced beers, see especially the 1840 work by Johann Carl Leuchs, entitled (in translation) *Complete Brewing Lore, or a Scientific-Practical Treatise of Beer Brewing in its Entirety and According to the Newest Improvements.*

10. DAMPFBIER

The name of this beer translates into English as steam beer. It is a medium-body, low-effervescent, all-barley ale that originated in the Bavarian Forest, near the Czech border, in the 19th century. It was amber to darkish and fermented fast and warm with the same ale yeast that gives a classic Bavarian hefeweizen its fruity clove and banana notes. Thus, the yeast's fermentation byproducts result in an unusual flavor profile for a barley beer. Apparently, the CO_2 bubbles that burst on top of the rocky head during high kräusen looked to the uninitiated as if the brew was releasing steam. Apparently, this accounts for the beer's steam moniker.

11. GÜSTROWER KNIESENACK

This beer originated in the small town of Güstrow in the northeastern Ger-

Photo courtesy of Horst Dornbusch

After test brewing beers #11 to #15, the finished beers were subsequently sampled professionally by a panel of Doemens-certified beer sommeliers, who gathered in the Weyermann Visitors Center, on May 9, 2019.

man state of Mecklenburg-Vorpommern. One of the oldest references to the brew is in a 1624 pamphlet by an anonymous author, who gave his tract the long-winded title (in translation) of *"Encomium or praise of the world-famous / healthy / strong and tasty barley beer called Kniesenack / which originates in the Mecklenburg country of Güstrau, where it has its origin where it is being brewed."* The bloated verbosity of this title fittingly contains a redundancy, because *"encomium"* is Latin for "praise." Apparently, kniesenack was a beer reserved for society's upper crust, which we can surmise from the beer's unusual name that derives from the word "kense," which, the anonymous author tells us, is "Wendish or Slavonic and therefore a lofty appellation; considering that in days past eminent persons such as dukes would be called kense."

The grain in a kniesenack mash was "good, well-prepared barley malt dried on the floor by smoke." It was then "ground, but not very fine — otherwise the beer would not run and the kniesenack would not be clear — and then, the mash [was] well cooked, well stirred, and rinsed through and then again cooked well and rinsed through." In addition, the anonymous author feels compelled to emphasize that one enjoys kniesenack only in small sips "like a strong and sharp, splendid wine; not even 15 or more sips or both cheeks full . . . but fine and gentle." According to a document from 1856, which is in the archives of the Grand Duchy of Mecklenburg, the "bright, clear, tasty" kniesenack reached its glorious peak during the Thirty Years War (1618-1648), when it not only delighted the troops of the Holy Roman Empire defending Güstrow, but also those of the Swedish king, who subsequently sacked and plundered the town.

To a modern brewer, the brew house process sounds very much like two sequential, full-mash decoctions of the same grain bed with two rounds of batch sparging. The historical sources also suggest that kniesenack was a poorly hopped, high-gravity brew made from well-kilned and slightly smoky to partly roasted barley malts. Its strength might have been similar or close to that of a modern doppelbock or barleywine. (See a recipe for Güstrower kniesenack on page 72.)

12. KEUTEBIER

This beer probably originated in Holland in the 14th century. At the beginning, it was most likely a sweet, unhopped gruit beer made from a mash of barley malt, oatmeal, and a little wheat flour. The relative proportions are unclear. Keutebier-making eventually spread throughout the entire northwestern European lowlands, which is why there are many different spellings for this brew, including koet, coyt, keut, koit, keuta (Latin), and quente (French). Although keutebier is hardly ever produced nowadays, it is of immense historical importance, as it is the effective fore-

EXTINCT GERMAN STYLES

RECIPES & SENSORY EVALUATIONS

There are literally hundreds of old German beer styles that are mentioned in antiquarian books, in German or Latin. Therefore, the five recipes selected here for brewing were chosen entirely subjectively based in part on their seeming importance at the time or on their potential curiosity value for today's brewers. Given the vagueness of the historical sources, none of the five test brews should be construed as "authentic" clones. Rather, because replicating old beers with modern ingredients and equipment always involves some speculation, the recipes here are merely re-imagined. Though based on published material from the past, they necessarily rely also on a good portion of educated guessing. Finally, in the specifications that follow, all quantities reflect the empirical results achieved on the 66-gallon (2.5-hL) system at Weyermann Malting in Bamberg, Germany but they have been transposed to apply to a standard, 5-gallon (19-L) homebrew system with a nominal extract efficiency of 65%.

Photo courtesy of Horst Dornbusch

GÜSTROWER KNIESENACK

(5 gallons/19 L, all-grain)
OG = 1.076 FG = 1.014
IBU= 15 SRM = 18 ABV= 8.1%

INGREDIENTS

12.5 lbs. (5.7 kg) Weyermann Bohemian Floor-Malted Pilsner
2.65 lbs. (1.2 kg) Weyermann Beech-Smoked Barley malt (rauchmalz)
6 oz. (0.17 kg) Weyermann Carafa® II malt
3.4 AAU Tettnanger hops (60 min.) (0.75 oz./21 g at 4.5% alpha acids)
SafAle K-97 or LalBrew Köln Kölsch Style Ale or a clean German ale yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Dough-in at 95 °F (35 °C), then begin to raise temperature to 144 °F (62 °C); rest 30 minutes and then raise temperature to 154 °F (68 °C); rest 20 minutes; raise temperature to 162 °F (72 °C); rest 20 minutes; raise temperature for mash-out to 172 °F (78 °C) (which was achieved in Bamberg with a 5-minute decoction boil of one quarter of the mash). Lauter/sparge as usual. Boil 75 minutes, adding hops as indicated.

When the boil is complete, whirlpool for 15 minutes and then cool to 66 °F (19 °C) into an open fermenter. Package when terminal gravity of 1.014 is reached.

GÜSTROWER KNIESENACK

(5 gallons/19 L, partial mash)
OG = 1.076 FG = 1.014
IBU= 15 SRM = 18 ABV= 8.1%

INGREDIENTS

7 lbs. (3.2 kg) Pilsen dried malt extract
2.65 lbs. (1.2 kg) Weyermann Beech-Smoked Barley malt (rauchmalz)
6 oz. (0.17 kg) Weyermann Carafa® II malt
3.4 AAU Tettnanger hops (60 min.) (0.75 oz./21 g at 4.5% alpha acids)
SafAle K-97 or LalBrew Köln Kölsch Style Ale or a clean German ale yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Place crushed grains in a large stock pot. Dough-in with 4.3 qts. (4 L) of water at 107 °F (42 °C) to stabilize mash at 95 °F (35 °C), then raise temperature to 144 °F (62 °C). Stirring while heating will help prevent potential scorching of the grains. Rest 30 minutes and then raise temperature to 154 °F (68 °C); rest 20 minutes; raise temperature to 162 °F (72 °C); rest 20 minutes; raise temperature for mash-out to 172 °F (78 °C). Dump grains into a large muslin bag and separate from the wort by placing in a large colander and washing with 1 gallon (4 L) of hot water. Top off to 6.5 gallons (25 L) then while off heat, stir in the dried malt extract. Once all the extract is dissolved, return wort to heat and bring to a boil. Follow the remainder of the all-grain recipe instructions.

Sensory Evaluation of Test Brew: This is a very balanced strong beer with a snow-white, very tall and sturdy head — obviously the result of the large amount of floor malts. The color resembles that of a Bavarian dunkel, but with an appealing burgundy hue. The malty bouquet is very complex with faint notes of honey, herbs, and strawberry. On the palate, the beer impresses with an extremely pleasant mix of smoke and warming alcohol leading into a noticeable residual sweetness in the finish. Overall, this "fine and gentle" kniesenack is reminiscent of barrel-aged whiskey.

EXTINCT GERMAN STYLES

Photo courtesy of Horst Dornbusch

KEUTEBIER

(5 gallons/19 L, all-grain)
OG = 1.046 FG = 1.014
IBU = 5 SRM = 3.4 ABV = 4.7%

INGREDIENTS

6 lbs. (2.7 kg) Weyermann Bohemian Floor-Malted Pilsner Malt
1.75 lbs. (0.8 kg) Weyermann Bohemian Floor-Malted Wheat Malt
14 oz. (400 kg) Weyermann Beech-Smoked Barley Malt
6 oz. (170 g) acidulated malt
6 oz. (170 g) instant oatmeal or malted oats
2.5 AAU Hallertauer Perle hops (0.3 oz./11 g at 8.2% alpha acids) (in the mash)
Any German ale yeast (optimal: altbier-style Wyeast 1007 or White Labs WLP036)
¾ cup corn sugar (if priming)

STEP BY STEP (TWO ALTERNATIVES)

Medieval mash method (before the invention of the thermometer): Mash in at any tap water temperature, at an approximate liquor-to-grist ratio of 3.5:1 (1.7 qts./lb.). Slowly bring the entire mash to a boil, while stirring almost constantly. Lauter until the liquor surface is level with the top of the mash. Replenish the lautered liquor and boil the mash again. Lauter until the kettle original gravity (OG) is 1.042. Bring wort to a boil. Boil the wort for 45 minutes, whirlpool for 15 minutes, cool, and ferment at the yeast's mid-range temperature. Bottle or keg as normal.

Modern mash method (used in Bamberg): Mash-in at 95 °F (35 °C); rest 5 minutes; raise temperature to 113 °F (45 °C); rest 20 minutes; raise temperature to 126 °F (52 °C); rest 20 minutes; raise temperature to 154 °F (62 °C); rest 20 minutes; raise temperature to 154 °F (68 °C); rest 20 minutes; raise temperature to 162 °F (72 °C); rest 20 minutes; raise temperature for mash-out at 172 °F (78 °C).

Boil the wort for 45 minutes, whirlpool for 15 minutes, cool, and ferment at the yeast's mid-range temperature. Bottle or keg as normal.

KEUTEBIER

(5 gallons/19 L, partial mash)
OG = 1.046 FG = 1.014
IBU = 5 SRM = 3.4 ABV = 4.7%

INGREDIENTS

3 lbs. (1.36 kg) Pilsen dried malt extract
1.25 lbs. (0.57 kg) wheat dried malt extract
14 oz. (400 kg) Weyermann Beech-Smoked Barley Malt
6 oz. (170 g) instant oatmeal or malted oats
1 tsp. 88% lactic acid
2.5 AAU Hallertauer Perle hops (0.3 oz./11 g at 8.2% alpha acids) (in the mash)
Any German ale yeast (optimal: altbier-style Wyeast 1007 or White Labs WLP036)
¾ cup corn sugar (if priming)

STEP BY STEP

Place the crushed grains in a muslin bag. Steep the grains in 2 qts. (2 L) of water at 154 °F (68 °C) for 60 minutes. Remove the grains and slowly wash with 2 qts. (2 L) of hot water. Top off kettle to 5.5 gallons (21 L), then stir in all the dried malt extract while off heat. Once fully dissolved, bring wort to a boil and boil for 30 minutes. When the boil is complete, whirlpool for 15 minutes, cool, and ferment at the yeast's mid-range temperature. Bottle or keg as normal.

Sensory Evaluation of Test Brew: The color of this keutebier resembles that of rosé wine. There is a slight cherry and herb candy aroma in the nose. On the palate, the low hop content is only faint, which is fitting for a late-medieval interpretation of this style. This makes the beer taste slightly syrupy, with notes of honey and straw. It is also very low in effervescence. Interestingly, even though this brew was judged the least beer-like of the five recreations covered in this article, it was also deemed surprisingly refreshing, especially if served chilled.

Photo courtesy of Horst Dornbusch

POTSDAMER STANGENBIER

(5 gallons/19 L, all-grain)
OG = 1.050 FG = 1.010
IBU = 15 SRM = 3 ABV = 5.3%

INGREDIENTS

6.5 lbs. (3 kg) Weyermann Barke® Pilsner malt
2.2 lbs. (1 kg) Weyermann Floor-Malted Bohemian Wheat Malt
0.84 lb. (0.38 kg) Weyermann Carafoam® malt
0.84 lb. (0.38 kg) Vienna malt
3.3 AAU Tettnanger hops (60 min.)
(0.65 oz./19 g at 5% alpha acids)
2.3 AAU Tettnanger hops (0 min.)
(0.46 oz./13 g at 5% alpha acids)
A Kölsch-style yeast (such as Wyeast 2565 or SafAle K-97)
¾ cup corn sugar (if priming)

STEP BY STEP

Mash-in at 126 °F (52 °C); rest 15 minutes; raise temperature to 144 °F (62 °C); rest 25 minutes; raise temperature to 162 °F (72 °C); rest 20 minutes; raise temperature for mash-out to 172 °F (78 °C). Lauter as normal. Note that run-off tastes very malty, is very pale, and emanates slightly nutty aromas.

Boil 75 minutes, adding hops as indicated. After the first hop addition, wort smells of fresh popcorn. At the end of the boil add the aroma hops and whirlpool for 15 minutes. Cool to 66 °F (19 °C). After the beer reaches terminal gravity (should be approximately 1.010 after five or six days), reduce temperature by 4 °F (2 °C) per day to as low a level as the equipment allows. Package about four weeks after brew day.

POTSDAMER STANGENBIER

(5 gallons/19 L, extract only)
OG = 1.050 FG = 1.010
IBU = 15 SRM = 4 ABV = 5.3%

INGREDIENTS

4 lbs. (1.8 kg) Pilsen dried malt extract
1 lbs. (0.45kg) wheat dried malt extract
0.5 lb. (0.23 kg) Vienna dried malt extract
3.3 AAU Tettnanger hops (60 min.)
(0.65 oz./19 g at 5% alpha acids)
2.3 AAU Tettnanger hops (0 min.)
(0.46 oz./13 g at 5% alpha acids)
A Kölsch-style yeast (such as Wyeast 2565 or SafAle K-97)
¾ cup corn sugar (if priming)

STEP BY STEP

Start heating 6 gallons (23 L) of water. As the water warms, remove from heat and stir in all the extract. Stir until fully dissolved then return to heat and bring to a boil.

Boil 60 minutes, adding hops as indicated. At the end of the boil add the aroma hops and whirlpool for 15 minutes. Cool to 66 °F (19 °C). After the beer reaches terminal gravity (should be approximately 1.010 after five or six days), reduce temperature by 4 °F (2 °C) per day to as low a level as the equipment allows. Package about four weeks after brew day.

Sensory Evaluation of Test Brew: This is an effervescent, milky-pale, yeast-turbid, and highly quaffable summer session beer with a very restrained maltiness. Upfront, it starts out very crisp with notes of citrus and hay. These notes continue all the way to a fairly dry and refreshing finish.

EXTINCT GERMAN STYLES

Photo courtesy of Horst Dornbusch

WIESS

(5 gallons/19 L, all-grain)
OG = 1.040 FG = 1.010
IBU = 25 SRM = 4 ABV = 3.8%

INGREDIENTS

5.3 lbs. (2.4 kg) Weyermann Bohemian Floor-Malted Pilsner Malt
1.8 lbs. (0.82 kg) pale wheat malt
0.67 lbs. (0.3 kg) Weyermann Carahell® malt
0.33 lbs. (0.15 kg) acidulated malt
3.2 AAU Spalt hops (60 min.)
(0.95 oz./27 g at 3.4% alpha acids)
6.9 AAU Hersbrucker hops (whirlpool)
(3 oz./85 g at 2.3% alpha acids)
A Kölsch-style yeast (such as Wyeast 2565 or SafAle K-97)
¾ cup corn sugar (if priming)

STEP BY STEP

Mash-in at 113 °F (45 °C); rest 5 minutes; raise temperature to 153 °F (66 °C); rest 30 minutes; raise temperature to 162 °F (72 °C); rest 15 minutes; raise temperature to mash-out temperature of 172 °F (78 °C). Boil 75 minutes, adding hops as indicated. At the end of the boil add the aroma hops and whirlpool for 15 minutes. Chill to the mid-range of your yeast's fermentation temperature, aerate, and pitch yeast. Ferment and then bottle or keg as normal.

