FOREWORD BY
SAM CALAGIONE
FOUNDER & PRESIDENT
OF DOGFISH HEAD BREWERY

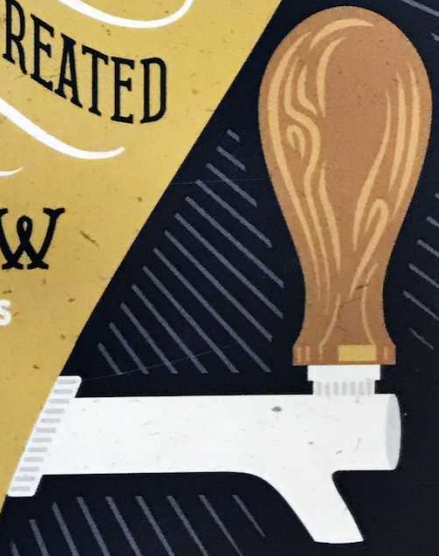
PATRICK E. McGOVERN

# ANCIENT BREWS

REDISCOVERED & RE-CREATED

INCLUDING

HOMEBREW
INTERPRETATIONS
& MEAL PAIRINGS



# ANCIENT BREWS

## *Rediscovered and Re-created*



Patrick E. McGovern

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**This volume is intended as a general information resource for readers interested in the history and re-creation of ancient beverages, along with meals that might have accompanied them. Neither the publisher nor the author can guarantee that every reader will be able to re-create any particular beverage or meal from the instructions given or that every reader will be able to drink any re-created beverage without any adverse effects. As of press time, the URLs displayed in this book link or refer to existing websites. The publisher is not responsible for, and should not be deemed to endorse or recommend, any website other than its own or any content available on the internet (including, without limitation, any website, blog page, or information page) that is not created by W. W. Norton. The author, similarly, is not responsible for third-party material.**


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For mood-enhancing atmospherics and more meal suggestions, go to: http://www.penn.museum/mcgovern/ancientbrews/.

# PREFACE

Sam Calagione, founder of Dogfish Head Craft Brewery, and I are often asked how we met, got the idea to re-create ancient fermented beverages based on scientific evidence, and began making them for the *Ancient Ales and Spirits* series at Dogfish Head Craft Brewery. I provide some of the answers to these questions in this book.

Our story is still very much a work in progress. Just like an archaeological excavation, I have sorted through and analyzed the tattered remains of our species' brewing past, which are an infinitesimal fraction of what our ancestors made and drank. I have scoured the literature on alcoholic beverages, past and present. Together, Sam and I have devised and tested reasonable hypotheses of what went into an ancient drink and how it was made. We have not always agreed, but then that's to be expected. Human beings see the world through the prism of their own experiences, perceptions, and emotions.

We may agree on the broad outlines of our story, but we continue to add more and sometimes quite different details. To give you one example, in the second chapter on *Midas Touch*, which launched us on our adventures, I recount a tear-gassing incident in a restaurant in Ankara, Turkey. In the heat and confusion of the moment, one of our filming team left a satchel full of cash on a chair. Of course, it was gone after we filed back into the restaurant. Later, when we shared stories, I had only a vague recollection of the missing pouch. Sam remembered the incident in minute detail, perhaps because of his astute business acumen.

My focus is the past, Sam's is the present. Together, we make great re-created beverages together.

## DISCOVERING ANCIENT FERMENTED BEVERAGES IN THE FIELD

THE READER MIGHT think that reconstructing an ancient fermented beverage is straightforward. You just need to scrape out the residues inside what you believe to be an ancient beverage container, one that might have been used to make, store, serve or drink a beer, wine, mead, or extreme beverage (more about that in Chapter 1). You lay your hands on the highest-power analytical tools you can and then test the residues. Voilà, you have the answers for making a re-created fermented beverage!

I wish it were that simple. That point was driven home to me as I pioneered the field of organic residue analysis in archaeology, beginning in the 1980s. Despite many false starts and failed experiments, the past 30 years have been full of discoveries, including the earliest chemically attested grape wine, barley beer, chocolate "wine" (*Theobroma*: Chapter 7), and extreme fermented beverage (*Chateau Jiahu*: Chapter 3) from China. I started with grape wine and barley beer, whose stories are recounted in my other books, *Ancient Wine* and *Uncorking the Past*. I ended up with extreme fermented beverages, which can combine all and sundry from your environment—high-sugar fruits, honey, roots and cereals, herbs and tree resins—into a palatable and very powerful drink. They are the most challenging to my mind.

