

GRAPES, WINE, AND THE MISSOURI BOTANICAL GARDEN CONNECTION



Henry Shaw, the founder of Missouri Botanical Garden, had a passionate interest in the history and study of wine. He wrote and published *The Vine and Civilisation* [sic] in 1884. In this self-published work, Shaw outlines how wine influenced global civilization from the ancient world to his time and gives great detail on grape-growing regions and wine production around the world. He mentions little about wine grapes in Missouri other than to say "Catawba and Norton's Virginia" are considered the best for wine making in the state, "notwithstanding late cold springs, mildew, and the rot, good wine is made..." Shaw was a collector and connoisseur of fine wine. At the time of his death he had over 3,000 bottles from the finest vineyards in France and Germany.



Dr. George Engelmann was a botanist and physician in St. Louis during the 19th century. Engelmann was keenly interested in all new plants being discovered by scientists in the United States and Mexico, assembling a large private herbarium now located at the Missouri Botanical Garden. He worked closely with Isidor Bush, owner of the largest St. Louis nursery at the time, to publish the *Illustrated descriptive catalogue of American grape-vines* 1875. The catalog was later translated to French and became the definitive work delineating North American *Vitis* species. Starting from the 1870s, an insect named phylloxera began destroying the European wine industry. Using Engelmann's herbarium specimens, Engelmann and Missouri entomologist Charles V. Riley determined that the phylloxera insect was native to North America and that American grape species were resistant to the pest. Engelmann, along with Bush and two other Missouri horticulturalists, George Husmann and Hermann Jaeger, helped develop and organize the shipment of millions of phylloxera-resistant American grapevines to France, where they were used as hardy root stocks to which European vines were grafted. The defeat of the phylloxera problem was the first triumph of modern biology over an immense economic disaster, and Missouri scientists Engelmann, Riley, Bush, Husmann, and Jaeger played a key role in the solution. As phylloxera has become pandemic, grapes all over the viticultural world are now grafted on to the resistant root stock, all of which have North American origins.

Caption: A surviving bottle of sherry, bearing Henry Shaw's Tower Grove label, that is now kept at the Missouri History Museum in St. Louis.

HENRY SHAW AND DR. GEORGE ENGELMANN, TWO KEY FIGURES IN THE HISTORY OF THE MISSOURI BOTANICAL GARDEN, BOTH HAD STRONG INTERESTS IN GRAPE VINES AND WINE MAKING, INFLUENCING THE SCIENCE, PRODUCTION, AND APPRECIATION OF VITIS LOCALLY, NATIONALLY, AND INTERNATIONALLY.



GRAPES ARE PART OF A LARGE, PRIMARILY TROPICAL FAMILY OF MOSTLY CLIMBING VINES.

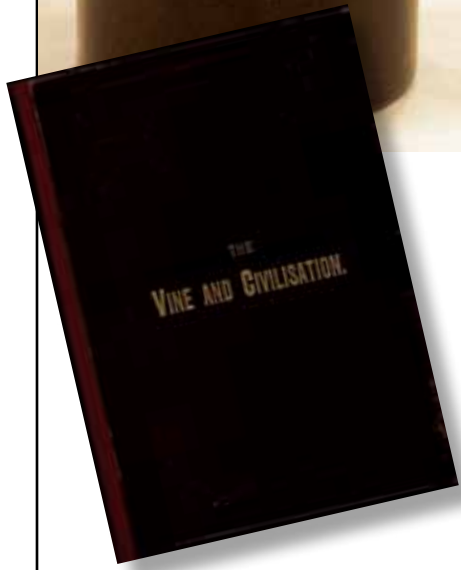
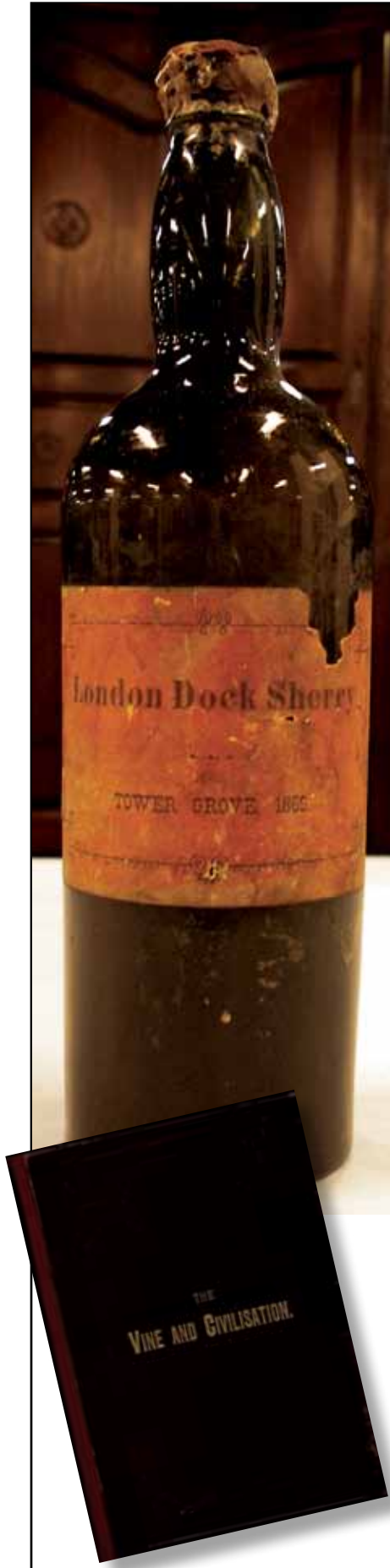
GLOBAL GRAPE DIVERSITY

