

# UNLOCKING THE EMPEROR'S MEDICINE CHEST

HOW ANCIENT CHINESE REMEDIES ARE CHANGING  
MODERN HEALTH CARE

By Peter Gwin • Photographs by Fritz Hoffmann

又分寸歌  
墟存神藏或中而踰府足。  
石關兮陰都寧。閉通谷兮。幽門肅。步廊神封而靈  
兮。大赫氣穴。四滿兮。中注育俞。上通乎商曲。守



靈樞卷之二



For more than 2,200 years, Chinese healers have treated illness with a range of natural ingredients—including notoginseng, seahorses, rosebuds, licorice, and human placentas. These and thousands of other substances continue to be used every day in China and other parts of the world. (Go to [ngm.com/Jan2019](http://ngm.com/Jan2019) to learn more about the ingredients shown and what they're used for.)

In the fourth column, jars 4, 14, 24, and 34 hold ingredients being used in a promising cancer treatment developed at Yale, known as PHY906.

1. Safflower
2. Schizonepeta spike
3. Abalone shell
4. White peony root
5. Seahorse
6. Gastrodia tuber
7. Lotus leaf
8. Reed rhizome
9. Chinese angelica root
10. Chinese softshell turtle
11. Notoginseng
12. Rush pith
13. Hawthorn fruit
14. Baikal skullcap root
15. Citrus peel
16. Paper wasp nest
17. Molted cicada shell
18. Tuckahoe
19. Szechuan lovage root
20. Human placenta
21. Lophatherum stem and leaf
22. Cuttlefish bone
23. Citron daylily
24. Chinese date
25. Epimedium leaf
26. Night-blooming cereus
27. Frankincense
28. Trichosanthes fruit
29. Perilla leaf
30. Senna leaf
31. Asian white birch bark
32. Pangolin scale
33. Sweet wormwood
34. Licorice root
35. Rosebud
36. Chinese foxglove root
37. Monk fruit
38. Earthworm
39. Lotus seed
40. Cape jasmine fruit

ITEMS NOT TO SCALE. PHOTOGRAPHED AT EMPEROR'S COLLEGE OF TRADITIONAL ORIENTAL MEDICINE, SANTA MONICA, CALIFORNIA (2, 3, 6, 7, 8, 10, 12, 13, 16, 18, 19, 20, 21, 22, 27, 28, 33, 36, 40) AND NATIONAL WILDLIFE PROPERTY REPOSITORY, COMMERCE CITY, COLORADO (5, 32); SOURCES: ROBERT NEWMAN, EMPEROR'S COLLEGE OF TRADITIONAL ORIENTAL MEDICINE; AMY MATECKI, INTERNATIONAL CENTER FOR INTEGRATIVE MEDICINE





In my hand  
I'm holding a warm,  
beating heart. About  
the size of a softball,  
it's a luminous globe  
of scarlet, pink, and  
white tissue.

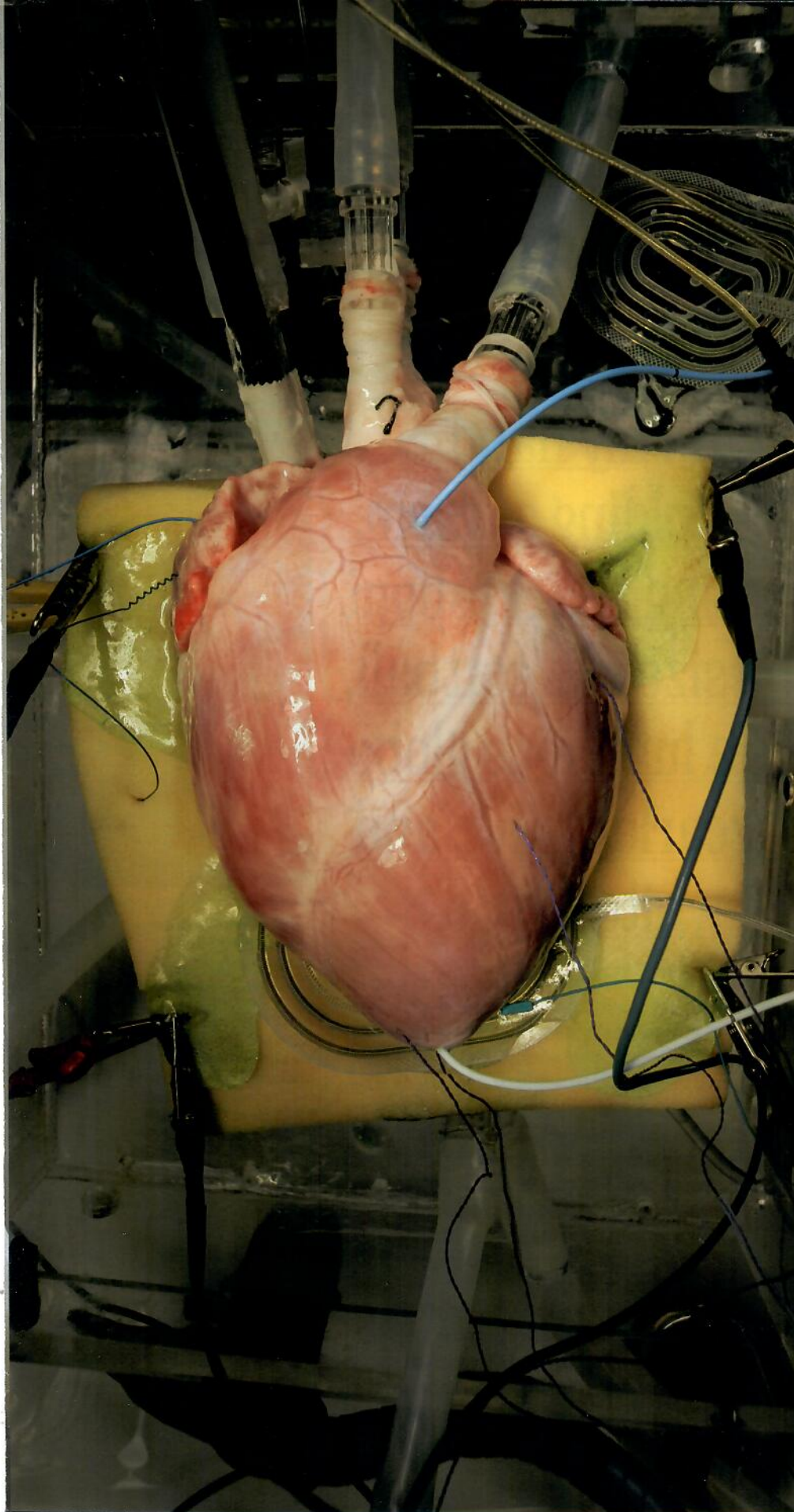
I can feel its chambers contracting and hear the whoosh of the fluid it's still pumping. It's slimy and gives off a slightly pungent odor.