WIESS

(5 gallons/19 L, extract with grains)
OG = 1.040 FG = 1.010
IBU = 25 SRM = 4 ABV = 3.8%

INGREDIENTS

3.1 lbs. (1.4 kg) Pilsen dried malt extract
1 lbs. (0.45 kg) wheat dried malt extract
0.67 lbs. (0.3 kg) Weyermann Carahell® malt
1 tsp. 88% lactic acid
3.2 AAU Spalt hops (60 min.)
(0.95 oz./27 g at 3.4% alpha acids)
6.9 AAU Hersbrucker hops (0 min.)
(3 oz./85 g at 2.3% alpha acids)
A Kölsch-style yeast (such as Wyeast 2565 or SafAle K-97)
¾ cup corn sugar (if priming)

STEP BY STEP

Start heating 5 gallons (19 L) of water. As the water warms, place the crushed grains in a muslin bag and submerge in the water. When the water hits 170 °F (77 °C) remove the grains and allow to drip back into the pot. Remove from heat and stir in all the malt extract. Stir until fully dissolved then return to heat and bring to a boil.

Boil 60 minutes, adding hops as indicated. At the end of the boil add the aroma hops and whirlpool for 15 minutes. Chill to the mid-range of your yeast's fermentation temperature, aerate, and pitch yeast. Ferment and then bottle or keg as normal.

Sensory Evaluation of Test Brew: This beer appears golden blond and slightly turbid. The head is tall and strong. On the palate, this beer has a faint sweetness and some graininess, balanced by a mild acidity. The noble hop aromas come to the fore especially in the finish. Cognoscenti will recognize this beer right after the first sip as a chewier and heftier forerunner of the modern Kölsch.

EXTINCT GERMAN STYLES

BRAUNSCHWEIGER (BRUNSWICK) MUMME

SEGELSCHIFFMUMME (FIRST RUNNINGS)

OG = 1.128 FG = 1.037
IBU = 80 SRM = 14 ABV = 12.1%

STADTMUMME (SECOND RUNNINGS)

OG = 1.043 (before a 75-minute boil) FG = 1.005
IBU = 40 SRM = 7 ABV = 4.8%

INGREDIENTS

14.44 lbs. (6.55 kg) German Pilsner malt
0.79 lb. (0.36 kg) Weyermann Caramunich® I malt
0.79 lb. (0.36 kg) melanoidin malt
Segelschiffmumme: 16.4 AAU Saaz hops (60 min.)
(4.1 oz./116 g at 4% alpha acids)
Stadtmumme: 9.4 AAU Saaz hops (60 min.)
(2.34 oz./66 g at 4% alpha acids)
Any strong attenuating ale yeast (such as SafAle US-05)
¾ cup corn sugar (if priming)

STEP BY STEP FOR BOTH SEGELSCHIFFMUMME AND STADTMUMME

Set the mill gap for this heavy grain bed to approximately 1.5 mm. Mash-in for both beers at 126 °F (52 °C) at a liquor-to-grist ratio 2.6:1 by weight (1.25 qts./lb.). Rest 10 minutes. Raise temperature to 144 °F (62 °C) and rest 25 minutes. Raise temperature to 154 °F (68 °C) and rest 25 minutes. Raise temperature to 162 °F (72 °C) and rest 20 minutes. Raise temperature to 172 °F (78 °C) for the mash-out. Recirculate until clear, then sparge. Continue lautering until kettle gravity is about 1.088 then discontinue runoff to that kettle. Boil the wort for the segelschiffmumme, to achieve 30% evaporation, or when SG is about 1.128. This portion of the wort develops a reddish, sour-cherry-like sheen. Taste this high-gravity wort: It has a surprisingly pleasant, melanoidin-derived taste of bread crust, malt candy, and toffee. Pour this wort into a coolship for overnight cooling, sedimentation, and aeration.

For the second-runnings stadtmumme, continue lautering and sparging the same mash into a separate kettle, until the OG is about 1.043. Boil this wort for 75 minutes; and finish the brew in the usual fashion through heat-exchanging and fermenting it.

Extract with grains versions: The use of extracts can easily be swapped out for the segelschiffmumme recipe but creating the stadtmumme is hard to achieve with an extract-based recipe. For the segelschiffmumme, simply replace the Pilsner malt with 6.25 lbs. (2.8 kg) Pilsen dried malt extract while maintaining the same pre-boil and post-boil volumes as well as hopping rates. Steep the grains in the water as it heats up to 170 °F (77 °C). Remove grains and stir in the dried malt extract while off heat. When all the extract is dissolved bring wort to a boil, adding hops according to the all-grain recipe. The rest of the all-grain instructions can be followed.

Sensory Evaluation of both schiff- and stadtmumme Test Brews: The schiffmumme is truly a "big" beer. It is chestnut brown, slightly turbid, with a creamy, fine, and long-lasting head of foam. The bouquet is powerful with notes of strawberry, gooseberry, and dried fruit. On the palate, the mouthfeel is velvety with the alcohol providing warming underpinnings for delicate notes of caramel and creamy sweets, both of which linger. The long-lasting, malty finish has mildly estery hints of mint and pear. Overall, this beer is rich and absolutely delicious.

The color of the stadtmumme is much lighter, but in most sensory aspects it resembles its mighty cousin, but in a restrained fashion. The bouquet and the upfront taste are reminiscent of sweet, creamy caramel and apple pie. These notes give way to a brief but distinct sensation of hop bitterness, which fades relatively quickly. This ale is surprisingly substantial and complex on the palate considering that it is a mere second-runnings brew.

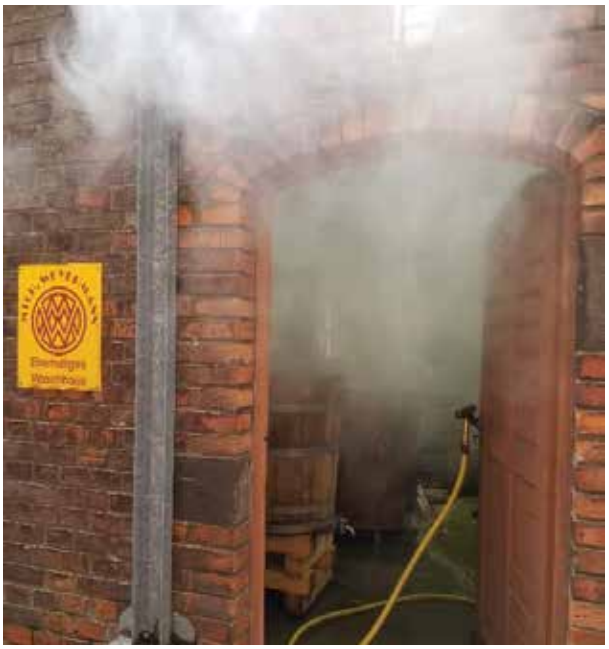


Photo courtesy of Horst Dornbusch

Steam escaping from a reconstructed medieval brew house at Weyermann during the boil of a heavy sailor's brew from the time of the Hanseatic League.

runner of many modern ales in Germany, Holland, Belgium, and France, including altbier, Kölsch, witbier, bière de garde, and bière de saison.

Sources from the 17th century indicate that keutebier was eventually brewed with some wheat malt instead of oatmeal, and with hops. One of the oldest and most detailed recipes is in a publication by Dr. Robert Krumbholz, entitled (in translation) *Crafts of the City of Münster until 1661*, and preserved in the Prussian State Archives. The author tells us that his recipe was intended as a "house drink" and is based on an older document from 1591, which is no longer in existence.

A keute mash was allowed to rest for a full day, which probably activated phytase enzymes and lactic acid bacteria to give the beer a slightly sour taste. It also enhanced its keeping quality. In a modern reconstruction, this aspect would probably call for some acidulated malt in the grain bill. A few hours of kettle-souring might also do the trick. Apparently, the entire mash was brought to a "boil" (decoction) and "filtered" (lautered) through a bed of straw covered with a cloth. The same mash was then mixed with an addition of hops (yes, in the mash!) and with fresh liquor, which modern German brewers call *nachguss* (literally, after-pour). After a second lautering, the resulting wort was boiled and sent to a fermenter, where it might have been fortified with a little sugar and seasoned with cloves (not used in our recipe). One keutebier interpretation is now a Brewers Association competition category. See "Dutch-Style Kuit, Kuyt or Koyt" at https://s3-us-west-2.amazonaws.com/brewersassoc/wp-content/uploads/2018/03/2018_BA_Beer_Style_Guidelines_Final.pdf. (See a homebrew recipe for keutebier on page 73.)

Photo courtesy of Horst Dornbusch

A Potsdamer stangenbier that we test-brewed on the Weyermann Malting Company system.

13. POTSDAMER STANGENBIER

This is an unusual brew, named after its place of origin, Potsdam, which is a suburb of Berlin. The second part of the beer's name, stange, denotes a cylindrical glass, similar to a Kölsch glass, in which this beer was originally served. Some 400 years ago, Potsdamer stange was an unfiltered ale from a mash of mostly barley and a little wheat, but by the turn of the 20th century, it had become a lager. It is gold to amber in color and highly effervescent. Reputedly, Prussian brewers, known for their frugality, poured the thick yeast slurries and beer residues from returned barrels back into their fermentation tanks filled with fresh wort. The amount of beer recovered was probably very small, but this practice ensured a quick and vigorous start of the fermentation. The Potsdamer stangenbier remained popular in old Prussia until the First World War but it has since disappeared almost entirely. (Find a homebrew recipe for Potsdamer stangenbier recipe on page 74.)

14. WIESS

The word *wiess* means "white" in the dialect of the city of Cologne. It is a yeast-turbid, well-hopped, roughly 4% ABV quaffing ale from the late 19th century, made with a substantial portion (up to 20%) of wheat malt. It quickly disappeared from its home turf at the end of the second World War, when it was replaced by the filtered, golden Kölsch, with approximately 5% ABV.

Wiess was often matured for up to three months prior to bottling. This is probably the reason why, at the turn of the 20th century, many academics, such as the Berliner Professor Franz Schönfeld, (see sources) often referred to wiess as a "top-fermented, hop-bitter lager beer," which indicates that while it is fermented with a top-fermenting (ale) yeast strain, it is treated like a lager. (See a homebrew recipe for wiess on page 75.)

Photo courtesy of Horst Dornbusch

The reconstructed medieval brew house at Weyermann with a direct-fired kettle, where the segelschiffmumme was boiled for three hours.

15. BRAUNSCHWEIGER (BRUNSWICK) MUMME

There are two versions of this ale, a super-strong one, called segelschiff-mumme (sailing ship mumme), and a very light one, called stadtmumme (city mumme). The ship mumme was an old seafarers' beer. It was transported from the brew houses of Brunswick to several ports of the Hanseatic League, including Bremen and Hamburg. From there, trading ketches would take the beer to all four corners of the world. According to many sources, mumme was a very syrupy, super-high-gravity, fairly low-alcohol, highly shelf-stable brew with a huge residual sweetness. Ship mumme was in demand not only as a trading commodity, but also as a nutritious, caloric beverage that was consumed by sailors on long sea voyages. According to an *Economic Encyclopedia* published by Johann Georg Krünitz in 1775 (see sources), ship mumme has an "excellent, sweet taste, and a deep brown, beautiful color . . . [and] is the best, because it keeps well on the water . . . without offense or ruin."

The ship mumme's high original gravity was apparently the result of stopping lautering relatively early on and then boiling the wort for an extra-long time. Perhaps surprisingly, this high-gravity sailors' tipple had a fairly low alcohol content of only 2.5–4.5% ABV in spite of an excess supply of fermentable sugars for the yeast to metabolize. Unbeknownst to the brewers of yore, the best explanation for this phenomenon might be a stuck fermentation resulting from the premature depletion of nitrogen sources, such as free amino nitrogen (FAN). In a heavy mumme wort, it is not inconceivable that the yeasts of yesteryear used up all available nitrogen during a turbulent primary fermentation, but then shut down their metabolism, leaving the finished beer with an unusually high viscosity. It seems impossible, however, to fully replicate these aspects of the brew with modern malts and modern yeasts, which just keep on working and producing more alcohol.

The city mumme was much less viscous then the ship mumme. It was consumed by the good burghers of Brunswick. We can only surmise that it was made from the second, weaker runnings of the mumme mash after the separation of the heavier first runnings that were destined for the Hanseatic traders and sailors, as was done with the test brew. (Find a homebrew recipe to create both versions of mumme on page 76.)

Photo courtesy of Horst Dornbusch

After the boil, the segelschiffmumme wort rests overnight in a reconstructed medieval cool ship.

SELECT, ANNOTATED LIST OF RELEVANT HISTORICAL SOURCES

Photo courtesy of Horst Dornbusch

This is the cover of the world's first encyclopedia of beer styles. It was published in 1575 by the German physician Dr. Heinrich Knaust.

The invention in 1439 of movable type for printing by Johannes Gutenberg proved to be a turning point in the dissemination of human knowledge, including knowledge about beer and brewing. Before Gutenberg, just a privileged few had access to hand-written manuscripts; after Gutenberg, even the unwashed masses could become educated and learn how to read. Here is a selection of some of the most useful sources about old German beer styles, with some of my own thoughts on them.

- Publius Cornelius Tacitus, *De origine et situ Germanorum*, available online at https://la.wikisource.org/wiki/De_origine_et_situ_Germanorum_(Germania). See especially chapter XXIII.

- Dr. Heinrich Knaust, *Fünff Bücher, Von der Göttlichen vnd Edlen Gabe / der Philosophischen / hochtheweren vnd wunderbaren Kunst / Bier zu brawen. Auch von Namen der vornempsten Biere / in gantz Teudtschlanden / vund von derer Naturen / Temperamenten, Qualiteten, Art vnd Eigenschafft / Gesundheit vnd vungesundheit / Sie sein Weitzen / oder Gersten / Weisse / oder Rotte Biere / Gewürtzet oder ungewürtzet. Auffs new ybersehen / vnd in viel wege / vber vorige edition / gemehret vnd gebessert. Erfurt, 1575.* This is perhaps the most important early printed record about old German beer styles, as well as the first-ever dictionary of beer styles in any language. Written in the late Renaissance in antiquated medieval German, the author describes some 125 contemporary beer styles, mostly from Germany, replete with the occasional brewing tip. The endlessly long title of this tome translates into: *Five books about the divine and noble gift, the philosophical, highly valued and wonderful art of beer brewing. Also about the names of the loftiest beers in all of Germany and their names, temperaments, qualities, type and characteristics, health and unhealth, be they wheat or barley, white or red beers, spiced or unspiced. Newly reviewed and in many ways over the previous edition enlarged and improved.*

- Anonymous author. *Der zu allerley guten Getränken treuherzig anweisende wohlerfahrene Curiose Keller-Meister aufgeführet in einem gantz neu heraus gegebenen und in folgenden Theilen eingerichtetem und kurz verfasstem von Wein, Bier, Meth, Brandwein und Essig handelndem Kunst Buch.* Nuremberg 1710. The translation of this rambling and seemingly incoherent title reads as follows: *The faithfully teaching and well-experienced curious cellar master presented this newly released and in several parts divided and densely written art book dealing with wine, beer, mead, brandy, and vinegar.* The anonymous author calls himself "a faithful friend and lover of the arts." In part three of the book, he elaborates on *"die nutzlich- und nöthige Bierbräu-Kunst"* (the useful and necessary art of brewing beer).