The plant family that includes grapevines, Vitaceae, is named for the grapevine genus, *Vitis*, the Latin word for vine. Members of the Vitaceae are mostly woody vines with tendrils on the opposite side of the stem from the leaf, although some are stem succulents (*Cyphostemma*). Tendrils help vines climb by curling around nearby plants or other supports. Fossil data suggest that the Vitaceae is at least 90 million years old. Today, the family includes 14 genera and over 900 species. The majority of Vitaceae species are found in the tropics; for example, *Ampelocissus* (90 species), *Cayratia* (45 species), *Cissus* (200 species), and *Cyphostemma* (150 species) are distributed in tropical Africa, Asia, America, and Oceania. Scientists at the Missouri Botanical Garden and elsewhere have contributed significantly to current understanding of diversity within the Vitaceae through projects and their publications such as the *Flora of China*, *Flora Mesoamericana*, *Flora of North America*, and *Flora of Missouri*.

Grapes used for food, juice, and wine come primarily from the European grapevine *Vitis vinifera*, one of about 60 species in the genus *Vitis*. *Vitis* originated approximately 18 million years ago and is unique in the family in that its species are found mostly in temperate regions (about 38 Asian and 19 North American species). *Vitis vinifera* is the only European species in the genus and includes two subspecies: the cultivated grapevine (*V. vinifera* ssp. *vinifera*) and its wild ancestor the European wild grape (*V. vinifera* ssp. *sylvestris*). Humans began cultivating the European wild grape more than 9,000 years ago. Since then, selection for vines with desirable traits (e.g. large, sweet fruits and plants that can self-fertilize) has led to changes in the cultivated grapes from their wild ancestors. Evolution in response to human selection, a process called domestication, is how crops originate and is the foundation of contemporary crop improvement.

Caption: (Top left) *Cissus* spp. from Nicaragua. (Top middle) *Cyphostemma juttae* growing in University of Catania Botanical Garden, Italy. (Top right) *Cyphostemma juttae*. (Right) Tendrils of a *Vitis riparia* plant wrap around the metal wire in the research vineyard at the Missouri Botanical Garden. Tendrils are believed to be an adaptation that allows plants to support themselves on other plants or objects. (Bottom right) *Ampelopsis brevipedunculata* is a common volunteer species in Missouri, often popping up in garden beds and alleys.

References: Angiosperm Phylogeny Group | Tröndle D., Schröder S., Kassemeyer H-H, Kiefer C., Koch MA, Nick P 2010 | Molecular phylogeny of the genus *Vitis* (Vitaceae) based on plastid markers. *American Journal of Botany* 97(7): 1168 – 1178 | Ren H and Wen J. 2007. *Vitis*. *Flora of China* 12: 210 – 222. | Wen J, Nie Z-L, Soejima A, Meng Y. 2007. Phylogeny of Vitaceae based on the nuclear GAI1 gene sequences. *Canadian Journal of Botany* 85: 731-745 | Zecca G., Abbott JR, Sun W-B, Spada A, Sala F, Grassi F 2012. The timing and mode of evolution of wild grapes (*Vitis*). *Molecular Phylogenetics and Evolution* 62: 736-747 | Zohary, D., and M. Hopf. 2000. *Domestication of plants in the Old World*. Oxford University Press. New York, New York, USA. | Myles, S., A. R. Boyko, C. L. Owens, P. J. Brown, F. Grassi, M. K. Aradhya, B. Prins, A. Reynolds, D. Ware, C. D. Bustamante, and E. S. Buckler. 2011. Genetic structure and domestication history of the grape. *Proceedings of the National Academy of Sciences* 108(9): 3530 – 3535.



LOCAL MISSOURI VITACEAE

Vitaceae species are beautiful and ubiquitous members of Missouri forests. Most are woody vines whose leaves emerge above the forest canopy, leaving visitors to observe only a thick stem reaching from the ground to the tree tops. Four Vitaceae genera representing 15 species occur naturally in Missouri: *Ampelopsis* (*A. arborea*, *A. brevipedunculata*, *A. cordata*) *Cissus* (*C. trifoliata*), *Parthenocissus* (*P. quinquefolius*, *P. vitacea*), and *Vitis* (*V. aestivalis*, *V. cinerea*, *V. labrusca*, *V. palmata*, *V. riparia*, *V. rotundifolia*, *V. rupestris*, *V. vulpina*). Vitaceae provide an important food source for native forest birds and other animals.