The organ is alive almost eight hours after I watched Paul Iaizzo remove it from a sedated pig in a basement lab, connect it to tubes simulating arteries and veins, and spark it back into rhythm with an electric jolt, as a paramedic would shock a human heart back to life. Although it's outside the pig's body, the heart flexes and lurches on its own, driven by some unseen, unexplained, primordial force. More than grotesque, I find it hypnotic and beautiful.

The pig's heart is still beating partly because Iaizzo, a professor of surgery at the University of Minnesota, treated it with a bath of chemicals mimicking those in bile from bears. It's a scientific application of a belief Chinese healers



Yale University professor Yung-Chi Cheng examines a notoginseng plant at a research center in China's Yunnan Province. Cheng is researching herbal treatments based on ancient Chinese formulas, including a cancer treatment that is currently in drug trials.



**FAR LEFT**

This 1620 version of *The Yellow Emperor's Classic of Internal Medicine*, first compiled some 2,100 years ago, includes a map of qi lines and acupuncture points. Acupuncture remains a contentious subject among Western doctors, though many agree it's effective at treating some symptoms.

PHOTOGRAPHED AT  
U.S. NATIONAL LIBRARY  
OF MEDICINE

**CENTER**

James Harrison relied on a form of acupuncture and other Chinese therapies to help him recover from pain and soreness during his 16-year NFL career. "If it makes me feel good," the recently retired player says, "I don't need no scientific proof."

**LEFT**

A pig heart at the University of Minnesota continues to beat hours after being infused with a synthetic version of bear-bile acid. For over a millennium, Chinese healers have prescribed bear bile for epilepsy, heart pain, and other ills.



espoused as far back as the eighth century: Bear bile can benefit the human body.

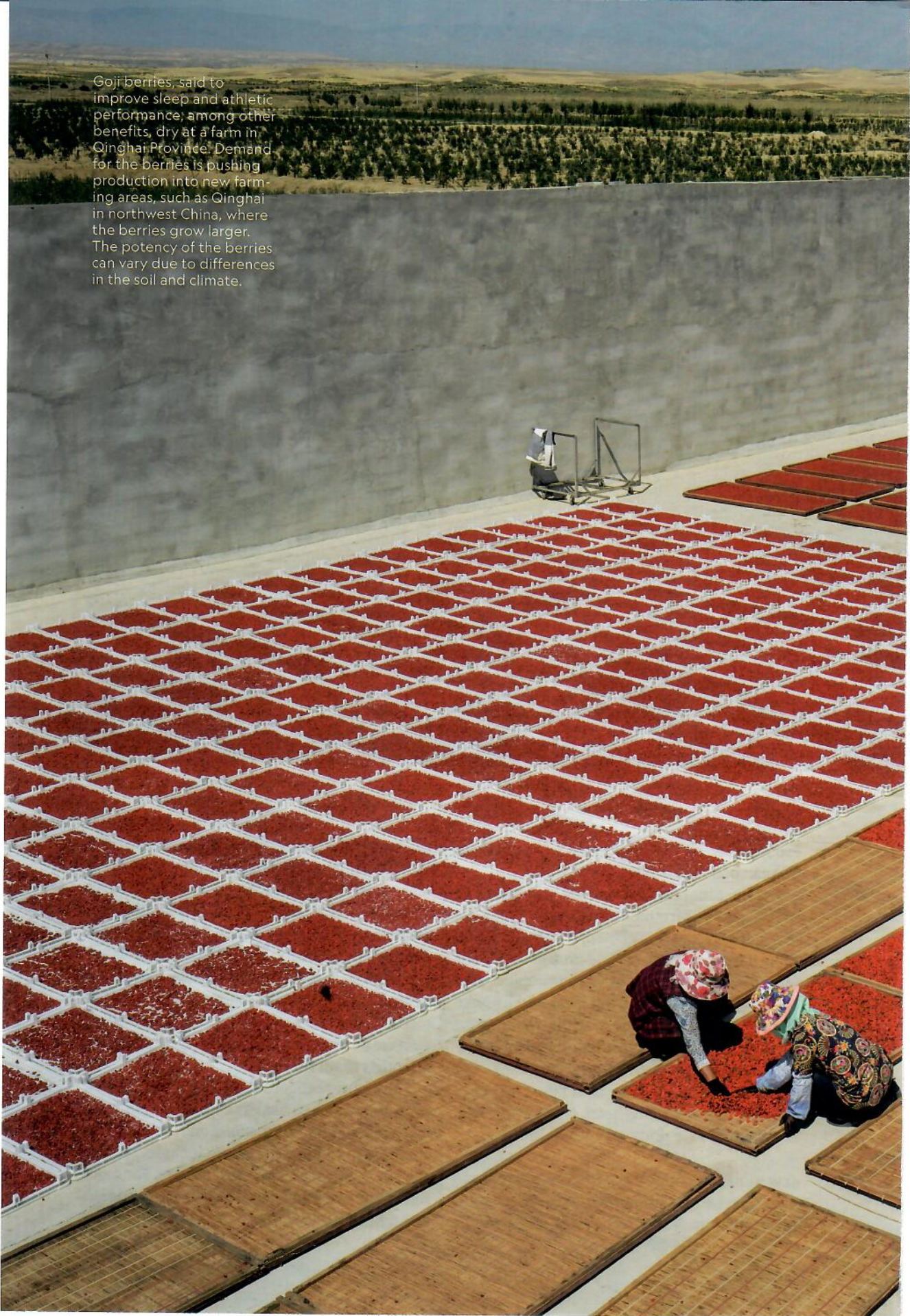
A robust market for bear bile still exists. In Asia bears are farmed for their bile, kept alive in small cages, with catheters inserted to drain their fluids. Animal welfare groups decry the practice, which is inarguably inhumane. And yet, as I hold the beating pig heart and listen to Iaizzo describe how the chemicals that protect a bear's organs from atrophying during hibernation could also sustain human organs, I can't help but wonder whether bear bile could have saved my father's failing heart, or whether someday it might save mine, or my children's.

**FEW SUBJECTS IGNITE** more heated debate in health circles than traditional Chinese medicine. It's further complicated by the work of researchers

like Iaizzo and many others who are looking at traditional cures through the lens of cutting-edge science and finding some interesting surprises—surprises that could have profound impacts on modern medicine. Cultures from the Arctic to the Amazon and Siberia to the South Pacific have developed their own medicine chests of traditional cures. But China, with one of the oldest continuous accumulations of documented medical observations, offers the biggest trove for scientists to sift through.