- Anonymous author (probably Johann Heinrich Kaven). *Der Vollkommene Bierbrauer oder kurzer Unterricht all Arten Bier wie auch verdorbene Biere wieder gut zu machen, auch alle Arten von Kräuter-Bieren.* Leipzig, 1784. The translation of this title is: *The complete beer brewer or a short set of Instructions to brew all kinds of beer, as well as make spoiled beers good again, and all kinds of herb beers.*

- Georg Krünitz, *Oekonomische Encyclopaedie oder allgemeines System der Staats- Stadt- Haus- und Landwirthschaft in alphabetischer Ordnung.* This is a 242-volume, roughly 170,000-page *Economic encyclopedia or general system of state, city, home and agricultural economics in alphabetical order*, published in several cities by several printing houses between 1773 and 1858. This encyclopedia represents a comprehensive description of the technologies and production processes of all trades, including brewing in the fifth volume, right up to the early stages of the Industrial Revolution.

- Johann Christian Gotthard, *Handbuch Der Praktischen Technologie Oder Manufactur- Fabrik- Und Handwerkskunde Für Staatswirthe, Manufakturisten, Fabrikanten Und*

Handwerker, Hamburg and Mainz 1804. Title translation: *Handbook of practical technology or manufacture, factory, und trades knowledge for economists, manufacturers, factory owners, and tradesmen*. Part 1 of the book deals with beer brewing.

- Johann Albert Joseph Seifert, *Das Bamberger Bier, oder praktische, auf chemische Grundsätze gestützte Verfahrensweise, Handgriffe und Gewerbs-Vortheile beim Brauen des Bamberger Bieres*, Bamberg 1818. Translation: *Bamberger beer, or the practical methods, based on chemical principles, of procedures and trade advantages of Bamberger beer.* Although this book focuses on the beers made in Bamberg, it also gives a detailed picture of the brewing methods commonly used in central Europe in the early 19th century.

- Johann Carl Leuchs, *Vollständige Braukunde, oder wissenschaftlich-praktische Darstellung der Bierbrauerei in ihrem ganzen Umfang und nach den neuesten Verbesserungen*, Nuremberg 1840. Translation: *Complete brewing instructions, or the scientific-practical elaboration of a beer brewery in its entirety and according to the most recent improvements*. This book contains detailed instructions for making brews flavored with such botanicals as bitter oranges, lemons, cherries, ginger, blueberries, plums, and coriander.

- Chr. H. Schmidt, *Grundsätze der Bierbrauerei nach den neuesten technisch-chemischen Entdeckungen, oder die Kunst, an allen Orten ein wohlschmeckendes, gesundes und haltbares Bier zu brauen und Brauhäuser mit Keimtennen, Malzdarren und Kellern zweckmäßig anzulegen und einzurichten. Mit besonderer Berücksichtigung der Bayerischen Brauerei, aber auch mit Beschreibung der vorzüglichen Brauverfahren in Oesterreich, am Rhein, in den Niederlanden, Belgien, England, Schottland und mit mehreren Rezepten zu den beliebten Luxusbieren. Sechsundneunzigster Band. Zweite völlig umgearbeitete und sehr vermehrte Auflage*, Weimar 1853. Translation of this long title, which says it all: *Principles of beer brewing based on the latest technical-chemical discoveries, or the art to brew a well-tasting, healthy, and shelf-stable beer anywhere; and to build and install purposefully brew houses with germination floors, malt kilns, and cellars. With particular reference to Bavarian breweries, but also with a description of brewing methods in Austria, along the Rhine, in the Netherlands, Belgium, England, Scotland , and with several recipes of the most beloved luxury beers*.

  This book is the 96th volume, 2nd revised and expanded edition, of a collection of works edited by the "Gesellschaft von Künstlern, Technologen und Professionisten" (Society of artists, technologists, and professionists) entitled: *Neuer Schauplatz der Künste und Handwerke. Mit Berücksichtigung der neuesten Erfindungen*. Translation: *The newest show place for the arts and trades. Under consideration of the newest inventions*).

Around the turn of the 20th century, technical brewing books in Germany started to incorporate the results of the scientific revolution of the era, while still establishing a rearview-mirror link to older beer styles. These books include:

- E. Prior, *Chemie u. Physiologie des Malzes und des Bieres*, Leipzig 1896. Translation: *Chemistry and physiology of malt and beer.*

- J. E. Thausing, *Die Theorie und Praxis der Malzbereitung und Bierfabrikation*, Leipzig 1898. Translation: *Theory and practice of malt preparation and beer fabrication.*

- E. Michel, *Lehrbuch der Bierbrauerei*, Augsburg 1900. Translation: *Textbook of beer brewing.*

- Franz Schönfeld, *Obergärige Biere und ihre Herstellung*, Berlin 1902. Translation: *Top-fermented beers and their production.*

- E. J. Lintner, *Grundriss der Bierbrauerei*, Berlin 1904. Translation: *Basics of beer brewing.*

Other, more recent sources about old beers include:

- Karl Hennies and Robert Spanner, *Die Brauerei im Bild – Der Werdegang des Bieres*, Nuremberg 1940. Translation: *The brewery in pictures — The evolution of beer.*

- Karl Lense, *Katechismus der Brauerei-Praxis*, Munich 1940. Translation: *The catechism of brewery practice.*

- W. D. Speckmann. *Biere, die Geschichte machten*, Ratiszell 2005. Translation: *Beers that made history.*

- Christine von Blankenburg, *Die Hanse und ihr Bier — Brauwesen und Bierhandel im hansischen Verkehrsgebiet*, Cologne, Weimar, Vienna 2001. Translation: *The Hanseatic League and its beers — Brew industry and beer trade in the Hanseatic trading area.* BYO

Photo by Les Jörgensen

WORT CHILLING

Cooling options, designs, and limitations

by Brad Smith

One of the first challenges a new brewer runs into is how to chill their boiling hot wort down to room temperature to pitch the yeast. I recall filling the bathtub with water and a few bags of ice in an effort to get my first batch of extract-produced homebrew cool enough so I could add the tiny packet of dry yeast. Initially it cooled very quickly, but those last 10 °F (5 °C) seemed to take forever.

Within a few months one of my first major equipment upgrades was an immersion chiller I made from some copper tubing I picked up at the hardware store. I wrapped it around a coffee can to make a coil and bought some fittings to attach it to my garden hose, creating a primitive copper immersion chiller. This system lasted some 20+ years before I finally upgraded to a larger brewing system and a plate chiller.

The basic physics behind wort chillers is easy to understand and drives the various designs, so I'm going to cover the physics up front before we go into each design. There are four basic designs used by homebrewers: The ice bath, immersion chillers, counterflow chillers (often called tube-in-tube in the heat transfer world), and plate chillers, aka plate heat exchangers. Most commercial brewing systems use plate heat exchangers for wort cooling.

Before we dive into the science and design of wort chillers, let's discuss some of the advantages of chilling your wort.

Photo by Walter Diaz

There are many different designs for immersion and counterflow chillers. This DIY project featured in the September 2013 issue of BYO *is a less conventional take on a counterflow chiller that allows disassembly at the end of each stretch of piping for easy interior cleaning with a brush.*

WHY CHILL YOUR WORT?

You can make beer without taking measures to actively chill your wort. There is a method called "no chill" where hot wort is transferred into a sanitized sealed container and left to sit overnight. The next morning it is transferred into a fermenter and yeast is pitched. I'm personally not a huge fan of "no chill" brewing for the reasons I'll outline in the next few paragraphs, but it can be done, and you can still make great beer this way.

Setting aside "no chill" for a moment, there are some advantages to chilling your wort as quickly as possible. These include reducing the risk of infection, improving the clarity of your beer, and reducing the risk of off-flavors.

One of the primary reasons to quickly chill your wort is to reduce the risk of infection. As soon as the wort temperature drops below about 140 °F (60 °C), there is a risk that wild yeast or bacteria can infect your wort before you get a chance to pitch your yeast. The longer you spend in this "lukewarm" zone, the greater the risk.

A second reason to chill your wort is that it improves the clarity of your beer. Wort contains proteins and tannins that are a byproduct of both hops and malt. Some of these precipitate out as part of the "hot break" when you first start to boil the wort. However if you chill your wort quick enough you will also get a substantial "cold break" of proteins, tannins, as well as hop material that will precipitate out. This is what brewers call the "trub" or sediment that remains after you chill your wort. Since these proteins and tannins are a major cause of haze, reducing them at this stage will give you clearer beer.

Another reason to chill your beer quickly is to reduce the risk of Dimethyl Sulfide (DMS), which can result in a creamed corn off-flavor in the finished beer, and is a particular risk for lagers. DMS is formed by heating a chemical called S-Methyl Methionine (SMM), which is an amino acid formed during the germination and kilning of the malt. Fortunately, a vigorous boil will substantially reduce the DMS in the finished beer, but SMM continues to be converted to DMS well below boiling, so you don't want to leave hot wort sitting around for hours after the boil. Chilling it quickly eliminates this risk.

THE SCIENCE OF WORT CHILLERS

All wort chillers follow the basic laws of thermodynamics, and these laws govern chiller design.

There are three ways to transfer heat between a hot object and cooler one: Radiation, convection, and conduction. When we look at something like a hot pot of wort, all three of these principles will apply, but conduction is the primary method used in wort chillers.

Radiation is the transfer of heat via electromagnetic waves. All objects radiate energy via infrared waves. For example, your hot pot of wort will radiate some energy to the surrounding area you could easily see if you looked at it through an infrared camera.

Convection occurs when a fluid, such as your wort, is heated or cooled. The heated fluid tends to flow

away from its source, which is why hot air rises. Convection creates currents within fluids and gasses which transfer heat. Convection is going on inside of your hot kettle of wort, which is why you may get hot spots or cool spots within the pot as it boils or chills.

Conduction is the final heat transfer method and involves the direct transfer of heat between objects that are touching. Molecules at higher temperature collide with those at lower temperature increasing their kinetic energy. Metals also conduct electricity extremely well because they have free moving electrons that rapidly transfer energy between atoms. This is the heat or cool you will feel if you put your hand directly on a window or touch a hot surface, and is also the main method used to chill your wort.

While radiation and convection are occurring when you chill your wort, these processes are relatively slow. You could leave a hot kettle of wort open to the air and it will slowly radiate the energy away. Convection will eventually result in a constant temperature in the wort as it cools, and some energy will also directly conduct through the pot and into whatever is holding your pot, but it will take a long time.

THE CONDUCTION EQUATION

Since conduction dominates the overall design of chillers, let's take a look at the basic conduction equation. This equation assumes that you have two materials at different temperatures like our wort and chilling water separated by a boundary material like the chiller itself.

$$\mathbf{Q = k\,A\,\Delta T}$$

Where:

Q = Heat transferred per unit time
k = Thermal conductivity of the boundary material used
A = Area of the boundary
ΔT = Difference in temperature between wort and chill water

Put into words, the rate of heat transfer is simply a product of the thermal conductivity of the boundary material, area of the boundary, and the difference in temperature between the wort and chill water. Any of our modern wort chillers have wort at a hot temperature and use some kind of lower temperature water source such as water from a garden hose or faucet on the other side with a boundary in between, so the equation applies.

When designing a wort chiller, the goal is to maximize the rate of heat transfer **Q**, since we want to chill the wort as quickly as possible. So let's look at each of the terms on the right side of the equation to see how we might design a chiller that maximizes heat transferred.

The first term, **k**, is the thermal conductivity of the material used to separate the wort and chill water. For efficient heat transfer we might want to pick a material that has high thermal conductivity. For example, the thermal conductivity of an insulating material like a Styrofoam cup is very low at around 0.03 W/(m K), while stainless steel has a conductivity **k** of around 20 W/(m K) and copper can be as high as 392 W/(m K) in conductivity.

Not surprisingly, most wort chillers are made from metal as it conducts heat well and is relatively easy to clean using chemical agents. Copper and stainless steel are the two metals most often used in both homemade and commercial chillers.

Because copper is such a great heat conductor it is frequently used by homebrewers, though stainless dominates the commercial market. This is mainly due to the fact that stainless is resistant to corrosion when cleaned using commercial cleaning agents.

The next term in our equation is **A**, which represents the heat transfer surface area between the cold chill water and hot wort. If we can increase the area of the boundary, we can also increase the heat transfer. This is the principle idea behind plate chillers, which use multiple layers of thin metal in a sandwich to maximize the area between hot wort and cold water. Each layer is roughly the height and width of the chiller, so if you have a few dozen layers you can create the equivalent of a very large area for heat exchange Most commercial heat exchangers are built on this principle and larger chillers often just add more plates to an existing design.

The final term, **ΔT**, represents the difference in temperature between the wort and cooling water. The larger this difference is, the faster the heat exchange. So if we could, for example, pump ice cold water into our chiller the entire time it would work much better than lukewarm water from the tap.

If we consider the consequences of **ΔT** on a real world chiller, several other facts come to light. For example, hot wort cools more quickly than cool wort because of the higher **ΔT**. As the wort chills, the **ΔT** between the wort temperature and the chill water becomes smaller, so the heat transfer rate, **Q**, becomes smaller. That's why something like an immersion chiller will drop the temperature very quickly at first, but may become agonizingly slow as you get near room temperature.

If we consider **ΔT** from the perspective of chill water flowing through our chiller, the chill water temperature is also heating up. So chill water entering one end of our chiller may be nice and cold, but it will heat up as it runs through the chiller, thus becoming less effective. This is not a bad thing, as the water has already absorbed a lot of heat from the wort, but in a design like an immersion chiller it will result in hot and cold spots in the wort. This uneven cooling creates significant challenges for immersion chillers as adding length does not always result in faster cooling.

A final consequence of **ΔT** is that we want to maximize the flow of chill water through our chiller, while limiting the flow of wort. Pumping more chill water through is usually a good thing as chill water absorbs heat and carries it away from the wort. However in something like a counterflow or plate chiller we're usually trying to regulate the flow of hot wort so we

can achieve a target temperature on the output of the chiller.

Obviously the design of real-world chillers is a complex subject as real flow rates, temperature changes, manufacturing, material, cleaning, cost, and maintenance considerations come into play. However the first principles represented by the conduction equation above are the driving force in chiller design. The underlying thermodynamics are the main reason why most chillers fall into a few simple design types.

THE ICE BATH/ COLD WATER METHOD

Many of us started our brewing hobby with a simple extract kit. Lacking a chiller, most of us either added cold water directly to the wort if we did a partial boil, bringing the total volume up to the desired volume, or immersed our pot or fermenter in a bathtub full of ice water. Let's take a look at the effectiveness of those two methods.