I am a combination archaeologist and chemist, which is sometimes called a biomolecular archaeologist or an archaeological chemist. The process of discovering and re-creating an ancient fermented beverage starts with archaeology. If you don't have the best samples you can get—the best dated, the most well-preserved, and the least contaminated—then you're wasting everyone's time and money.

Well-excavated archaeological sites are the be-all and end-all. Forget about any vessels bought on the antiquities market, which could well be fakes or lack verifiable provenances. What you need are organic samples in association with other well-dated finds. You might be fortunate enough to uncover a silo of grain, a workshop for making a fermented beverage, a temple, tomb or house where the beverage was

enjoyed by everyday people, or perhaps a shrine or temple where it was served up to the gods.

It's icing on the cake if your samples have *not* been exposed to water and oxygen, which will degrade and destroy them. Your best option is an undisturbed tomb or habitation in the desert. Intact shipwrecks, which have sunk hundreds (ideally, thousands) of feet to oxygen-free levels beneath the surface, can also be good. Likewise, bogs and glaciers can be kind to organic remains but generally yield only the isolated body or object from an uncertain time and circumstance. For example, the Ice Man named Ötzi, found in the Italian Alps, is fascinating and very well-preserved, but without a larger archaeological context, it is anyone's guess whether he was traveling north or south and whether or not he was murdered or lost his way in a storm. Moreover, any canteen of fermented beverage, which he might well have been carrying to see him on his way, is yet to be recovered from the ice. Such a vessel might lay thousands of feet away from the body in a deep crevasse.

I am in the enviable position of being based at the University of Pennsylvania Museum, one of the best archaeological museums in the United States. Its collections of well-excavated finds span the world. I have my pick of the best samples. Many of the collections are dominated by putative fermented beverage vessels, such as the numerous Greek vases adorned with Dionysiac scenes and the standardized jars for drinking corn *chicha* (Chapter 8) in Peru from antiquity up to the present.

Despite the excellent proveniences of many of these artifacts, you must still proceed cautiously. I once noticed some early wine jars in the museum's Egyptian storeroom. They dated to the Early Dynastic period, about 3100 to 2700 B.C., when the royal winemaking industry began in the Nile River Delta (Chapter 4). They appeared very promising. One look inside convinced me otherwise: their interior bottoms were littered with cigarette butts. They had been convenient ashtrays for interns registering articles during the WPA (Works Progress Administration) days of the Depression.

I am also frequently invited into the field as a consultant on organic residue analysis. It is the ideal arrangement because I can watch the

artifacts come out of the ground, assess contamination by groundwater, and examine other remains associated with a specific artifact (a humanly contrived object) or ecofact (a natural object, especially plant material, when dealing with ancient fermented beverages). I can monitor how well the excavation is being carried out, and whether the artifacts and ecofacts are being properly handled. The best samples come from *in situ* (Latin, literally "in place") contexts such as intact tombs or habitation floors, which have been sealed beneath destruction levels. Ideally, any burning was minimal, since that destroys organic materials.

Artifacts or ecofacts of interest should *not* be overly washed in water or conserved with any chemical that might interfere with analysis. Soil samples are collected at the same time to assess the background environmental chemistry, which can be heavily influenced by microorganisms churning out the same compounds for which we are searching. All the samples are wrapped in aluminum foil and packaged in polyethylene plastic bags for the trip back to the States. The plastic should be very high quality and free of plasticizers (such as the omnipresent phthalates) and other contaminants, which can interfere with the detection of ancient organic compounds.

Archaeologists can be their own worst enemies in overprocessing what they have discovered before there's a chance to ferret out the invisible chemical compounds. Fortunately, word has gotten out that organics comprise much of what we are as humans—from the clothes we wear and the houses in which we live to the food and drink that we consume. Indeed, our very bodies belong to the organic world.

Even after selecting the best samples, you still need to obtain the requisite permissions from the local departments of antiquities to export the samples, which is often a major hurdle. You can imagine the reluctance of officials to hand over a gold or silver drinking-horn. It helps to be an archaeologist. The growing interest in ancient fermented beverages, which have often played major cultural roles in nearly every country's heritage, has often been another point in my favor.

As my area of research has become better known, I have also had many archaeologists arrive on the doorstep of our laboratory, sam-

ples in hand. Drawing on their knowledge of parts of the world with which I was less familiar, I could decide whether to move forward on an analysis.

## IN THE LAB

THE SECOND HALF of my job title involves doing the chemistry that will shed light on the contents of the vessels. Working in a relatively poorly funded laboratory of a private museum, our staff has been limited to using the most basic analytical instruments. Fourier-transform infrared spectrometry (FT-IR) has been the mainstay of our operation from the beginning, and it has the advantage of providing an initial assessment of how rich in organics a sample from an artifact or ecofact is. The technique can sometimes precisely identify the chemical "fingerprint" compound of interest or biomarker.