The Chinese record dates back to the third century B.C., when healers began analyzing the body, interpreting its functions, and describing its reactions to various treatments, including herbal remedies, massage, and acupuncture. For more than 2,200 years, generations of scholars added to and refined the knowledge. The result is a canon

Goji berries, said to improve sleep and athletic performance, among other benefits, dry at a farm in Qinghai Province. Demand for the berries is pushing production into new farming areas, such as Qinghai in northwest China, where the berries grow larger. The potency of the berries can vary due to differences in the soil and climate.







of literature dealing with every sort of health problem, including the common cold, venereal disease, paralysis, and epilepsy. This knowledge is contained in books and manuscripts bearing such enigmatic titles as *The Pulse Classic* (third century), *Prescriptions Worth a Thousand Pieces of Gold* (seventh century), and *Essential Secrets From Outside the Metropolis* (eighth century).

Traditional medicine remained the primary form of health care in China until the early 20th century, when the last Qing emperor was overthrown by Sun Yat-sen, a Western-trained doctor who promoted science-based medicine. Today Chinese physicians are trained and licensed according to state-of-the-art medical practices. Yet traditional medicine remains a vibrant part of the state health care system. Most Chinese hospitals have a ward devoted to ancient cures. Citing traditional medicine's potential to lower costs and yield innovative treatments, not to

cheaper than doctor-prescribed pharmaceuticals. A patient can read about a traditional remedy online, order the herbs on Amazon, and watch YouTube videos on how to prepare them at home. The result is a growing alternative health sector, which in 2017 saw U.S. herbal supplement sales top eight billion dollars, a 68 percent increase since 2008.

You'll also find doctors who denounce traditional Chinese medicine as pseudoscience and quackery, pointing to some of its most outlandish claims, like the ancient practice of prescribing firecrackers to chase away demons, or mysterious concepts still embraced, such as a nebulous life force called qi (a term translated literally as "the steam that rises from the rice"). Others rail against its use of animal parts and warn against the potential dangers of its herbal formulas.

"Rarely do you find anyone who looks at it objectively," says medical historian Paul

Unschuld. A leading authority on the history of Chinese medicine—and often an unsparing critic of the way it's interpreted—he has collected and translated hundreds of ancient medical texts and is working with a Chinese-German startup to study them for ideas about treating a variety of

## ALL THE CANCER PATIENTS WHO TOOK THE HERBAL FORMULA EXPERIENCED RELIEF FROM NAUSEA, BUT SOMETHING ELSE HAPPENED: THEIR TUMORS SHRANK FASTER.

mention raise China's prestige, President Xi Jinping has made it a key part of the country's health policy. He has called the 21st century a new golden age for traditional medicine.

From a research perspective, it very well may be a golden age. Scientists from leading universities in the United States and Europe, including UCLA, Duke, and Oxford, as well as many in Asia, are looking at the scientific underpinnings of some traditional treatments for diseases such as cancer, diabetes, and Parkinson's.

But the practice of melding the modern with the traditional is also spreading among health care consumers. When they don't find relief from Western medicine, Americans increasingly are turning to traditional treatments, notably acupuncture, which is now covered by some health insurance plans, and cupping, a muscle therapy that involves suction and is endorsed by many professional athletes. The internet has fostered the growth in herbal remedies, which are often

illnesses, including epilepsy. "People generally see only what they want to see," he says, "and fail to fully examine its merits and its faults."

I encountered this hornet's nest firsthand when I wrote a story about rhinos being poached for their horns. According to ancient Chinese formulas, rhino horn can be used to treat fever and headaches. In Vietnam I found patients using it to treat hangovers and the side effects of chemotherapy. Multiple scientific studies have determined that rhino horn, which is made of keratin (the same substance as human fingernails), induces little to no discernible pharmacological effects when ingested. But some patients using rhino horn may find relief because of the placebo effect. After the story was published, I got letters from readers angrily denouncing Chinese medicine as "ignorant," "cruel," and akin to "witchcraft."

Such criticisms aren't without merit. Rhino horn sales in Asia are a primary factor pushing

rhino populations toward extinction. In addition to bears, many other animals—including several threatened species such as tigers, leopards, and elephants—are poached in the wild or farmed for their parts.

But modern medicine has its own controversial practices. The effectiveness of many popular antidepressant drugs remains hotly debated, with some studies showing they are barely more effective than placebos. Yet these drugs are extensively marketed and widely prescribed by physicians, generating billions of dollars in revenue. (This isn't to say depression drugs don't work. If a patient's symptoms are relieved, then one can argue they work. But the chemicals in the pills themselves may not always be the source of the relief, just like the chemicals in rhino horn aren't necessarily the source of relief for patients who take it.) When considered alongside other notable examples—the overprescription of opioids, doctor-endorsed fad diets, and questionable surgeries—Western indignation over traditional Chinese medicine can seem more hypocritical than Hippocratic.

This is where snake oil might offer some illumination. Long synonymous with swindling, snake oil actually refers to a traditional Chinese ointment derived from the fat of the Erabu sea snake. Historians believe that such ointments were introduced to the U.S. during the 1800s by Chinese immigrants building railroads, who used them to treat aching joints and muscles. The substance acquired its shady reputation when American hucksters began selling mineral oil as Chinese snake oil.

But here's the rub: Studies have shown that fat in the Erabu sea snake, an ingredient in some traditional Chinese remedies, contains higher levels of omega-3 fatty acids than salmon. Omega-3s are known to reduce inflammation and harmful cholesterol, improve cognition, and help alleviate depression. They are now used in several skin care products. In the 2000s Japanese scientists fed Erabu fat to mice and observed that their ability to swim and to learn their way around mazes improved.

"Don't throw out the baby with the bath water," Yung-Chi Cheng, a pharmacology professor at Yale School of Medicine, says with a chuckle. "People forget that one of the oldest, most effective, scientifically proven drugs came from traditional medicine—*aspirin*." The ancient Egyptians used dried myrtle leaves to treat aches and pains,

and Hippocrates, the fourth-century B.C. Greek physician, considered the father of Western medicine, prescribed an extract of willow bark for fevers. But it wasn't until the 1800s that European scientists figured out that the active ingredient in both is salicylic acid and synthesized it. Today aspirin, at pennies a dose, is arguably the world's most cost-effective drug.