Adding cold water directly to the wort to chill it can be done with many extract kits that use a partial batch boil. There is a slight risk of infection when adding tap water directly to the wort, but you can pre-boil or use filtered/bottled water to mitigate it. Obviously you need to chill the water you are adding as it won't reach room temperature quickly if you add lukewarm water.

The problem with the direct addition of cold water is that our old friend **ΔT** kicks in. Consider, for example, a volume of wort at 212 °F (100 °C) mixed with an equal volume of chilled water at 39 °F (4 °C), the temperature of the typical refrigerator. Since the volumes and heat capacity of the two additions are the same, it is pretty easy to show that the temperature of the mixture will be the average of the two temperatures, which is:

(212 + 39)/2 = 126 °F
or
(100+4)/2 = 52 °C

So the wort is still well above room temperature, and too hot to pitch the yeast. It will take a long time for that wort to reach a good pitching temperature if no further measures are taken to cool the wort.

Taking your pot or fermenter and immersing it in a bath of ice water is a more effective technique. If we recall that metal is a better heat conductor than glass or plastic, the boil pot may actually be the best choice for this method. Assuming you have enough ice to keep your bath of ice water near freezing, you will get a steady transfer of heat from the wort to the ice bath over time until you reach your target temperature.

The main concern with this method is that you will need to stir both the wort and ice bath to avoid getting hot/cold spots near the boundary. Also you do have a fairly small area, **A**, in contact between the wort and bath when we compare it with something like a plate chiller, so this method can take more time than a dedicated

chiller, and obviously you need a lot of ice. For example, a 12-inch diameter, 12-inch high pot (0.3 x 0.3 meters) has roughly a volume of 5.8 gallons (22 L) but the area, **A**, of the pot bottom and walls is 565 square inches (0.36 square meters), which we can compare against other alternatives.

The advantage of this method is its simplicity. You can use a deep sink or bathtub as your ice water bath, and you need no extra equipment other than a few bags of ice and some patience.

THE IMMERSION CHILLER

The next step up for most brewers is a simple immersion chiller. This is typically made from a long length of copper tubing wrapped into a coil of some kind. If you are going to build your own, I recommend using at least ⅜-inch (9.5 mm) inner diameter tubing as the smaller tubing restricts the flow of chill water too much. You also need appropriate fittings to adapt the chiller to a garden hose or kitchen faucet. Some commercial models are also made from stainless steel tubing for easier cleaning.

To use an immersion chiller, you immerse the coil in your kettle and then flow cold water through the coil. The chill water is coldest where it enters the chiller, so you will create a "cold spot" on either the top or bottom (depending on which direction you drive the water) as well as near the chiller boundary. You can occasionally gently stir the wort to avoid hot and cold spots.

The effectiveness of the immersion chiller depends on the same three terms we discussed earlier, **k**, **A**, and **ΔT**. All things being equal, a copper chiller will transfer heat more quickly than a stainless steel one, and is also considerably more effective than trying to immerse a stainless pot in water. If we look at typical area, **A**, for a chiller, consider a ½-inch (12.7 mm) outer diameter tube that is 25 feet (7.6 m) long. The raw area of the outside of the tube is 473 square inches (0.3 sq. m), which is comparable to the total area of the immersed 5.8-gallon (22-L) pot we considered earlier.

Photo courtesy of MoreBeer!

Immersion wort chillers are usually made from copper tubing and are immersed into the boil kettle as cool water flows through the tubing, cooling the wort it is in contact with.

Considering **ΔT**, most tap water is not quite ice cold, so immersion chillers do tend to slow down considerably as the wort approaches room temperature. However, some immersion designs do include a second stage coil into what is called a "two stage immersion chiller." In this design, a second coil is added up front and immersed in a pot of ice water. The idea is to pre chill the chill water entering the main coil, so you get faster cooling. This can be particularly effective if your tap water is a bit warm or you want better performance when the wort approaches room temperature.

Overall the performance of a typical immersion chiller can be quite good, particularly for small batches at or below the 5-gallon (19-L) range. Larger batches may need a bit more chilling power. In addition, immersion chillers are relatively simple to clean and maintain, and are also very affordable. Finally, since the chiller works in the kettle before you

transfer your wort to the fermenter, you are able to leave most of the trub behind in the pot. This can be a substantial advantage since a lot of proteins, tannins, and hop material precipitate out of the wort as you chill it and most brewers want to separate this trub material from the wort before fermenting.

COUNTERFLOW CHILLERS

A counterflow chiller is similar in basic design to an immersion chiller. Typically they are large coil designs, often using thermally conductive copper tubing as the inner layer. The difference is that a counterflow chiller has a second outer tube built over the inner one. Wort is typically pumped or siphoned through the inner tube while chill water is pumped in the opposite direction through the outer tubing. The name "counterflow" comes from the fact that the wort and water are pumped in opposite directions through the two tubes.

The reason for the counterflow design is to have the coldest chill water contacting the coolest wort first. At the other end of the tube you have the hottest wort contacting the warmest chill water. As a result you get a reasonably "average" **ΔT** over the entire device, giving good performance on both ends of the device. If you restrict the flow of wort and have cold enough chill water you can chill the wort to room temperature in a single pass through the chiller. Further you can regulate the temperature of the wort by adjusting the flow of wort through the chiller.

The thermal performance of this chiller is going to be just a bit better than an immersion chiller in terms of overall cooling time, as the materials' area are similar but the counterflow design increases **ΔT** performance slightly. Most brewers do enjoy being able to chill their wort in a single pass, however, and you can increase the size of the chiller to improve chill times.

One disadvantage of the traditional coil-shaped counterflow chiller is that it is more difficult to clean. Since the cooling is taking place in the chiller, bits of trub, proteins, and tannins precipitate out in the device. Typically you need to backflush the chiller immediately and run cleaning fluid through it to avoid clogging. In addition, a lot of the trub that precipitates out ends up in the fermenter. So unless you have something like a conical fermenter that lets you separate the trub during fermentation, you are going to end up with more hop and grain material in your fermenter than you would with an immersion chiller.

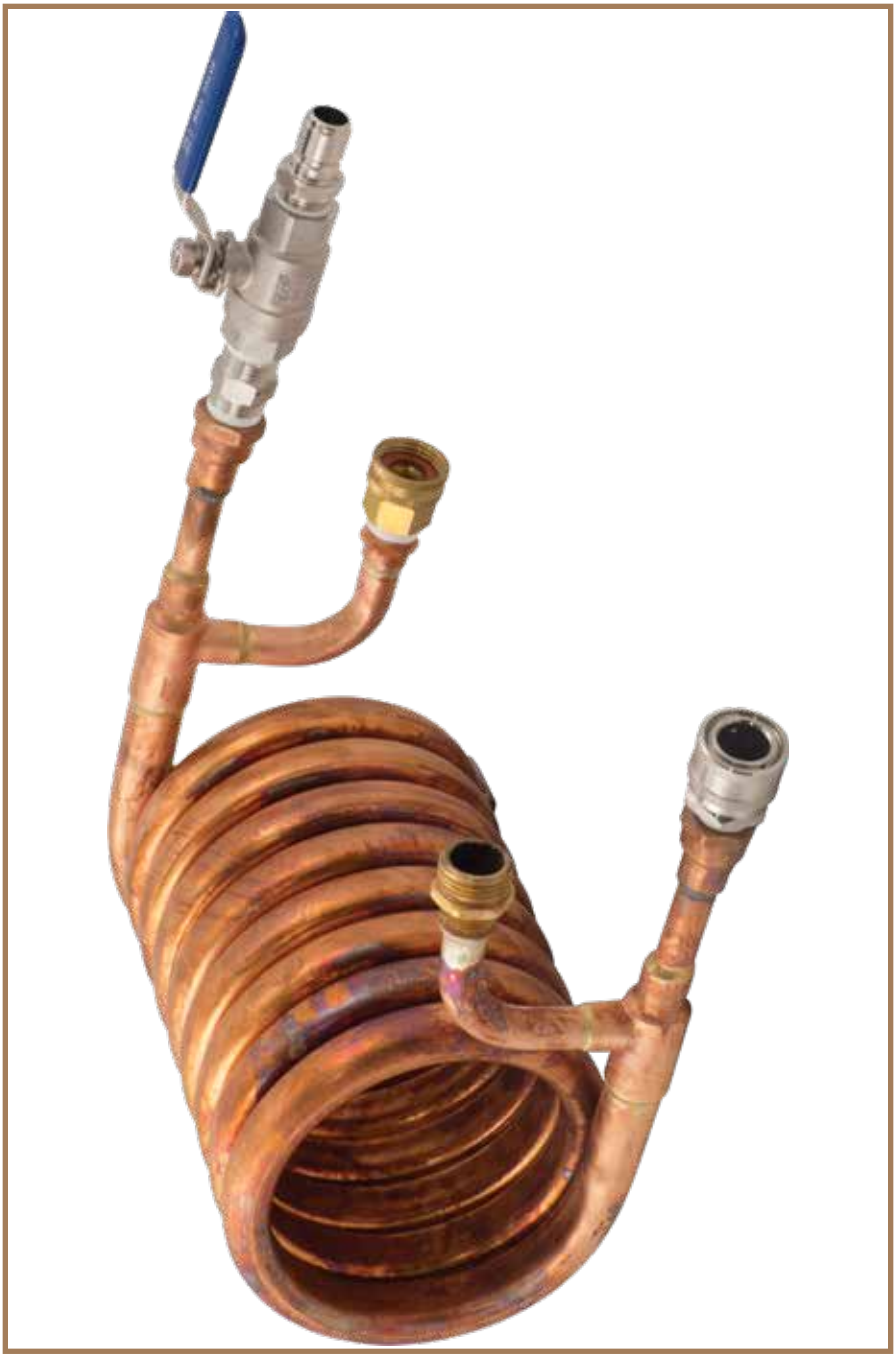


Photo courtesy of MoreBeer!

The basic design of counterflow chillers involves a tube inside another tube, where wort flows one direction in the inner tube and cool water flows in the opposite direction in the outer tube.

PLATE CHILLERS/ HEAT EXCHANGERS

For commercial and larger homebrew batches, a plate chiller is usually the design of choice. A plate chiller is designed as a sandwich of thin stainless plates, often several dozen of them. Wort travels one direction through the plate, while chill water travels the opposite direction, filling alternate layers with wort or water. Since chill water and wort travel in opposite directions, the **ΔT** advantage we de-

Photo courtesy of MoreBeer!

Plate chillers allow for the fastest cooling, as wort travels one direction through the plate, while chill water travels the opposite direction, filling alternate layers with wort or water.

scribed for a counterflow chiller applies, and the wort is chilled in a single pass by limiting the flow of wort or limiting the flow of chill water.

The advantage of a plate chiller is primarily in the large area, **A**, used. Consider a homebrew design like the Blichmann Therminator, which has 40 plates each with a dimension of roughly 7 x 3 inches (17.8 x 7.6 cm). The area covered by the 40 layers is approximately 840 square inches (0.54 sq. m), which is almost twice what many of the other designs provide. In addition, this design offers a good chill water flow rate, so you can chill 10 gallons (38 L) of wort in a single pass in less than 15 minutes.

Commercial chillers and heat exchangers use a similar, albeit scaled up, design, that allows increased wort and chill water flow with even more plates.

While plate chillers have excellent performance and are scalable to larger batch sizes, they do have some disadvantages. Like a counterflow chiller, they do dump trub precipitates directly into the fermenter, so they are best used with a conical fermenter if you want to keep your trub and wort separate. Also, the trub can get stuck in the thin plates of the chiller, potentially even plugging it up. I strongly recommend trying to prevent trub from going into the chiller and back flushing your plate chiller immediately after use followed by a thorough cleaning. They are also more expensive than many other homebrew chiller designs.

CONCLUSION

Chilling your wort quickly has some significant advantages including improved clarity, lower risk of infection, and reduced risk of off-flavors. Quickly chilling your wort and pitching your yeast can also shorten your brew day. Which method you use to chill your wort is very much a personal choice. Only you can balance the time, cost, and effort involved. Even simple methods like an ice bath can be very effective if you have enough ice on hand, though an immersion or counterflow chiller can be easier to work with depending on your setup. For large-batch brewers, a large counterflow chiller or plate chiller will usually work best in terms of time and setup, and virtually all commercial-size breweries use variations of the plate design. BYO

RELATED LINKS:

- Looking for more science behind what goes into chilling wort? Byo.com digital members can get Mr. Wizard's take on the subject here: https://byo.com/mr-wizard/what-are-the-keys-to-an-efficient-wort-chiller/

- Want to build your own counterflow chiller for about $40? Here is how to do it: https://byo.com/project/build-a-counterflow-wort-chiller/

- Immersion chiller cooling times can be sped up with a rib cage design that chills a 5-gallon (19-L) batch in 10-15 minutes. Digital members can find plans to build one at: https://byo.com/project/rib-cage-wort-chiller/

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…And more sponsors to come! List current as of September 18, 2019

WEDNESDAY, MARCH 25, 2020

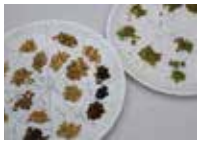
INSIDER TOUR OF DENVER-AREA CRAFT BREWERIES - You'll tour – and taste – at four different craft breweries in the Denver area during this pre-event optional offering. You'll have the opportunity to meet brewers and ask questions in addition to sampling their beers. Includes a beer-pairing meal. A great way to kick off your BYO Boot Camp experience and check out some of Denver's thriving craft beer scene.

THURSDAY, MARCH 26, 2020 DENVER BOOT CAMPS

Each Boot Camp will run from 9:30 a.m. to 5 p.m. and is limited to just 35 people. Your Boot Camp will include lunch as well as a post-Boot Camp Colorado Beer Reception with local craft breweries pouring samples to wrap up your full day.

TROUBLESHOOTING HOMEBREW FAULTS & FIXES – ***with Ashton Lewis*** – Join *Brew Your Own*'s Mr. Wizard and Technical Editor Ashton Lewis as he walks you through the potential minefield of beer flaws and faults homebrewers can face. You'll learn how to troubleshoot – and fix! – your own homebrews with Ashton who has helped thousands of homebrewers over the last 20+ years troubleshoot common and not-so-common beer problems as *BYO*'s Mr. Wizard. You'll have a chance to experience many faults first-hand to better recognize them later. Plus as a special bonus, bring in your own troubled homebrews and Ashton will use your beer as a live example walking the class through the thought process as he figures out what might have gone wrong with your homebrew and what you can do to fix the problem moving forward.

ALL-GRAIN BREWING ESSENTIALS – ***with John Palmer and John Blichmann*** – Designed for intermediate to beginner homebrewers getting into all-grain brewing, this full-day workshop will cover all you need to know to successfully make great homebrews using all-grain brewing both with traditional and newer techniques. *How To Brew* author John Palmer and equipment guru John Blichmann will take you hands-on through the full all-grain process from milling, mashing, and sparging before going into the boil. You'll get to know the equipment, techniques, and ingredients first-hand and learn all-grain brewing by doing in a small-class environment. They'll also cover newer homebrew all-grain techniques such as Brew-in-a-Bag and No Sparge in addition to traditional mash methods and some advanced tips as well.