By far, my greatest asset over the years has been the dedicated and enthusiastic cadre of Ph.D. analytical chemists from industry, all volunteers, who decided to take up a second career in archaeological chemistry. Equally intelligent and committed students, both undergraduate and graduate, have worked alongside us. You can image how passionate they can be when it comes to archaeology and fermented beverages! Many have gone on to make their own mark in the field.

Our wet chemical bench is where we start with any sample. Even if we have what appear to be uncontaminated physical residues, we have learned that an extraction with organic solvents will usually help to release the compounds from their matrices and to make them more concentrated. Many of our "residues" are invisible to the naked eye as well, having been absorbed into the pores of pottery wares, whose ionic or polar properties retain and preserve some organics for thousands of years. Boiling in methanol and chloroform, which are relatively more and less polar with respect to the absorbed compounds, enables recovery of the suite of preserved organics.

Based on the FT-IR results of the extracted residues, we then move forward with increasingly more precise chemical analyses, including gas chromatography-mass spectrometry (GC-MS), liquid chromatog-

raphy tandem mass spectrometry (LC-MS-MS), and headspace solid-phase microextraction (SPME) coupled to GC-MS. For the chemically challenged, these techniques separate the various compounds of an unknown sample by their boiling points. As the compounds come off the chromatographic column at different times, they are fed into a mass spectrometer and successively fragmented to measure the masses of the parent and daughter ions. From these data, we are able to determine which compounds are present in our sample.

Over the years, our laboratory has built up a network of collaborators, who are so highly motivated by the prospect of reconstructing ancient fermented beverages that they donate their state-of-the-art instruments and all-important expertise in running them and interpreting the data. Among the many governmental, industrial, university, and private institutions that have filled in the analytical gaps in our museum laboratory, we have most recently worked with NASA's Goddard Space Flight Center, the Scientific Services Division of the Alcohol and Tobacco Tax and Trade Bureau (TTB), the Scientific Research and Analysis Laboratory of Winterthur Museum, and the Monell Chemical Senses Center.

## EXPANDING OUR PERSPECTIVE

FT-IR AND GC-MS analyses of our samples are about as close as we get to a "shotgun" approach to identifying as many compounds as possible in a sample. Usually, we already have working hypotheses for what the vessels might have originally contained, which are based on auxiliary scientific data. I have already mentioned the importance of the archaeological context of the artifact or ecofact, which often provides clues as to what kinds of fermented beverages were available.

Since fermented beverages are essentially processed plant materials, archaeobotanical findings can provide valuable clues for what we might expect to discover chemically. Sieving soil samples using a range of mesh sizes helps in the recovery of tiny seeds and larger plant parts. Wet flotation methods, using different density liquids, enable other botanical remains to float to the surface of the liquid so they can be

collected and analyzed. Pollen can be identified microscopically, as can phytoliths (characteristic silica particles in plant tissues) and starch remnants. The latter have much to tell, especially if they are embedded in a grinding stone, incorporated into dental calculus (tartar), or mixed into the residue itself.

In this interdisciplinary endeavor, you also need to be something of an art and textual critic. Ancient artwork and inscriptions can bring the mute scientific data to life, as it were, by illustrating and describing how the fermented beverages were made and drunk. Yet we cannot assume that they represent reality; they might be selective or even wrong. They are human creations likely made after the fact—unlike our samples that are contemporaneous with the drink.

Ancient Egypt stands out as the premier instance of how illuminating iconographical and textual evidence can be. As early as 3000 B.C., thousands of years before anything comparable appeared in other parts of the ancient world, Egypt's tombs, temples, and palaces show wine and beer being made—step by step—and enjoyed by men and women alike. If you have any doubts about what is depicted, accompanying inscriptions provide commentary. The problem is that once a motif had established itself in the Egyptian artistic repertoire, it was repeated through the ages. What might have started out as an eyewitness rendition thus became a hackneyed idiom of the past, perhaps with little relevance to the present. For Egyptians, though, such stock images assured them a safe passage across the Nile into eternity.

Anthropological accounts of premodern and modern peoples making and enjoying their fermented beverages add another dimension. Native drinks are usually central to their societies and, as such, are highly conserved through time. Although we might be stymied by an unusual archaeological feature or scientific result, the puzzle is often solved by an ethnographic or ethnohistorical study.

Bringing all the various clues from the different disciplines together, archaeological chemists must make educated guesses as to what plants and processing methods were involved in making an ancient fermented beverage. They must search through the available chemical literature for a given region to decide what distinctive biomarkers of specific natural products to look for. Modern search engines can speed up