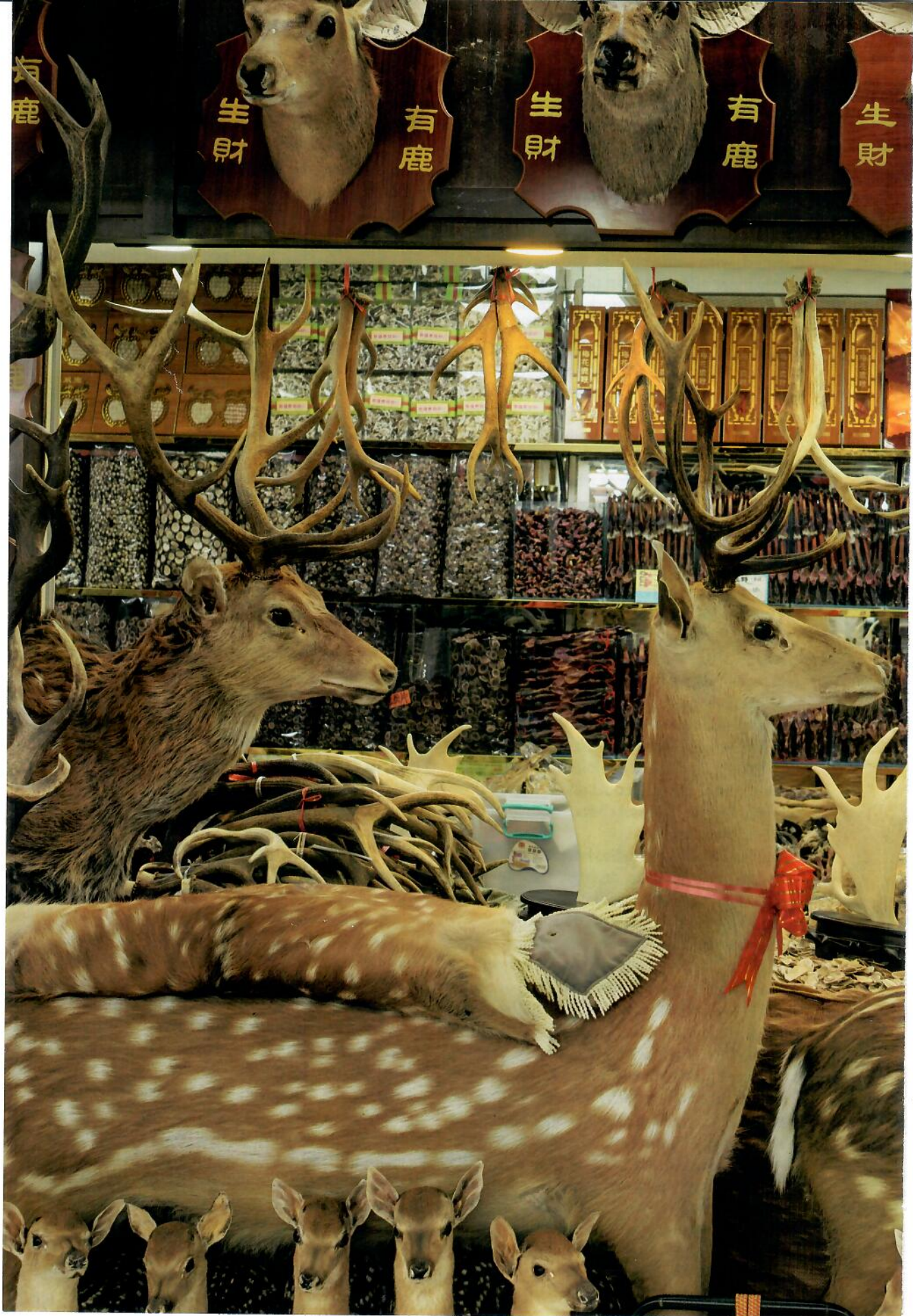
"It all started with people observing willow bark was effective and then using it to treat illness," Cheng says. "In this case, science followed the medicine, not the other way around."

Aspirin is hardly the only case of a modern drug hiding among traditional treatments. In 1972, the year Cheng finished his Ph.D. in pharmacology at Brown University, a chemist in the People's Republic of China named Tu Youyou announced the discovery of an antimalarial substance based on a Chinese medicinal herb mentioned in a fourth-century formula.

During the Vietnam War, Tu had been tapped to work on a secret military project to help the Vietcong combat malaria. The disease accounted for roughly half their casualties. Western health researchers were also trying to solve this problem, screening more than 200,000 compounds. But Tu wondered if an answer might lie in classical Chinese medical texts. She tested several plants related to fever and found a remedy based on a yellow-flowering herb called wormwood (*Artemisia annua*). The drug derived from her research, called artemisinin, has been credited with saving millions of lives and earned her the 2015 Nobel Prize for medicine.

MY NOSE IS FREAKING OUT as I follow Cheng on a tour of his labyrinthine lab at Yale, where his team is analyzing the characteristics of a variety of herbs to investigate their medicinal value. Amid the sighs and gurgles of various chemical experiments, I catch whiffs of black pepper, rosemary, camphor, ginger, chili, cinnamon, and other scents I can't identify. The back of my throat tingles. I think I might sneeze. I notice I'm hungry for Thai food.

On his desk, Cheng has a bobblehead doll in his likeness. A gift from the staff, it depicts him in a suit rather than the slightly baggy sweaters he generally favors, but it captures his thoughtful demeanor, receding hair, and large earlobes, which according to Chinese tradition signify longevity. On first impression Cheng may seem like





A shop at a market in Guangzhou, China, specializes in deer parts—including antlers, penises, and tendons—used in traditional formulas. One obstacle to acceptance of Chinese medicine in the West is the controversial use of animal parts.

## STEPS TO AN HERBAL REMEDY



### 1 DIAGNOSE PATIENT

A practitioner identifies a patient's ailment through an extensive examination that can include checking the pulse and tongue.



### 2 GATHER INGREDIENTS

Each patient is unique: People suffering from the same symptoms may receive significantly different prescriptions.

## 君

### Monarchs

These principal ingredients target the immediate cause and symptoms of the disease.

## 臣

### Ministers

These herbs are said to enhance the monarch's effects and also target underlying symptoms.

## 佐

### Assistants

These treat secondary symptoms, eliminate toxins, and optimize the effects of the other herbs.

## 使

### Guides

Not always necessary in prescriptions, these herbs help deliver ingredients to targeted areas.

#### HERBS SCIENTIFICALLY SHOWN TO

- (FI) Fight infection
- (RI) Reduce inflammation
- (RF) Reduce fever

#### Forsythia fruit (FI) (RI)

PROPERTY: -FLAVOR



#### Honeysuckle flower (FI) (RI) (RF)

PROPERTY: -FLAVOR



#### Burdock fruit (RI)

PROPERTY: -FLAVOR



#### Fermented soybean

PROPERTY: -FLAVOR



#### Schizonepeta leaf (FI) (RI)

PROPERTY: -FLAVOR



#### Mint leaf (FI) (RI) (RF)

PROPERTY: -FLAVOR



#### Reed rhizome (RF)

PROPERTY: -FLAVOR



#### Bamboo leaf (FI) (RI) (RF)

PROPERTY: -FLAVOR



#### Balloon flower (FI)

PROPERTY: -FLAVOR



#### Licorice root (FI) (RI)

PROPERTY: -FLAVOR



YINQIAO FORMULA

# Traditional Treatment

Herbal prescriptions, many dating back millennia, are a big part of traditional Chinese medicine. Formulas may consist of a single herb or many and are customized based on a patient's condition, age, gender, and body type. The recipe for mixing Yinqiao, a 10-herb treatment for the common cold, is shown here.