RECIPE FORMULATION ESSENTIALS – ***with Brad Smith*** – Learn the best ways to jump into creating your own signature recipes and understand the keys to developing a specific grain bill, hop schedule, and ingredient proportions to meet your homebrewing goals. Brad Smith, owner of Beersmith software and a *Brew Your Own* Contributing Writer, has helped thousands of homebrewers design their own beer recipes and now you'll learn first-hand from this recipe building expert how to use both artistic and scientific approaches to beer design to end up with the beer you had envisioned in your glass. You'll explore ingredients, techniques, and even your own brewing system during this practical boot camp that will get you on the right path to craft your own recipes for better beers at home. Please note Brad will also be offering an advanced recipe design workshop on Saturday as well.

CIDERMAKING – ***with Jason Phelps*** – Join professional Cidermaker Jason Phelps to learn all the steps you need to know to successfully craft your own hard cider, both still and carbonated, at home. Jason has taught many hobbyists about making hard cider in addition to making it himself at his New Hampshire Cidery every day. He'll have you roll up your sleeves and take you through the process of crushing, pressing, fermenting, all the way to bottling. You'll learn how to choose apples and get to know cidermaking equipment and the tests you need to run on your cider.

ADVANCED ALL-GRAIN TECHNIQUES – ***with Gordon Strong*** – Pull out the mash tun and get ready to learn advanced all-grain techniques hands-on with *Brew Your Own* "Style Profile" Columnist, book author, and President of the Beer Judge Certification Program, Gordon Strong. Gordon will walk you through a world beyond straight infusion mashing with keys to mastering step mashing, sour mashing, and decoction mashing. Plus you'll learn about playing with mash thickness and other ways to control your all-grain wort production. Please note this workshop will also be offered on Saturday as well.

ADVANCED YEAST TECHNIQUES – ***with Dr. Chris White*** – Join Dr. Chris White of White Labs as he discusses how to master different yeast-related techniques including harvesting yeast, figuring cell counts, the dos and don'ts of repitching including steps such as yeast washing, building up a proper yeast starter, storing your yeast samples, and much more. Here's your chance in a full-day seminar format to learn about getting the most from your yeast from one of the true leaders in the beer yeast field.

ADVANCED HOMEBREW HOPPING TECHNIQUES – ***with Dave Green*** – Join *Brew Your Own*'s Dave Green as he explores when and how to add hops to create awesome hop-forward brews. You'll explore the basics of hop biology (and why it matters to us!); techniques and timing of hop usage including mash hopping, boil hopping, whirlpool/knockout hop stand additions, and dry hopping; hop varietal choice strategies including hop pairing/blending; evaluating hops including hands-on hop rubbing and sensory training; and practical usage techniques including hop extracts, boil-hops "management" (bags, filters, free addition), and water adjustments for hoppy beers. By the end of the full day Dave will make sure you are making informed hops decisions and getting the most out of your hops – and into your glass!

FRIDAY, MARCH 27, 2020
BONUS BOOT CAMP SEMINARS
9:15 A.M. TO 5 P.M.

We are adding a third bonus day to our normal event schedule based on feedback we've received from past attendees who wished they had a chance to learn from all our assembled speakers beyond their Boot Camp workshops. So for 2020, we've scheduled a full day of seven different seminars led by our cast of brewing all stars who will share their knowledge with you on their area of expertise. It will be a full day packed with great tips and techniques from the best in the industry so get ready to learn. Plus you'll have even more time to check out the latest homebrew gear and ingredients with our Boot Camp sponsors located right in the meeting area.

9:15 A.M. – 10 A.M.
Brad Smith on Recipe Design

10:15 A.M. - 11 A.M.
Dr. Chris White on Yeast Propagation for Homebrewers

11:15 A.M. – NOON
Ashton Lewis on Avoiding Brewing's 5 Biggest Mistakes

NOON TO 1 P.M.
Lunch

1:15 P.M. – 2 P.M.
Gordon Strong on Evaluating Homebrew Like a Beer Judge

2:15 P.M. – 3 P.M.
John Blichmann on Layout Designs for Homebreweries

3:15 P.M. – 4 P.M.
John Palmer on Brewing Water Demystified

4:15 P.M. – 5 P.M.
Kara Taylor on Yeast and Fermentation Myths Busted

TURNING PRO & COMMERCIAL BREWERY START-UP: THREE-DAY BOOT CAMP

– with Steve Parkes – By popular demand, we're expanding our past two-day Brewery Start-Up Boot Camp to three full days to better cover more material in more depth for you. When you register for this class you will attend it for Thursday, Friday, and Saturday unlike our other offerings.

Opening up a commercial brewery is a far cry from just ramping up the amount of beer you brew. Steve Parkes, who has trained hundreds of pro brewers as lead instructor and owner of the American Brewers Guild, will walk you through the steps, planning decisions, and keys you need to know if you want to open a successful commercial craft brewery. Learn from his decades of expertise and wide range of experience to help you better achieve your goals of turning pro. Over three full days Steve will guide you in depth through all the various elements you'll have to know for the next big step toward starting a craft brewery.

SATURDAY, MARCH 28, 2020 DENVER BOOT CAMPS

Each Boot Camp will run from 9:30 a.m. to 5 p.m. and is limited to just 35 people. Your Boot Camp will include lunch as well as a post-Boot Camp Colorado Beer Reception with local craft breweries pouring samples to wrap up your full day.

ADVANCED RECIPE FORMULATION – ***with Brad Smith*** – Take your recipe creations to the next level by dialing in the specific grain bill, hop schedule, ingredient proportions, and water treatments to meet your brewing goals. Brad Smith, owner of Beersmith software and a *Brew Your Own* Contributing Writer, has helped thousands of homebrewers design their own beer recipes and now he's ready to get in-depth on the details of beer design so you end up with the beer you had envisioned in your glass. You'll explore ingredients, techniques, and understanding your own brewing system during this boot camp designed for advanced homebrewers that will help you craft your own recipes for better beers. This workshop can be taken in combination with Brad's Recipe Formulation Essentials class on Thursday that offers more of an introduction to intermediate and beginning brewers to the concepts of writing your own recipes.

ADVANCED YEAST LAB – ***with Kara Taylor*** – Join White Labs' Laboratory Operations Manager Kara Taylor for some hands-on yeast lab work to develop skills you can bring back home to help you make better beer. Learn how to accurately count yeast using a microscope, culturing yeast, using slants, harvesting yeast, washing and reusing yeast, propagation and determining growth rates, and more. Here's your chance to learn hands-on what you may have read in books and magazines, or listened to in seminars, and Kara's the perfect teacher to lead you through the world of yeast using lab equipment you can source for your home use.

HANDS-ON HOMEBREW SCIENCE – ***with Ashton Lewis*** – Get hands-on with pH meters, slants and loops, stir plates, centrifuges, and other brewing science gear with *BYO* Technical Editor and Mr. Wizard Columnist Ashton Lewis. Ashton will walk you through how to best use scientific gear at home to help you improve the quality of your beer. You will have the chance to understand not only how to use and care for the equipment properly, but also how to take the results and put that data into action to produce better beer in your glass. This workshop will focus only on those pieces of equipment suitable – and affordable – for your homebrewery.

BREWING WATER ADJUSTMENTS – ***with John Palmer*** – Water is the least understood ingredient when making great beer. John Palmer, who literally wrote the definitive book on the subject, *Water: A Comprehensive Guide for Brewers*, will help take the mystery out of water's role in brewing and how to make better beer as a result. You'll learn how to read water reports, understand flavor contributions, and how to adjust your brewing water to make different styles of beer. You'll leave with not only an understanding of the chemistry concepts of brewing water, but also the practical how-to aspects of getting the most from from this critical brewing ingredient.

MEADMAKING – ***with Jason Phelps*** – Interest in mead is on the rise throughout North America. Now you can learn all the steps you need to successfully craft your own homemade meads. Join professional Meadmaker Jason Phelps as he takes you through the keys to making a great mead at home including key techniques, yeast selection, fermentation strategies, and more. Learn how to select and work with different honey varieties as well as best practices for adding ingredients such as fruits and spices to your mead.

ADVANCED ALL-GRAIN TECHNIQUES – ***with Gordon Strong*** – Pull out the mash tun and get ready to learn advanced all-grain techniques hands-on with *Brew Your Own* "Style Profile" Columnist, book author, and President of the Beer Judge Certification Program, Gordon Strong. Gordon will walk you through a world beyond straight infusion mashing with keys to mastering step mashing, sour mashing, and decoction mashing. Plus you'll learn about playing with mash thickness and other ways to control your all-grain wort production. Note: This Saturday workshop is a repeat of the Thursday class and is offered twice due to its popularity.

HOME CHEESEMAKING – ***with Pamela Zorn*** – You make your own beer so now it's time to learn how to make your own cheese to pair with it! Pamela Zorn has been teaching people how to make their own cheese for years from her Colorado cheesemaking retail shop. You'll learn hands-on how to craft soft cheeses as well as be introduced to the world of making your own hard cheese plus understand the keys to making great cheese from a variety of different kinds of milk. Get ready to roll up your sleeves with this full-day introduction to the fun world of home cheesemaking – a perfect fit with your homebrewing!

SUNDAY, MARCH 29, 2020

INSIDER TOUR OF DENVER-AREA CRAFT BREWERIES

You'll tour – and taste – at four different craft breweries in the Denver area during this post-event extra offering. You'll have the opportunity to meet brewers and ask questions in addition to sampling their beers. Includes a beer-pairing meal. A great way to wrap up your BYO Boot Camp experience and check out some of Denver's thriving craft beer scene.

Three-Day and Two-Day Registration Options Available.
Full Event Details Available at: BYOBootCamp.com

BY DREW BEECHUM & DENNY CONN

TWEAKING OUT

The many ways to adjust a recipe

Okay, let's hop in the Wayback Machine …

<epic movie trailer voice>In a world … where you make your own beer … you're urged to design your own beer recipes. But Be Careful! Before you take that deep dive into the recipe abyss — ask yourself if you have the tools to focus and understand if you've made a beer worth drinking. </epic movie trailer voice>

Say you've internalized all the ways you can design a recipe. You've decided which approach is right for you. Most critically, you've brewed a beer from the recipe you've designed. Maybe you're really lucky and you're one of the minority who gets it right the first time, congratulations! Sit back with a pint and plan on brewing that recipe over and over for the rest of your homebrewing life.

But what if it isn't quite what you wanted? It's in the ballpark or at least the same zip code, but maybe you're thinking that you should have used a different hop, or more hops, or at a different time … or that maybe you should have added (or left out) a particular grain, or changed the amount. Or maybe treated your water differently … or, or, or.

There are a lot of places to tweak a recipe. How do you decide where to start, and how do you decide if you really improved the beer? We mean, sometimes a tweak is just a tweak.

The first rule of recipe tweaking: Tweak only one thing at a time.

Photo by Charles A. Parker/Images Plus

TWEAKING A RECIPE

This process implies that you've gotten somewhat close to your vision, but it just needs a little "something" that would make it better. If you feel like you're not even close, or that several elements need to be changed, you're looking at major redesign territory — a back-to-the-drawing-board process.

The first rule of recipe tweaking: Tweak only one thing at a time. If you do more than one, you don't really have any idea which element was effective, or if one tweak was counterproductive to another tweak. Remember, we're talking about a recipe that is nearly there, but needs a little "something" to make it the beer you want.

The next rule: Understand your ingredients. Knowing the flavor impact a malt, hop, or yeast may have is key to knowing what ingredient tweak you need. Sure, sometimes you're taking an established recipe and swapping out one ingredient for another in order to learn what that ingredient tastes like in a context that you're familiar with. And there's absolutely nothing wrong with that. But you also need to know that substituting 5 pounds (2.3 kg) of base malt for 5 pounds (2.3 kg) of crystal isn't a good idea!

The final rule: Understand the interaction between tweaks. If your original gravity (OG) is low and you add more malt, the beer will have more body and maltiness. You may then need to make other tweaks to balance that.

So let's take a look at some beer recipe characteristics and how you might manipulate them.

Tweaking Original Gravity (OG)

If you want to adjust the original gravity of your beers, there are two ways to do it. Change the amount of stuff you cram into your wort (mostly fermentables but also dextrins, proteins, minerals and little gladiators named Wortus Maximus – OK, we have no evidence of that last one) or change the amount of water. Those are pretty much your only options as a brewer.

Keep in mind that if you're consis-

tently off your intended OG, the problem might be because you haven't matched the efficiency of the recipe to the efficiency of your brewing system. That needs to be sorted out before you do any of these tweaks or you'll end up chasing your tail. (First thing to check is your malt crush — it's very often the culprit!)

In terms of water, you need to key on your final volume after boiling. If your batch size into the fermenter is consistently low (which can make your OG too high), then you either need to start with more water or boil less vigorously. Algebraically and last momently, you can calculate the amount of boiled water needed to hit your target gravity. (Multiply your final kettle gravity points by the kettle volume. Divide that by your target gravity points and you'll discover the total volume you need. From there it's just a matter of subtraction. Win one for math teachers!). If your final volume is too large, flip the script — start with less water or boil less vigorously.

When you increase or decrease the amount of fermentables you use, you need to account for the tweak's impact on the balance of the beer. Start by carefully assessing the malt/hop balance of the beer. If you perceive the beer as thin and overly bitter, adding more malt could be the simple change you need to do. If the balance is right but your OG is low after adjusting recipe efficiency, you may need to add more hops along with the malt to maintain the balance.

Tweaking Final Gravity (FG)

Opposite problem time — now your beer has finished with a higher or lower gravity than intended. Did you choose ingredients that have more or fewer fermentable sugars than you thought during the recipe design phase.

Every grain has a certain potential amount of starch and sugars it can contribute to a beer. Many factors can change this – it's part of the glory of working with agricultural products. Sometimes the crop has a lower potential (or lower enzyme content), sometimes the malting process goes wibbly and you'll get less yield. Basically for a variety of reasons there's less sugar available than predicted. If you think this might be your problem, get a lot analysis sheet for the bag of malt you're using. Bear in mind, this probably isn't the problem as very dedicated and talented farmers and maltsters do their best to bring you what you expect.

For example, you can use sugar to achieve the OG you want, but because sugar is more fermentable than malts, the FG will usually be lower than it would with an all-malt beer. Crystal malts, on the other hand, maintain more sweetness after fermentation.

This can work to your advantage. One of the keys to making a great Belgian beer is making it, to use the Belgian term; "digestible." That means a light body so the beer doesn't fill you up when you drink it.

One trick to making a high-alcohol Belgian style isn't necessarily a high OG. It's the low FG that gets you there. (By the by – this is topsy turvy from many brewers' thoughts – "need more booze? Need more fuel!" aka more sugar for a higher starting gravity.) So instead think more efficiency – consume more of the sugar to get more of the alcohol. If your beer, Belgian or otherwise, continually finishes at a higher FG than you find desirable, replace some of the malt with sugar. Remember though, that in the symbiotic world of beer ingredients, reducing the FG like that can also have an effect on the body and hop perception of the beer.

Extract beers are notorious for finishing at a higher FG than may be optimal for the style. Denny has found that substituting a bit of sugar (maybe 0.25–0.5 lb./113–227 g) for some of the extract can get your FG to where you want it to be. When subbing in sugar, a good rule of thumb is that one pound (0.45 kg) of sugar in a 5-gallon (19-L) batch adds about 9 gravity points. By the way, that holds true of dried malt extract also . . . one pound (0.45 kg) will add about 9 points to a 5-gallon (19-L) batch. One pound (0.45 kg) of liquid extract will add about 7 points in a 5-gallon (19-L) batch.