## ANCIENT THEORIES

One belief is that the body consists of opposite but complementary qualities, or yin and yang, that maintain its healthy balance. Treatments following the four properties and five flavors are thought to promote balance.

## FOUR PROPERTIES

Herbs are labeled hot or cold for their ability to treat ailments considered related to either cold (yin) or heat (yang).

Cold Cool Neutral Warm Hot

**Yin** (cold) herbs treat yang (hot) ailments, such as swelling.

**Yang** (hot) herbs treat yin (cold) conditions, such as chills.

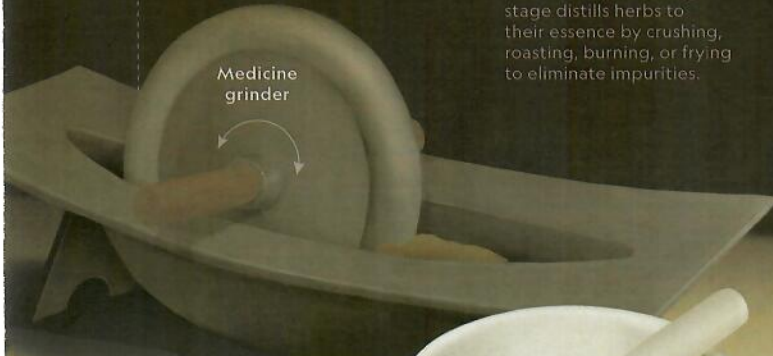


### 3 PROCESS PRESCRIPTION

Depending on the prescription, an herb may be processed in various ways to extract its healing properties in their proper potency.

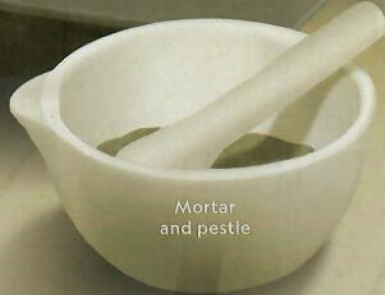
The Paozhi (processing) stage distills herbs to their essence by crushing, roasting, burning, or frying to eliminate impurities.

Medicine grinder



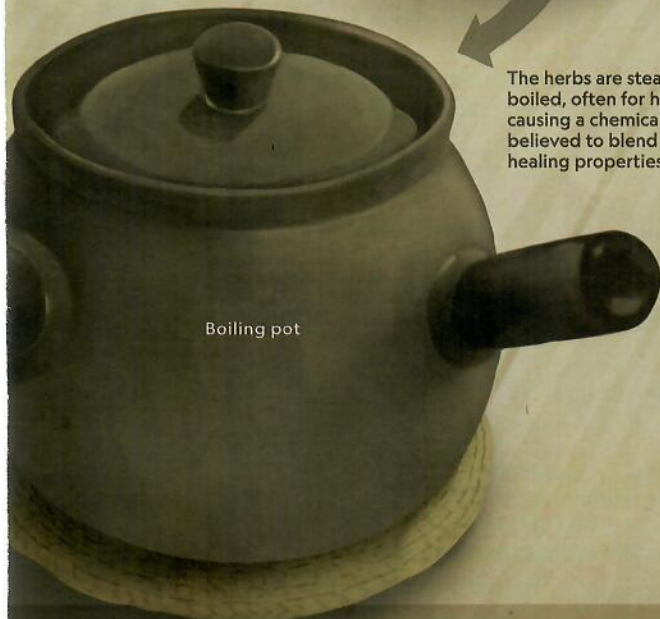
The grinder is sometimes used on soft herbs, like mint, the mortar and pestle on hard ones.

Mortar and pestle



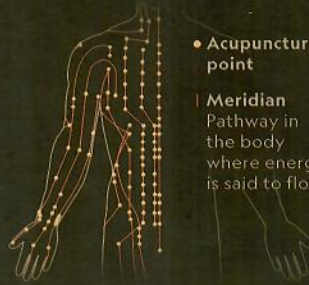
The herbs are steadily boiled, often for hours, causing a chemical change believed to blend their healing properties.

Boiling pot



### 4 TREAT PATIENT

A traditional prescription is designed to target specific parts of the body and to bring the patient's entire system back into balance.



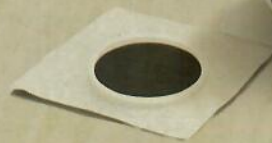
Acupuncture point

Meridian Pathway in the body where energy is said to flow

#### Traditional and artisanal

The medicine is consumed in a broth or tea of reed roots or applied as a patch at acupuncture points.

Patch



Tea



#### Premade and standardized

Generic remedies can be sold as pills or in packets, but some say teas from raw herbs are more effective.

Pills



Powder



#### FIVE FLAVORS

Different flavors are believed to have specific healing properties and the ability to target specific body areas and organs.



**Spicy**  
Stimulates sweating, blood circulation



**Salty**  
Aids bowel movements



**Bitter**  
Reduces heat



**Sweet**  
Relieves pain



**Sour**  
Stops sweating, coughing, and diarrhea



A traditional practitioner at a clinic in Chengdu, China, checks a patient's pulse as others wait. Next he will inspect the tongue and examine other body parts to identify symptoms, then prescribe a treatment to bring the body into balance and help it fight off illness.