Mash temperature can also have an effect on final gravity, although not as much as in the past. You can choose a higher mash temperature, which favors alpha amylase in order to leave more non-fermentables and raise the FG, or use a lower mash temperature to favor beta amylase and reduce the FG.

But remember that modern malt varieties and malting procedures have given us very well-modified grain with a lot of diastatic power. They seem to convert from starch to sugar with a stern look from the brewer. That translates to malts that meet the needs of large commercial brewers – a sure conversion of starch to sugar with no drama, unless you don't want a malt that's all go and no slow — but also limits the amount of effect that mash temperature will have. Of course, this depends on the particular malt and maltster, but it's something to be aware of.

Tweaking Bitterness

The best way to adjust bitterness is to use more or fewer hops. But there are a few other ways to go about it. For one thing, you can use hops that have similar properties but higher or lower alpha acid content. As an example, if you were using Magnum with an alpha acid content in the 12–14% range and decide that you can't add a small enough amount to get the bittering level you wanted, a hop like Tettnanger, which is a fairly neutral hop with much lower alpha acids, could be subbed in.

Conversely, if you decided that you needed more bitterness and don't want to increase the hop load that even a more efficient hop gives, one method other than simply increasing the amount of hops would be to add hop extract. If you use isomerized hop extract, you have the advantage of being able to use it in a glass of finished beer to be able to gauge how much to add to the entire batch.

Gypsum has the reputation of "increasing hoppiness." In reality, the effect is much more like giving the beer a dry finish, which increases the perception of bitterness. On the flip side, calcium chloride can be added to tone down the perception of an overly bittered beer. Remember, neither of these tweaks affects the actual IBU level of the beer, just your perception of it.

You can also approach it from the other direction, tweaking your malt bill to balance out the bitterness. An example would be subbing in some Munich malt for part of your pale malt, or using a different brand of pale malt.

TWEAKING BODY

The tried and true, oft attempted approach in homebrewing to increasing or reducing the body of a beer has been through mash temperature. As we mentioned earlier, using a higher temperature mash can increase your final gravity and the body perceived, but due to increases in the enzymatic power of malt, this doesn't work as well as it used to.

Our favorite way to adjust the body of a beer is through recipe design. Although it's trendy to diss crystal malts these days, they can make a significant difference in the body of your beer. (Compare Sierra Nevada Pale Ale to more modern pale ales – usually modern pale ales lack the crystal character of Sierra Nevada — often to their detriment.) If you want to increase body with little impact on flavor, then low-colored crystal malts, like Carapils®, Carastan, Carahell®, and Carafoam® are good choices.

Denny is partial to both the body-building and flavor impacts of using a bit of crystal 60L in an American pale ale and American IPA. Honey malt is a good choice to both increase body and add a bit of sweetness.

Drew, who's less of a crystal fan, reminds you — be judicious in your use unless you like really sticky, sweet beer. (Denny: Only if you misuse it!) And personally, he prefers using bready malts like Munich or everyone's favorite adjunct in New England, oats. (Drew: I was making weird oat pale ales years ago — if only I knew then where the market would go!)

As we mentioned body and FG have a symbiotic relationship. In general, increasing FG will lead to more body in the beer and reducing FG often leads to less body. But remember how we mentioned sugar — a high gravity contributor, but generally an undercutter of body!

TESTING YOUR TWEAK

If a tweak impacts more than one beer parameter at a time, you will be tempted to adjust more than one parameter at a time. After all, change is good — so more change is better!

If we're reducing the body by reducing the FG, we can guess that the hop perception will be stronger. Well, shouldn't we reduce the hops? No! Don't be tempted to do that. Make your single tweak (reducing the final gravity) and assess the beer, then decide where to go from there. There's really no other way to know what that second tweak needs to be.

How do you know if it worked? Well, sometimes it's just so obvious that you know what it did. For example, turning an American pale ale into an American brown ale by adding some sort of dark malt. It's going to be pretty apparent if it's darker or not!

Other times, though, it's not so apparent. Subbing one hop or malt variety for another, changing mash time or temperature, or making any kind of subtle change requires comparison between the before and after beers. And since confirmation bias is so unavoidable, the only way to know for sure if your tweak worked is to do a triangle test.

But that's a story for another column! BYO

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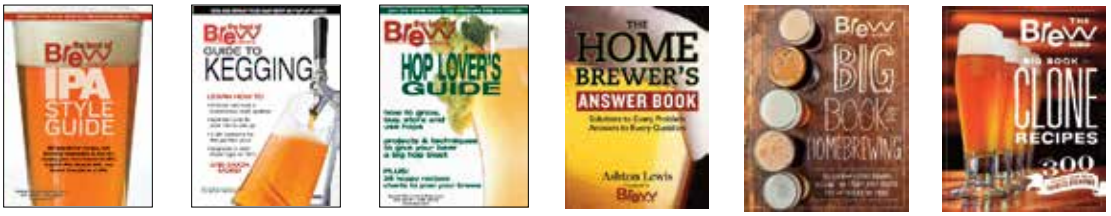

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BY COLIN KAMINSKI

DOSE CARBING

CO_2 generation from sugar sources

In last issue's column we went over the factors to consider when force carbonating beer. This month I would like to expand that knowledge by adding sugar as a tool to use for carbonation. While reading this upcoming column it may seem more difficult, but many brewers find the flavor changes natural carbonation creates make the effort to learn these processes worthwhile. Mastering your math will help you master your CO_2.

We have many sources of sugar we can use. We can buy glucose (dextrose or corn sugar), maltose, sucrose, and dried malt extract, to name just a few sources of sugar. We can save some wort from our brew day and freeze it till needed, brew a wort specifically to add for priming, we can simply repurpose a little wort on a brew day, we can take a beer that is still in active fermentation and add it to the beer we want to carbonate, or we can cap the beer at just the right time to hit our desired CO_2. No matter which method you choose, all of these methods use yeast to convert sugars to CO_2.

Many readers will see an equation and skip reading it to get to the conclusion. As a reader I have been guilty of this. As an author I struggle as to whether to include an equation or not. In "Advanced Brewing" the equations are important. In calculating how much sugar to add we need to understand how chemistry equations and the concept of molar mass work. If you're already well-versed in chemistry, feel free to skip to the end of this next section.

. . . many brewers find the flavor changes natural carbonation creates make the effort to learn these processes worthwhile.

Photo courtesy of Label Peelers

Corn sugar, more technically known as glucose monohydrate, is a common priming sugar for brewing because it is one of the easiest sugars for brewer's yeast to ferment.

PERIODIC PRIMER

The periodic chart of elements hung in every science class I ever took, but it wasn't until I needed chemistry that I bothered to learn how it worked. To work through this missive we only will need to understand two key concepts of the chemistry world: Atomic mass and molar mass.

The atomic mass is the number of protons and neutrons in an atom. If all isotopes of elements had the same number of neutrons this number would always be a whole number. Here we are going to use the actual atomic mass of the natural blend isotopes found on planet Earth. As an example, most carbon (C) has 6 protons and 6 neutrons (written as ^{12}C because 6 + 6 = 12) and we can use the atomic weight of 12. However, ^{13}C (6 protons and 7 neutrons) is also stable and is present, as well as other isotopes that decay over time (carbon dating sound familiar?), the actual value of the atomic weight of C to be precise is 12.011 and accounts for the extra isotopes found in any given Earth-bound samples.

The molar mass is defined as the weight of 1 mole of molecules of the molecule in question. The number that defines what a mole is is fairly abstract and a very large number. But a mole is defined as the number of ^{12}C molecules in 12.011 grams. This turns out to be 6.022×10^{23}, also known as Avogadro's number. When we see the molecule H_2O it means that it takes a ratio of 2 moles of hydrogen to bind with 1 mole of oxygen to make water. Or, restated, 2.016 grams of hydrogen and 15.999 grams of oxygen combine to make 18.015 grams of water.

In terms of brewing and creating carbonation we are talking about CO_2 and sugars. So let's look at a few relevant "molar mass" examples. Molar mass is the weight, in grams, of a specific atom or molecule to get one mole. Let's start with CO_2 and glucose, we will expand this to other sugars later.

CO_2 is one carbon and two oxygens, looking at a periodic chart we find that carbon's atomic mass is 12.011 and oxygen is 15.999. So the molar mass

of CO_2 is (12.011 + 2 x 15.999 = 44.009). Glucose is $C_6H_{12}O_6$. (12.011 x 6 + 1.008 x 12 + 15.999 x 6 = 180.156). We don't get to see glucose as pure glucose because it rapidly picks up water from the air and clumps. So when we purchase a bag of corn sugar, what we are actually getting is called glucose monohydrate or more precisely $C_6H_{12}O_6 \bullet H_2O$.

We are also going to need these:
Molar mass of sucrose $C_{12}H_{22}O_{11}$ = 342.3
Molar mass of maltose $C_{12}H_{22}O_{11}$ = 342.3 (*Note, this is made from the same atoms but simply structured differently than sucrose*)
Molar mass of ethanol C_2H_6O = 46.1

For all you chemistry geeks out there: Why was the mole of oxygen molecules excited when he left the singles bar? He got Avogadro's number! If you don't get it, don't worry. Moving on . . .

SUGAR DOSE RATES

Now that we know enough chemistry to be dangerous we can look at carbonating a beer. The first thing we must remember is the CO_2 level of a fermented beer is not 0. It is lower than we typically want, but if we know the exact CO_2 level then we can make a precise sugar addition to bump the CO_2 up to our desired level. The easiest way to measure the CO_2 level in homebrewing is take the fermentation temperature and look it up on a residual CO_2 chart. This is a rough estimate at best and the actual value is often a little higher because the beer likely has not had time to reach equilibrium with atmospheric pressure. Another approach to read residual sugar is to transfer the beer into a keg then hook a pressure gauge to the beverage-out fitting and shake the keg. While a beer is fermenting, solution becomes super saturated with CO_2. If you measure the CO_2 at the end of gravity change, it will still be supersaturated. This CO_2 will off-gas over the next few days. The reason this is important is you can over-carbonate if you simply use the residual CO_2 chart without measuring if you are pushing close to the end of fermentation.

As an example, if we measure (or guess) 1.1 volumes of CO_2 left over from fermentation and we want 2.8 volumes in the final packaged beer, that means we need enough sugar to create 1.7 volumes of CO_2. Now, this math is easier to do in grams/liter — there is a reason science uses metrics. So we will work in grams per liter and then you can convert from there if you so desire.

1 volume of CO_2 = 1.97 grams per liter (The weight of gaseous CO_2 at 1 bar of pressure in 1 liter of space.)

Since we need 1.7 volumes of CO_2 to move from 1.1 to 2.8 volumes in our beer, we first need to convert the volumes to g/L based on the numbers above. Once we are in g/L we then solve for the total grams needed based on the volume of beer we are carbonated. So let's say we're carbonating a beer in a standard corny keg, which is 5 gallons or 18.9 liters.

18.9 L x 1.7 volumes x 1.97 g/L = 63.4 g of CO_2

There are many ways we can use yeast to create CO_2. The simplest is to add some glucose to the beer, hold it at room temperature and let it do its magic. How do we sort out how much sugar to add? Back to the first section we go.

As we found out earlier, one mole of glucose is 198 grams [molar mass of glucose = 180 g/mol + molar mass of water = 18 g/mol]. Yeast will ferment the glucose and store energy in the form of ATP leaving ethyl alcohol (ethanol) and CO_2. It does so following this equation

$C_6H_{12}O_6 \bullet H_2O \rightarrow 2(C_2H_6O) + 2(CO_2) + 2ATP + H_2O$

The key with this equation is that one mole of glucose when fermented will create 2 moles of ethanol and 2 moles of CO_2. In other words, 198 grams of glucose makes 88 grams of CO_2. Another way to look at this is that 51% of the weight of glucose will be fermented into CO_2 (88 / 198 = 0.51). Since we only need 63.4 grams of CO_2 for our example we don't need a full mole of glucose monohydrate. Instead we calculate the following:

63.4 g / 92.12 g/mol = 0.72 moles of CO_2 needed for 1.7 volumes

0.72 moles x 198 g/mol = 142 grams of glucose monohydrate to carbonate our keg.

If we use sucrose (table sugar) or maltose (good luck finding it), we simply need to follow the same logic to generate our new numbers. Creating a spreadsheet can be handy device to perform these calculations for you.

Total Fermentable Sugars in an average wort (83.5%)
Maltose (40.43%) $C_{12}H_{22}O_{11[aq]} \rightarrow 4(C_2H_6O) + 4(CO_2) + ATP$
Glucose (20.6%) $C_6H_{12}O_{6[aq]} \rightarrow 2(C_2H_6O) + 2(CO_2) + ATP$
Maltotriose (16.6%) $C_{18}H_{32}O_{16[aq]} \rightarrow 6(C_2H_6O) + 6(CO_2) + ATP$
(*Not all yeasts can ferment maltotriose)
Fructose (1.7%) $C_6H_{12}O_{6[aq]} \rightarrow 2(C_2H_6O) + 2(CO_2) + ATP$
Sucrose (1.5%) $C_{12}H_{22}O_{11[aq]} \rightarrow 4(C_2H_6O) + 4(CO_2) + ATP$
Isomaltos (1.3%) $C_{12}H_{22}O_{11[aq]} \rightarrow 4(C_2H_6O) + 4(CO_2) + ATP$

We can also use dried malt extract (DME). Briess Pilsner DME is cited to be 75% fermentable by standard brewer's yeast as an example. If we divide the molar mass of CO_2 by the molar mass of fermentable sugars in wort and weight the answers by wort composition we find that 51% of wort sugars added are converted to CO_2. Removing maltotriose from our average only changes the result by 0.002% so we can use one constant for every yeast. So the equation for using DME comes out to look like:

1 g DME x 0.51 x 0.75 = 0.375 grams of CO_2 produced

Comparing this to the glucose monohydrate above, a given weight of DME will end up as 37.5% CO_2 while a given weight of glucose ends up as 51% CO_2. This implies you need about 1.36 times more DME than if you were using corn sugar for priming.

DELVING DEEP

Most brewers stop after here and don't look at other sugar sources. However, the advanced brewer will want to understand how to use any wort-derived sugar source. Many brewers perceive there to be a flavor advantage in using wort or partially fermented beer as a source of sugar to generate CO_2. This is where our math can really come in handy. We are going to run through some examples, the first is if we were to store wort from our brew day in the freezer or use fresh wort from the brewhouse on the day we need to carbonate and use it at end of fermentation to carbonate.

We are going to work in °Plato. If you only measure in standard gravity (SG) I will provide two equations to convert over to Plato (where most brewing equations are derived from since it is measuring the ratio of water-to-sugar). The first conversion formula is for normal day-to-day use. The second conversion equation is slightly more precise at high-gravity readings:

°P = [(SG - 1) x 1000] / 4 or °P = Gravity Points / 4
°P = (-1 x 616.868) + (1111.14 x SG) – (630.272 x SG^2) + (135.997 x SG^3)

We always measure the original gravity (OG) and the final gravity (FG) of our batches of beer (I hope). Again, despite being called OG and FG, these readings are in °Plato.