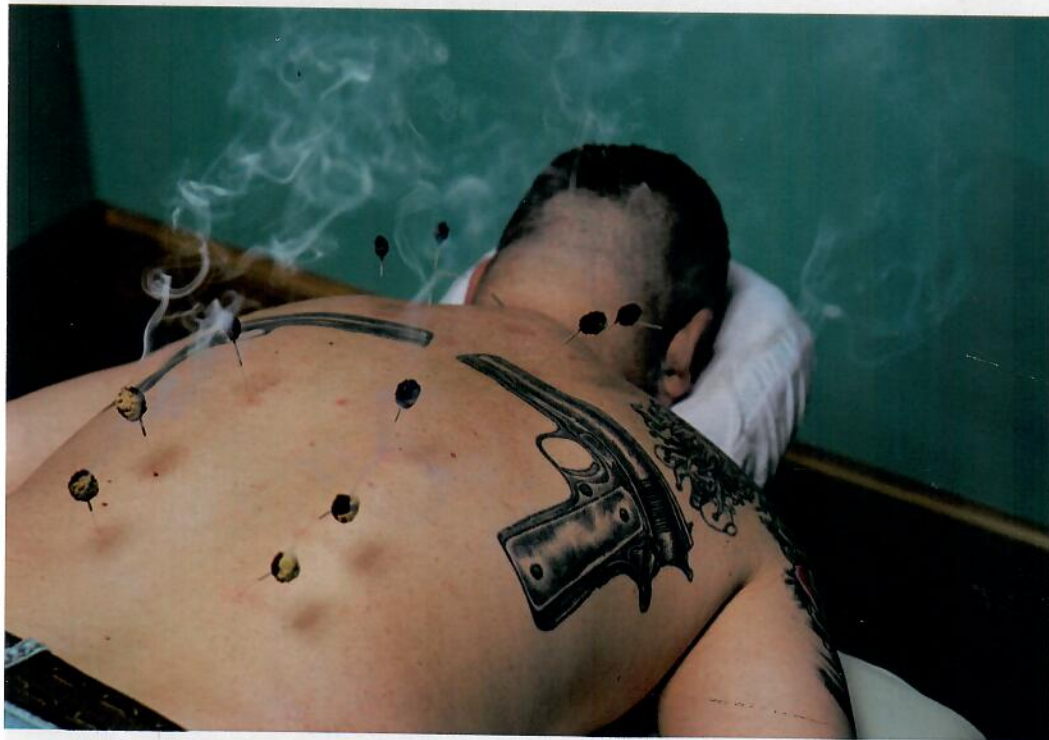


**RIGHT**

Two-month-old Ren Yanyu in Chengdu is bathed in an herbal solution meant to detoxify and cool the body during the humid summer months. The treatment is part of the Chinese philosophy of maintaining the body's overall well-being, not just treating ailments after they've surfaced.

**BELOW**

At a clinic in Beckley, West Virginia, Jeff Hendricks receives acupuncture and a plant-burning technique called moxibustion to ease pain related to four years of military service. He suffers from a brain injury, bulging disks in his neck, bone spurs, headaches, numbness in his hands, and PTSD. The VA-approved treatment reduces the need for conventional drugs.





a stereotypical advocate for traditional Chinese medicine. Though he's been in the United States for five decades since emigrating from Taiwan, he still speaks English with a strong accent, and at 74, he comes from a generation of Chinese that still has a deep attachment to many of the old traditions. "But I didn't really know much about Chinese medicine," he says, noting that as a child, his parents took him to doctors practicing science-based medicine.

Cheng has focused his research solidly in the realm of science, developing antiviral drugs for chronic diseases, such as hepatitis B. But he has also wondered whether there were other cures, based on herbs like wormwood, awaiting rediscovery. Now he's found one that may prove a breakthrough in cancer treatment. He opens a jar and hands me a pinch of a powder—a mixture of four herbs he calls PHY906.

"Taste it," he says. I put a tiny bit on my tongue. It's bitter, with hints of licorice.

During the 1990s Cheng noted that many cancer patients stopped chemotherapy because of

its side effects, including diarrhea and severe nausea. Patients who completed the full course of chemotherapy tended to live the longest, so curbing the side effects, Cheng reasoned, could increase life expectancy. He also knew that Chinese medicine had many herbal treatments for diarrhea and nausea.

His colleague Shwu-Huey Liu, an expert in pharmaceutical chemistry who's fluent in classical Mandarin, searched the Yale library's large collection of early Chinese medical texts. In an ancient book titled *Treatise on Cold Damage*, printed on slightly wrinkled bamboo paper, she found an 1,800-year-old recipe for a mixture of skullcap, licorice, peony, and Chinese date, described as a treatment for "diarrhea, abdominal pain, and scorching heat in the anus."

Cheng's team began trying different blends of the herbal formula. Over the past 20 years, they have proceeded from tests on mice to patients undergoing cancer treatment, overseen by the National Cancer Institute. As Cheng had hoped, almost all the patients who took the herbal formula experienced relief from nausea and other gastrointestinal distress, but something else happened: Their tumors shrank faster than those of patients who hadn't taken the herbal formula.

"I didn't expect that," Cheng says. "So now the question is, Why?"

Johnson & Johnson and Bristol-Myers Squibb, both major producers of cancer drugs, also would like to know the answer. At a pharmaceutical conference in Philadelphia, I listen as Cheng's son Peikwen explains to representatives from those and other leading drug companies what is known about how PHY906 works. A Stanford University graduate who also has an MBA, Peikwen, 43, joined his father to form a company to market PHY906 and develop other herbal drugs. He's dressed in a trim charcoal suit, and his fluency in Mandarin, medical terminology, and Silicon Valley argot equip him to bridge the worlds of Eastern and Western medicine and make him a persuasive advocate.

After analyzing tumors in mice that were given the formula, Peikwen says, researchers noticed a significant increase in tumor-eating macrophages—white blood cells that gobble up cancer cells. The way the herbs interact appears to be the key. "That's really where the frontier lies," Peikwen says. "PHY906 is a cocktail of chemicals—not unlike the drug cocktails that finally proved effective for AIDS patients. We're just unraveling

the original formula and putting it back together in a modern, scientifically based therapy.”

To date PHY906 has been used in eight human trials alongside different chemotherapy drugs and radiation to treat colorectal, liver, and pancreatic cancers, Peikwen tells the audience. “We are hopeful that PHY906 will become the first FDA-approved, multi-herb drug.”

Afterward, several pharmaceutical reps pull him aside to speak privately.

**PEIKWEN AND I HURTL**e into the heart of China on a modern bullet train. The ride is remarkably smooth, as if we’re floating above the track. Meanwhile, ancient China flashes by, an endless patchwork of farms under a gray winter sky. Peikwen agreed to let me visit the source of the herbs if I wouldn’t reveal the full names of the farmers or their locations, which he and his father, along with their partner Sun Ten, a Taiwanese pharmaceutical herb company, consider proprietary information.

I can say this part of China looks like a version of Kansas—tabletop flat with neatly furrowed fields as far as I can see. But among the wheat, rice, and rapeseed are plots of herbs tended by thousands of farmers. As the global appetite for herbal remedies has grown, Chinese farmers have devoted increasing amounts of acreage to hundreds of medicinal plant species. In 2017 the nation’s medicinal herb-growing industry generated about \$25 billion.

But before you quit your job to farm herbs, here’s the problem: Producing medicine-grade herbs is extraordinarily difficult. The chemical potency of each herb can vary greatly, depending on many factors—minerals in the soil, the altitude at which it’s grown, when and how it’s harvested. And then there’s the matter of subspecies that may look exactly alike but have slightly different chemical compositions.