Apparent Extract (AE) = OG – FG

This gives us an idea of how much sugar was consumed by the yeast but the numbers we really need for our calculations are the Real Extract (RE) and the Real Degree of Fermentation (RDF). Developing a spreadsheet to generate these numbers for you is simple and helpful.

Accounting for the weight of alcohol to differentiate it from AE, the Real Extract can be solved for using the common equation:

RE = (0.1808 x OG) + (0.8192 x FG)

The Apparent Degree of Fermentation (ADF) is also known as apparent attenuation in some circles. Note this will often be found in percent.

ADF = OG x AE/OG

This is useful to compare different fermentations, like when performing yeast trials or during recipe adjustments. However, the RDF is what we really need when calculating out more exact numbers (like for kräusening), and is sometimes referred to as real attenuation in some circles.

RDF = [100 x (OG – RE) / OG] x [1 / (1 - 0.001561 x RE)]

The correction of 0.001561 was created to allow for the creation of CO_2. These equations tell us everything we need to understand how much CO_2 we can create with our wort (among other things).

ADVANCED DOSE RATES

In order to use wort to carbonate your beer, the equation we need looks a lot like the DME equation from page 99, but we have to account for the water dilution factor in wort.

CO_2 from a gram of wort = 0.5055 x RDF x (OG / 100)

Since Plato is simply a measure of percent sugar by weight dissolved in water, we can easily solve for CO_2 evolution from almost any given wort with the gravity reading. When we merge all of these equations we get wort needed.

$Liters_{wort}$ = ($CO_{2desired}$ - $CO_{2measured}$) x 1.969 x $Liters_{beer}$ x 0.5055 x RDF x (OG / 100).

We have other options as well! What if we want to add a different wort that is fermenting (kräusening)? We logged the OG (of course!), we'll have to estimate the FG and we need the current gravity. With this information we can calculate how much sugar we have left in the fermentation. We should know the expected final gravity from having brewed before or we can estimate from what data we have on the yeast like the typical RDF and the OG. So if we swap out the RDF x (OG / 100) part of our equation with (Current Gravity - $FG_{expected}$) / 100, then we have adapted the unfermented wort equation to a fermenting wort or kräusening formula.

$Liters_{kräusen}$ = ($CO_{2desired}$ - $CO_{2measured}$) x 1.969 x $Liters_{beer}$ x 0.5055 x [(CG - $FG_{expected}$) / 100].

Now this equation is looking interesting!

What if we want to cap off or bottle the fermentation early? (Before you try this without a spunding valve, become very familiar with the process. You don't want bottle bombs.) We can rearrange this equation with a little effort. Remember that now the $Liters_{kräusen}$ / $Liters_{beer}$ = 1.

$FG_{capping}$ = [100 / ($CO_{2desired}$ - $CO_{2measured}$) x 1.969 x 0.5055] + FG

It should be noted that this entire math exercise assumes that no CO_2 is lost to headspace and if you have a large headspace you will need to account for the CO_2 lost to pressurize it. (Hint: We have assumed the volume of beer = the volume of the tank.)

I hope this gives you some ideas and tools to work out the perfect carbonation level and method for dose carbing your beer. Again, spreadsheets/calculators can be your friend. I do a lot of tasting before I am happy with my CO_2 levels and I hope you will take the time to study your CO_2 as well. BYO

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BY CAMERON JOHNSON

NANOBREWERY MODELS

Exploring three business plans

From their first batch of beer, I believe every brewer has at least a fleeting thought of selling their product to the public, and more specifically about sharing the joy of brewing with like-minded people who enjoy it just as much as they do. Alas, professional brewing is not immune to many of the issues that face other business owners: Cash flow, profitability, growth plans, and not least of all, being able to pay oneself a living wage. Aside from these barriers, one must also overcome the initial capital required to enter the industry on a professional level and scale. But brewers are nothing if not innovative, stubborn, and willing to put in extra work for the sake of a better product. Enter, the nanobrewer.

My goal in this column to provide a bit of insight into the legitimacy of the small-brewery model, focusing on the low-volume, high-margin "coffee shop-esque" concept that is dominating the current craft beer world. I think this is perhaps a more sustainable way to look at the future of craft beer in the United States. Indeed there is an easily drawn line between the neighborhood pubs of today, and the pre-Prohibition era brewing culture of the United States — where the public house was an integral part of small communities.

The first step to establishing a business, nanobrewery or otherwise, is to perform a profitability analysis. Now, I do not have a terrible preponderance of knowledge in the area of business finance (indeed mine has been a trial by fire at times), but fortunately I have friends who do have such experience. From talking with them, and reading articles in this very publication, I have learned that one of the most important tools in the early planning stages is the break-even analysis. This is a simple examination of cost vs. profit, taking into account fixed and variable costs, and balancing those against the factors that contribute to your profitability. More simply put, this examination allows you to realistically project what your gross revenue must be in a given period of time in order to meet your expected costs. (For a more in-depth examination of the financials of brewing, see Audra Gaiziunas' excellent article "Crunching the COGS: When it's not a hobby anymore" found in the January-February 2019 issue).

At The Incubator (a collaborative brewery I own and operate), the first step we work on when admitting a new member brewer is their business plan. Essentially, this is your proposed roadmap for your company's future, justifying why you should exist, what you exist for, and how you intend to operate. In many ways, the business plan is a living document which, like brewing, requires constant re-examination to ensure its quality and coordination with the overarching efforts of the brand. As your business develops, along with your understanding of where your brewery fits into your market, you should make edits to your plan, utilizing data you collect as you operate. This should include everything from monthly sales projections to demographic analysis. Indeed, a solid understanding of who your drinkers are is critical to carving out your brand's space within your market. Utilizing marketing tools like social media advertising, email campaigns, and even your local periodicals, you can build a picture of your current average customer, compare this to where you want to be selling, and adjust or redouble your efforts accordingly. (For more information on defining your brand and market in craft beer, see Ashton Lewis' "10 Keys to Nano Success" found in the May-June 2018 issue)

Alas, professional brewing is not immune to many of the issues that face other business owners . . .

Photo courtesy of MoreBeer!

ALTERNATING PROPRIETORSHIP

So, let's dive into our first business model. The alternating proprietorship license type was originally created as a way for operating breweries to capitalize on the time where their brewhouses sat unused between turns of their fermenters. The concept is a simple one — a brewery can rent out time on its operating space and equipment to another licensed brewery for the production of beer for sale by the lessee. One can see the appeal of such a situation for both parties involved. The operating brewery gains an additional revenue stream to offset their costs and provide another source of income during slow months or when all fermenting vessels are full, and the leasing entity benefits from the use of a large-scale production platform without a capital intensive initial investment, or the overhead of such a facility. In some cases, such as The Incubator Brewery I helped to establish, you might have multiple alternating agreements within one licensed location. In such situations, the most relatable concept is that of the Co-Op — a workspace wherein tenants share resources, collaborate, and pay an equitable portion of the associated costs of production. While these environments are wonderful for establishing new breweries, there are several limitations.

The first limitation is that retail sales for the leasing entity must occur at a separately-licensed premises. In some cases, this is as simple as a taproom next door, operating as a distinct LLC and allowing the leasing brewery to capitalize on retail margins for their product. Or perhaps the leasing brewery is waiting on the build-out of their taproom space and must sell wholesale kegs to local accounts for a period. The second limitation is one of logistics. At any time, the owner of the space and brewing equipment may need to use 100% of their available production capacity, thus ousting, or temporarily hamstringing the leasing entity. Maybe the mash tun is left full of souring Berliner weisse on a day you had set aside for brewing. Or perhaps the host brewery's glycol chiller breaks during active ferment on your gold-medal winning Pilsner. In any case, it is important to establish an alternating agreement long before production, such that the lessee and the lessor are protected. Indeed, such an agreement is required by the TTB during the initial filing of the license to operate under an Alternating Proprietorship license.

THE GYPSY BREWER

Next up, a related, albeit less common model, is that of the wandering brewer. This path is an evolution of the alternating proprietorship, wherein the leasing party does not have their own premise for operations, or their own taproom, thus cutting overhead down close to negligible, allowing the maximum amount of flexibility in terms of production volume, schedule, and variety. Now, while this does permit one to start and stop operations much more readily than any other model, it comes with one glaring limitation from the outset: Not having a source for retail income on your product. As you'll recall from Econ 101 (or a quick exploration on your cell phone calculator), it's much more profitable to sell a product for $5 a glass than it is to turn around and sell 120 of those glasses (in a half barrel keg) for the average wholesale cost of around $165. We'll discuss this a bit more in future articles, but for now, suffice it to say that trying to operate on a small scale only selling wholesale kegs is often a losing battle (ask me how I know). That being said, don't discount this concept if all you want out of professional brewing is a way to legitimize your hobby, and at least have it pay for itself, while you analyze whether this business is really one you want to dive headlong into, or if you're simply biding your time while your own facility is in planning. One of the great flexibilities of the craft beer world is, at least in part, due to the fanaticism of the fans of your product. Perhaps you can legitimize yourself as a producer of unique, value-added products, which customers are willing to pay a premium for through a bottle club? Maybe your Session Imperial Wet-Hopped Pastry Milkshake IPA is so good that accounts will fork out $300 per quarter barrel keg, marking it up proportionally to equally rabid patrons? Indeed, several now-successful commercial operations have begun as gypsy breweries — Grimm Artisanal Ales out of Brooklyn, New York, Triple Voodoo Brewing in San Francisco, California, not to mention the now world-famous Evil Twin and Mikkeller breweries, founded out of Denmark by the Bjergsø twins.

THE TAPROOM

The final model I'd like to explore in this article is that of the now commonplace neighborhood brewpub. We all know what this model is, and you may even be reading this article while sitting at the counter of such an establishment, but what really makes this style of small-scale brewing work? To contextualize this example, I'll define it as a brewery that sells the majority of its product over the counter in its own taproom (capitalizing on that high-margin per volume sale), and doing so on a relatively small system and production scale (typically a three to seven barrel system, producing 300 to 800 barrels of beer per year). I won't break into the financials here (Audra Gaiziunas does a very thorough job of that in her article), but a small brewery can easily be profitable selling around 500 barrels per year, if even half of those sales are done in one's own taproom. It is precisely this retail environment and associated sales which small businesses, especially craft beer, live or die by. Not only is your taproom a critical component in generating high-margin transactions, it is your brand's public face to your market. Much like an independent neighborhood coffee shop, the small brewpub relies on locals and locale. The environment you create must be comfortable, memorable, and reflect what your brand is about. From my career in architecture, I can say with confidence that the physical environment you create to house your brand, whatever it may be, is synonymous with how the public will perceive your product. Are you a farmstead brewery making artisanal beers with unique ingredients grown on-site? Then your taproom had better push that message. Or, perhaps you're a more edgy presence, featuring live metal-rock shows and unapologetically big beers. In this case, a warehouse with plenty of open space featuring an industrial ambiance would be more appropriate. Whatever your situation, on the nanobrewing scale, planning the space of your business is equally important as, and intrinsically linked to, your business plan.

While planning brewery operations may not seem quite as

fun as getting your hands dirty on a brew day, it is an essential part of developing your brand from pastime to profession. In the interest of justifying this profession on the nano scale with some more credible information, I've enlisted the help of Sam Holloway. Sam is the founder and president of the brewery business planning community Crafting A Strategy, and an Associate Professor at the Pamplin School of Business at the University of Portland. I wanted to conclude with this brief Q&A I had with Sam recently over a beer at Loowit Brewing, a small, neighborhood operation in downtown Vancouver, Washington (incidentally the site of NanoCon 2019):

Q: If you were advising a new small-scale start-up brewery planning to open this year, what would your top three points of advice be?
A: (1) Keep your fixed costs (rent) as low as possible. Try to serve your beers in the smallest space possible to get the greatest yield per square foot. (2) Find an innovative way to serve food without operating a restaurant. Food carts, sublease your kitchen space to a real food operator, allow outside food to be brought into your taproom. Concentrate on the beer and high margins, let food be someone else's challenge. But food is essential — profitability is getting one more pint ordered per four-top per visit. (3) Don't be in a hurry to package and distribute your beers. The economics of wholesale favor large established breweries — so just build another taproom if you want to expand.

Q: Are small-scale breweries advisable at this point in the U.S. craft beer market? If so, what are their main advantages/disadvantages over larger operations?
A: Small-scale is absolutely the way to go. You aren't selling beer or competing against other breweries — you are competing for drinking occasions with wine and spirits and you are selling an experience that goes far beyond the technical quality of your beer. If you think and act like a large brewery, you are setting yourself up for failure. Why play by the large breweries' playbook and try to sell in grocery stores when you can create an amazing retail experience of your own and control the conversations with consumers?
Q: As an educator and adviser in craft beer, what do you think the next 3 to 5 years are going to bring in terms of major changes in the U.S. beer landscape?
A: Fragmentation is the key trend. The top 100–150 breweries will continue to merge and acquire each other to drive down their average costs and play the volume/scale game. They have the most volume, but they aren't the most prevalent in the sample. We are headed toward 10,000 craft breweries domestically and the vast majority (95%) will be small neighborhood pubs. Fragmentation gives more entrepreneurs and more neighborhoods the chance to benefit from having their own brewery — this is where a 3-bbl system in the right neighborhood can produce a happy life and profitable lifestyle business for you and your investors. If you want to get big and wealthy via beer, you are about 25 years too late. BYO

BY BARRY SHANTZ

WATER CONTROL SYSTEM

Making the most of a float switch

One of the things that I enjoy about homebrewing is customizing my brewing system. I have built several contraptions to help improve the quality of my beer, make brew day go more smoothly, and reduce the risk of the mishaps that can add unneeded frustration. One of the things I built with those goals in mind is my water control system.

The water control system helps with three aspects of the brewing process: Filtration, hot liquor tank (HLT) fill, and sparging. First, the system filters the chlorination from the tap water. Second, it controls the water level when the HLT is being filled, automatically shutting off the water flow when the set point is reached. (Ever had a time when you got distracted and overfilled the hot liquor tank?) Third, during sparging, the system maintains a constant level of water in my mash/lauter tun (MLT), preventing the grain bed from inadvertently running dry.

The water level control assembly consists of several parts. There is a T-shaped frame of PVC pipe that sits on top of the HLT or MLT. Through a hole drilled in the T-frame, a piece of CPVC pipe is friction fit perpendicular to the T-frame. The CPVC pipe serves as the water level adjustment rod. At the bottom of the adjustment rod is a float switch. Slide the rod down through the cutout in the T-frame until the float switch is at the desired water level. Because the adjustment rod is tightly held in the T-frame, the float switch stays at the water level set point.

When the HLT is being filled, the float switch control sends a signal to a relay to open a solenoid valve, then closing when the float switch is triggered by the water. The solenoid valve that I used is from a dishwasher, but a dishwasher solenoid needs to be properly enclosed. Other kinds of valves, such as the 12V stainless steel solenoid valve listed below, would also work. When it is time to sparge, the water level control assembly is moved to the MLT, and the float switch now controls power to an electrical outlet into which my brew pump is plugged.

The control box is where the connections are made amongst the main electrical components. I used switches to turn the solenoid valve on to start the HLT fill and to turn the pump on and off for sparging. The control box includes an electrical outlet into which the pump is plugged for use during sparging. It also includes a connection from the float switch on the water level control assembly. I also used a 12V power supply because of the risk of running 120VAC current into the tank, and because most float switches are only rated for less than 50 volts. Be sure to cover any exposed 120VAC conductors inside the electrical enclosure.