Ask a pot smoker about the difference in potency from one marijuana strain to the next, and you’ll get an earful. Or ask a coffee grower: Arabica beans grown in one part of Ethiopia can have six times as much caffeine as those grown in another part of the country. And depending on how they’re ground and brewed, the same beans can yield different caffeine amounts.

These complications are part of the reason that the FDA has approved only two herbal prescription drugs—a genital wart treatment made from green tea extract and a diarrhea



medicine made from the sap of the South American dragon’s blood tree. Both those drugs contain a single herb, but PHY906 is composed of four, which means more variables must be controlled to make a consistent product. “This complexity is partly why there aren’t any FDA-approved, multi-herb drugs,” Peikwen says.

When we finally get to one of the fields that yielded PHY906, I’m frankly a little disappointed. Except for the fact that the farmer, Chen, is speaking Mandarin, he might as well have been from Kansas. Wearing muddy boots, a heavy parka, and a baseball cap, he pulls out his iPhone and asks Siri to translate the Chinese name of his crop into English. “Peony,” she answers.

As we tour his fields of peony and skullcap bushes, he explains his crop rotations, soil and water analyses, planting and harvesting protocols. Before shipping the herbs, he says, technicians from Sun Ten perform multiple tests to reconfirm the species; screen for microorganisms, toxins, and heavy metals; and complete other quality checks.



In a fire treatment session in Chengdu, an alcohol-soaked cloth is draped over a patient and set alight to warm the skin and open the pores; an herb-infused oil is then applied. The therapy aims to treat joint pain and other ailments, but research has yet to prove such claims.

“You’ve heard of farm to table,” Peikwen says. “The idea here is farm to bedside.”

I tell him that sounds like a marketing slogan. But it’s true, says Chen. “Most companies making herbal remedies don’t get them from farms like this. They get them from Bozhou.”

IF YOU BUY CHINESE HERBS ON Amazon, there’s a decent chance that they passed through the eastern city of Bozhou, the center of the Chinese medicine universe. Every day 10,000 traders sell thousands of different products to 30,000 buyers from all over Southeast Asia, all of them jammed in a colossal structure resembling a domed football stadium.

The morning I visit Bozhou, the market is already a raucous hive of commerce. I zigzag up and down endless aisles, one cavernous room after another, each chock-full of barrels, sacks, pallets, and wheelbarrows heaped with wares derived from what appears to be nearly every plant, mineral, and creature on the planet, including exotic items like deer penises, human

placentas, water buffalo bones, and dried seahorses. A section the size of a grocery store is devoted to the cure-all ginseng root—red and white, wild and cultivated, fresh and dried, ranging in price from a few dollars to several thousand. In the insect section, I stop counting the different centipede species at 11.

I’ve come here to see the source of most Chinese herbal drugs marketed around the world. You can find seemingly every ingredient here, but you’d have little clue how it was grown or where. Sure enough, I easily find all four ingredients for PHY906—but all are sold by resellers who know little of the herbs’ origins.

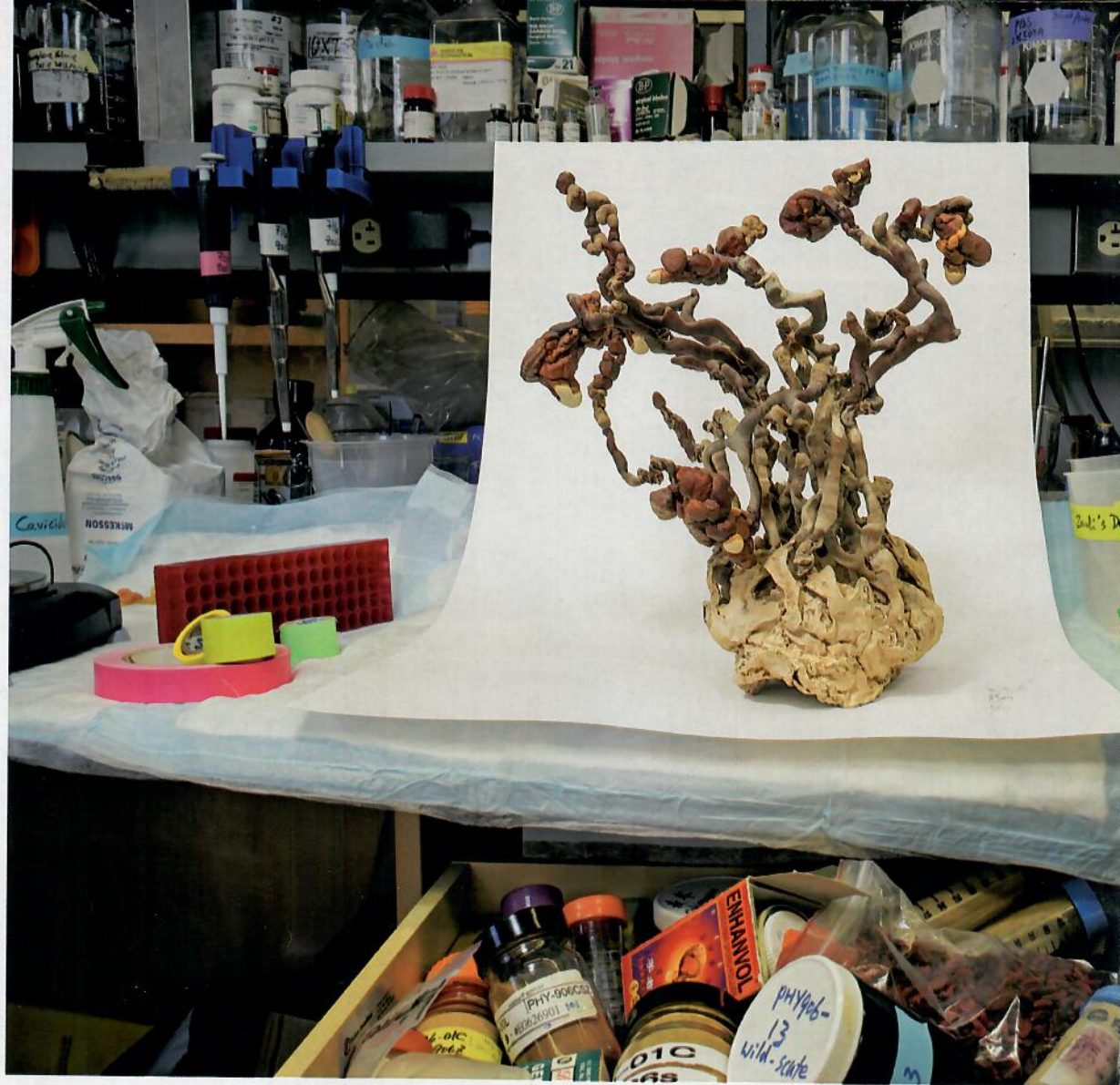
Before I leave the market, one ingredient catches my eye. In a section near deer antler velvet, I see a glass case with a row of bottles containing yellowish liquid. I ask the vendor what it is, and he gets his neighbor to translate. “Take from bear,” the man says. “Very good.”

PAUL IAIZZO LOVES BEARS. An avid outdoorsman who grew up in Minnesota, he has long

Apothecaries at Chengdu Tongrentang traditional pharmacy fill herbal prescriptions, dividing the mixtures into single doses that are folded into paper envelopes. At home, patients will brew them into a tea to drink.







been fascinated by the animals, which roam the state's forests. As head of the University of Minnesota's Visible Heart Lab, he's especially interested in their unique physiology and has teamed up with the state's Department of Natural Resources to study how they hibernate.

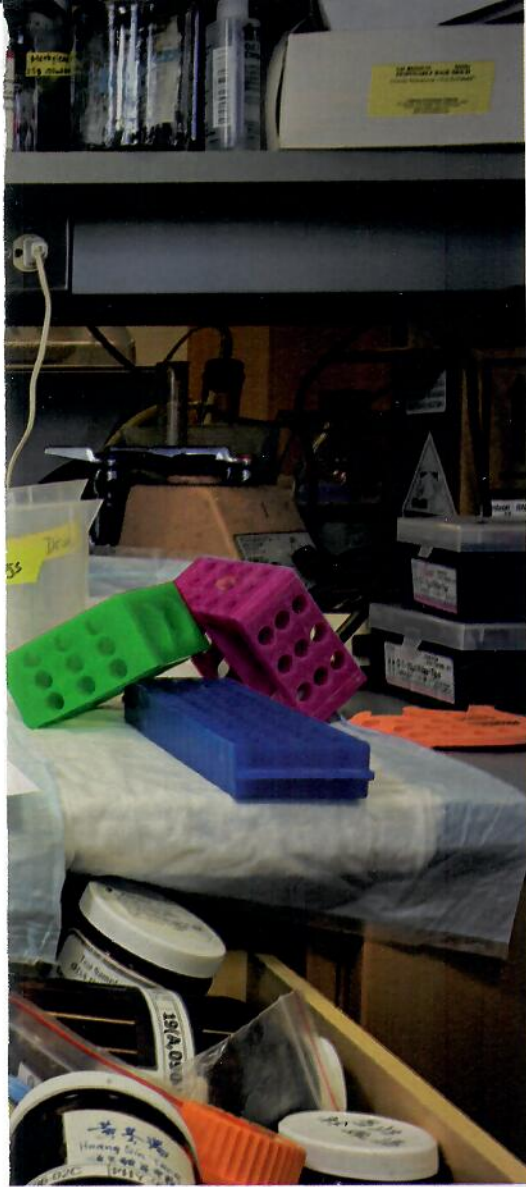
Tall and lean, with a mane of silver hair, Iaizzo ticks off a list of mysteries related to bears, which spend up to six months completely inactive yet suffer no ill effects. Their breathing slows to as few as two breaths a minute. Their temperature drops by 10 percent, which would cause hypothermia in a human. They regularly lose more than half of their body fat but no muscle. Their hearts can pause for 20 seconds, but their blood never clots. Humans risk deadly clots if

their hearts pause for only a few seconds. And yet if a predator approaches, a bear can wake up to defend its den. "And its heart suffers no damage," Iaizzo says.

The earliest mention of bear bile in Chinese literature turns up in a 40-volume treatise from the eighth century called *The Medical Secrets of an Official*. It prescribes bear bile for liver problems, as well as fever, hemorrhoids, and other ailments. In 1902 a Swedish scientist isolated one of the chemicals in bear bile, later named ursodeoxycholic acid, and it's now used in drugs for liver diseases and gallstones.

But Iaizzo and other researchers believe there are many more secrets to be revealed from bear bile, which is produced by the liver, stored in the





Cheng's team grew this *Ganoderma tsugae* fungus in the lab. The species has been found to shrink colorectal tumors in animals. "The Chinese have used herbs for centuries," Cheng says. "The challenge to scientists is to find out which formulas work, and why."

gallbladder, and secreted as hormones into the bloodstream. They are taking aim at a range of therapies, including treatments for muscular dystrophy and for bedridden patients who can lose half of their muscle mass in three weeks.

He's identified three classes of bile components that likely trigger hibernation and may help heart patients—fatty acids, bile acids, and delta opioids. During the procedure on the pig, he injected a synthetic mixture of these into the protective membrane around the beating heart to coat the organ for an hour before he removed it.

Over hundreds of experiments, he's seen pig hearts—which are very similar to human hearts—last up to twice as long as they usually do outside the body. There are many possible applications for humans. Most notably, hearts from donors could be kept viable longer and, once inside a recipient, could be restarted faster. Currently, a heart must be transplanted within six hours or less. In the U.S., 300 people die every year waiting for hearts.

"If we could preserve a heart for 24 hours, we could get it anywhere in the world," Iaizzo says. "And that could vastly increase the number of available organs. That would be a game changer."

I ask him whether the Chinese practice of drinking bear bile could really bestow any health benefits. "It could," Iaizzo says, noting the chemicals would enter the bloodstream and move through the heart and other organs. He doesn't condone farming bears for their bile, emphasizing that the chemicals can be synthesized, but the science is the science. And though the ancient Chinese didn't understand how bear bile helped humans, they observed that it did.

As I hold the pig heart, I can feel its rhythm slowing. It finally stops. The pig died hours ago, and now its heart has stopped too. Its color seems to dim—like a mahi-mahi that loses its lightning yellow glow as it dies in the hands of a fisherman. I wonder if whatever is now gone is what the ancient Chinese meant by qi.

I think of the moment in the hospital when I was holding my father's hand and felt his pulse finally stop. I'm suddenly aware of my own heart, flexing and lurching inside my rib cage, and wonder about its other mysteries. □

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Peter Gwin wrote about falconry in the October 2018 issue. Fritz Hoffmann has been photographing stories in China for 25 years.

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# NATIONAL GEOGRAPHIC

*The cells of  
a patient's heart,  
lungs, liver, kidney,  
brain—you name it—  
can be replicated  
on this chip to help  
researchers develop  
individualized  
treatments.*



THE  
FUTURE  
OF

# MEDICINE

HOW NEW TECHNOLOGIES AND ANCIENT REMEDIES  
ARE TRANSFORMING HEALTH CARE