The water control system helps with three aspects of the brewing process: Filtration, hot liquor tank (HLT) fill, and sparging.

Photos by Barry Shantz

Tools and Materials

- ½-in. NPT stainless solenoid valve (U.S. Solid USS2-00069)
- Float switch
- Relay
- 15 amp marine inlet
- Electrical enclosure box
- Control switches
- AC to DC power supply 12V 5A 60W
- 15 amp electrical outlet
- Water filter
- Length of PVC and CPVC pipe
- (1) PVC T-fitting
- (2) CPVC endcaps
- Silicone sealant
- Wood and screws for building the mounting board
- Miscellaneous wire, terminals, fuses, and electrical components
- Conduit and connector
- Saws for PVC pipe and wood
- Drill or drill press, drill bits
- Wire cutters

STEP BY STEP

1. WATER LEVEL CONTROL FRAME

The diameter of the PVC pipe (certified for potable water) for the T-frame must be large enough such that a hole can be bored for the adjustment rod to pass through. I built the T using three pieces of ¾-in. (OD) PVC pipe and the appropriately-sized 90° T- joint. Cut the PVC pipe long enough so that can be used with both your HLT and your MLT. I used ½-in. CPVC pipe, which measures ⅝-in. OD, for the adjustment rod. Make the rod long enough so that it will reach to near the bottom of the HLT and MLT. Drill a hole through the PVC T-frame, perpendicular to the plane of the T, for the adjustment rod. The hole needs to be centered and located so the adjustment rod will be over the middle of the tank. The hole you drill needs to provide a snug fit, so that the adjustment rod will be held in place by friction at whatever level you set it. The T-frame can also be set up to hold the tubing for filling the HLT and the sparge arm for the MLT.

2. WIRING THE FLOAT SWITCH

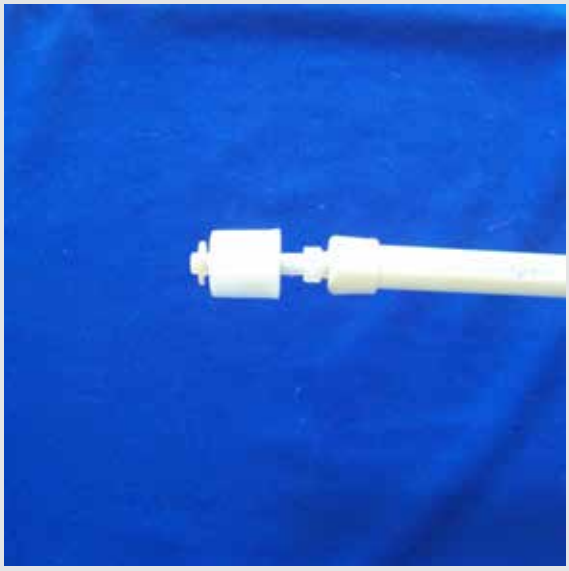
There are numerous online sources for float switches. I recommend using a marine-grade switch like a bilge pump float switch. Be sure that it is rated for temperatures that will be seen in a MLT.

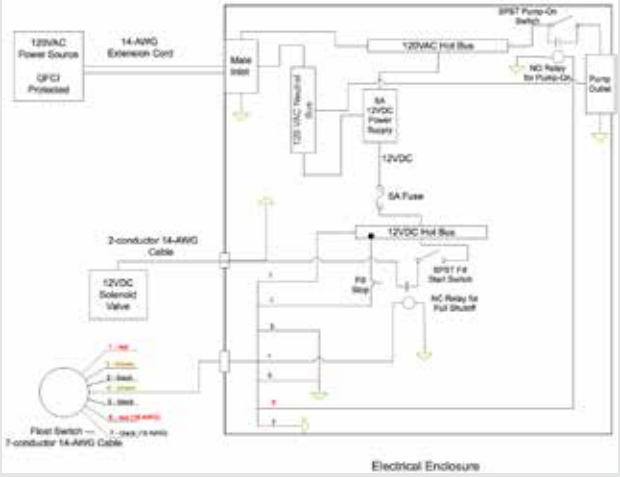
Drill a hole in the center of each of two plastic caps sized to fit over the end of the adjustment rod. Fit the float switch through the hole in one of the caps so the wires can be threaded up into the adjustment rod.

From the float switch, the wire runs up the length of the adjustment rod into the enclosure. For my cable that connects the assembly to the electrical enclosure, I fitted the cord through the hole in the second plastic endcap and threaded the cord down through the adjustment rod. Seal the endcaps in place with silicone sealant; alternatively they could be glued in place.

3. WIRING THE ELECTRICAL ENCLOSURE

Float switches are always low-voltage devices, so you will need a 12V power supply and a relay. I also recommend using a 12V solenoid valve for several reasons. Always make sure that whatever electrical devices you use are UL listed, and are rated for the voltage and current that they will be expected to carry. The relays, outlets, and switches should be mounted in an appropriate enclosure, and always make sure that proper grounding practices are followed.





**Special thanks to Geoff Parkins for this wiring schematic. For a larger view, please visit the online version: https://byo.com/project/water-control-system-making-the-most-of-a-float-switch/*

4. BUILDING THE MOUNTING BOARD

The filter, solenoid, and electrical enclosure need to be mounted to something. I built a wooden stand for this using pieces of plywood and lumber that I had on hand and ended up with the structure you can see in the picture at right. Mounting these elements on a wall would be a good option as well, securing them in place. I wanted this to be movable though. If you build this, be sure to keep this well out of your way while brewing. You do not want this to tip over.

My plywood backer board measures 42 in. x 19 in. x ⅝ in. (107 cm x 48 cm x 1.6 cm). The two vertical supports are 5 feet (152 cm) long, and were made by ripping a 2x4 (48 mm x 98 mm) in half on the table saw. The two feet that rest on the ground are 24 in. (61 cm) long. The feet are braced to the vertical supports with pieces of 2x4 (48 mm x 98 mm) ripped in half and mitered at 45 degrees at each end. Once I had the mounting board assembled, I covered it with a couple of coats of polyurethane.

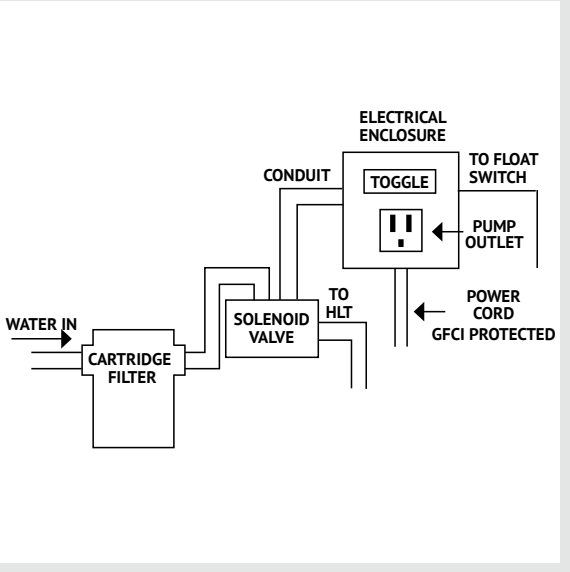
5. SELECTING THE WATER FILTER

I have used two different styles of water filters. I initially used an in-line filter from a refrigerator ice maker/water system. I later upgraded this to a single stage under-sink water filtration system and replaceable carbon block filter. I don't have any problems with sediment in my water supply, so single stage carbon filtration meets the need to remove chlorine and chloramines from my brewing water. I recommend 1 gallon/minute (3.8 L/min) or less for proper de-chlorination. It is slower for chloramine removal though. If you have issues with sediment, you could use a two-stage filter system, with a sediment filter in series ahead of the carbon filter.

6. MOUNTING ALL OF THE PARTS

When I arranged the components on the mounting board, I wanted the electrical enclosure to be above the solenoid and filter, so that any water drops from leaks would not fall onto anything electrical.

Once you have the solenoid and filter in place, run PVC tubing from your water supply to the solenoid, and from the solenoid to the filter. You will also need a piece of tubing to run from the filter to your HLT. BYO



**Brewing with electricity can be hazardous. There is a risk of electrical shock or death. If you decide to build this system, your design and finished project should be reviewed by a licensed electrician. Any 120VAC power used in brewing operations should be protected by a Ground Fault Circuit Interrupter (GFCI).*

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BY JERRY ZIEGLER

BREW DAD

Making it a family affair

I like beer. I like beer a lot. Over the years I've realized that I can't brew as much as I'd like due to the constraints of family. That's just the unfortunate truth and I'm pretty sure that many of you homebrewers can understand where I'm coming from. So I've tried to devise a way that I can make room in my life for my two greatest loves.

I started very simply like many homebrewers do, with an old Mr. Beer set I was gifted. I brewed a few less-than-stellar batches of beer and even a few that were dumped down the sink drain. I was single then and lived in a small, cramped, bachelor pad and I came to the realization that these were not the perfect conditions to craft my best brews. I ended up abandoning the Mr. Beer set and turned my sights toward the bright, glorious future where all my homebrews would be their best. I thought at some point in the magical land called the future I would have more time and money and the ability to dedicate myself more to the beer. And I did . . . for a while.

I think where I started to go off track with my homebrewing is when my son was born. He is my greatest accomplishment and my biggest source of joy and I love him more than I can express in this article. But, I realized pretty early on that the carefree lifestyle that I enjoyed, even while being a husband, was changing drastically. One aspect was that my brewing was suffering . . .

I started with trying to make sure I, at the very least, got four brews in over the calendar year. Sadly for my own pride, this was not always a possibility. Then, one evening, I'm not even sure how or why, but my wife offered to help. I may have been tired but I certainly wasn't about to look that gift horse in the mouth.

The process flowed not only smoother but it was more fun as well. We both enjoyed ourselves and after the first brew day were excited to do it again. We've always cooked together, but it never occurred to us to try brewing together. It became even more fun as my son, who's now 2 years old, got a little older and could be involved in the process as well. He can hand Daddy spoons, muslin bags, or a bag of hops. He can even use his "big strong muscles" to help Daddy move buckets and fermenters.

What started as a hobby for a single guy had become a family hobby and enjoyment for all of us. Turns out, I didn't have to sacrifice my homebrewing. In fact, it is now way better. I get to brew now when my son is awake instead of waiting for him to go to bed. I don't have to work around my wife's schedule anymore, we can create a game plan together. What used to be dad's hobby is something we now all enjoy. There is something satisfying with creating something from the ground up and doing it as a family.

Sometimes I think homebrewers like to play the role of the martyr. They like to tell you about the hours and weeks they put in on a beer or how long it takes to sanitize bottles. They pour over message boards and spend hours discussing things like temperature and specific gravity. They talk so much about the labor they forget about the love. It makes homebrewing sound like a chore or a lonely, thankless pursuit. Involve your family. Make it fun time and time well spent. Instead of trying to find the time to brew, make the time. Involve the people you love in the activity you love and I bet that you make more beer and enjoy the fruits of your labor doubly. BYO

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Photo courtesy of Jerry Ziegler

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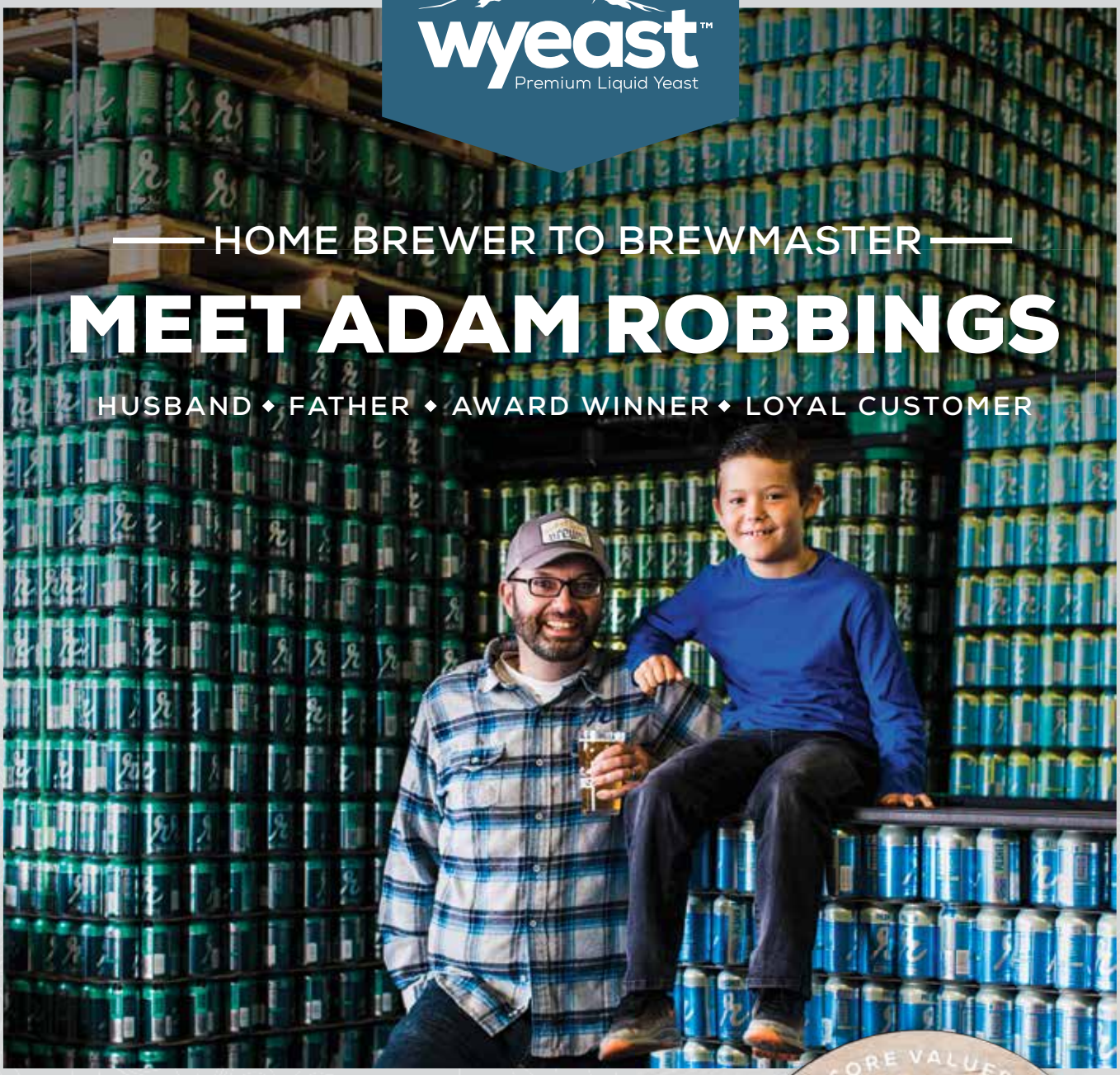

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When Adam Robbings received a homebrew kit from his wife Grace, he never imagined that brewing would become his livelihood. Fueled by a growing family, fascinated with fermentation and driven by his Londoner roots, Adam crafted home brews from Wyeast Smack Packs that earned him regional and national awards. And after just three years of home brewing, Adam's passion for brewing "bloody good" beer turned into a family-run, award-winning brewery: Reuben's Brews.

Not only is Adam a master of his craft, but he has found success without ever losing site of what's important—the same values that serve as the foundation of Wyeast.

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