Vitis species in Missouri and surrounding areas have evolved in response to challenging climates and pests over the course of thousands of years of natural selection. As a result, these species play an important role in the global grape industry by providing genetic resources that can withstand extreme climates and attacks by insects and pathogens. Starting with the phylloxera crisis in the mid 1800s, cultivated grapevines consist of two genetically distinct entities that are grafted together. Berries used for eating and making wine come primarily from the European species, *V. vinifera*, which forms the top half of the plant, named the scion. This is grafted to a rootstock, a distinct species that is hardier and more disease resistant than the European grape. Two native Missouri *Vitis* species, the river grape (*V. riparia*) and the rock grape (*V. rupestris*) are important sources of rootstocks for the global grape industry.

A Missouri-wide effort to advance grape research in the state is gaining momentum and includes scientists working at the Danforth Plant Science Center, Missouri Botanical Garden, Missouri State University, Saint Louis University, the University of Missouri, and Washington University, as well as the United States Department of Agriculture-Agricultural Research Service (USDA-ARS). Recently, the Missouri Botanical Garden, the USDA-ARS, and Saint Louis University collaborated to establish an experimental vineyard in the William T. Kemper Center for Home Gardening. The research vineyard includes multiple individuals of the river grape and the rock grape. Scientists are monitoring gene expression and nutrient uptake with the goal of comparing how closely related *Vitis* species respond to stressful environmental conditions. These data will be used to help develop improved rootstocks for grape growers.

STRONG ROOTS: MISSOURI GRAPEVINES THAT RESIST PATHOGEN AND CLIMATIC STRESS ARE USED AS ROOTSTOCKS IN GLOBAL GRAPE CULTIVATION.



Captions: (Top) Saint Louis University PhD student Laura Klein presses a herbarium specimen of *Vitis rupestris* in southwestern Missouri. (Bottom) Eighteenth century botanist George Engelmann collected specimens of numerous *Vitis* species which are housed in the Missouri Botanical Garden herbarium today. (Bottom left) Missouri Botanical Garden Horticulture staff members June Hutson and Chris Hereford record soil moisture in the research vineyard. Research Vineyard in the Kemper Center for Home Gardening. (Large photo) The research vineyard was funded in part by the Saint Louis University Center for Sustainability.



WINE IN MISSOURI

The versatile grape supports a wide array of businesses globally and right here in Missouri. The award-winning boutique wines made in Missouri all come from hybrid grapes of American species because the European wine grape, *Vitis vinifera*, doesn't grow well here. One example is the popular Norton grape, believed to be a hybrid between *Vitis aestivalis*, a North American species, and the European grapevine. The preferred grape for use in jams, jellies, and purple grape juice is the North American Concord grape (*Vitis labrusca*), which is also used to make sweet wines with a musky or "foxy" taste. The seeds are also valuable. Oil can be pressed from the seeds left over from wine or juice production and used in products such as cosmetics or as a dietary supplement. The Missouri Botanical Garden's William L. Brown Center has collaborated with the University of Missouri and Chaumette Winery to quantify health-promoting chemicals in the seeds of hybrid grapes. The healthful chemicals in grapes, primarily polyphenols in the seed and berry skin, have received considerable scientific attention not only in Missouri, but around the world.

Wineries and vineyards in seven regions of Missouri enhance the state's tourism industry. Nine wine trails lead visitors through beautiful landscapes to a series of neighboring wineries, where many have set up tasting rooms and tours, as well as other amenities for tourists. Missouri's wine country can be just as enjoyable as those of France or South Africa, while being far more affordable and accessible for short getaways.

Captions: (Large photo) Vineyards and wineries located in Missouri's beautiful countryside add over \$175 million and 6400 jobs to the state's tourism industry. (Top) The famous Norton hybrid produces strong red wines that are rich in resveratrol, a compound that may have health benefits. (Middle) Missouri produces nearly half a million cases of wine per year; that's over a million gallons! (Bottom) Missouri Botanical Garden Herbarium specialist Mary Merello collects *Vitis labrusca* samples from a Missouri concord grape vineyard.

GRAPE IS THE MOST ECONOMICALLY IMPORTANT BERRY IN THE WORLD; ITS TOTAL ECONOMIC IMPACT IN MISSOURI ALONE IS ESTIMATED AT \$1.6 BILLION PER YEAR.

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Science and Conservation at the Missouri Botanical Garden

With operations in over 35 countries around the globe, the Missouri Botanical Garden collaborates with local institutions wherever Garden botanists conduct research and field work, providing technical expertise, assistance with fund raising, and better communication with the worldwide scientific community.

The research division consists of 46 Ph.D. botanists assisted by 144 support staff and 20 graduate students. Studies concentrate on the plants of Meso- and South America, sub-Saharan Africa, Madagascar, China, Vietnam, and North America.

Individual Garden scientists are specialists in the plants of particular regions, in the systematics and evaluation of major plant families, and in the interactions between plants and people.

The Garden serves as the headquarters for the Center for Plant Conservation and for several major collaborative publications, such as *Flora of China* and *Flora Mesoamericana*.

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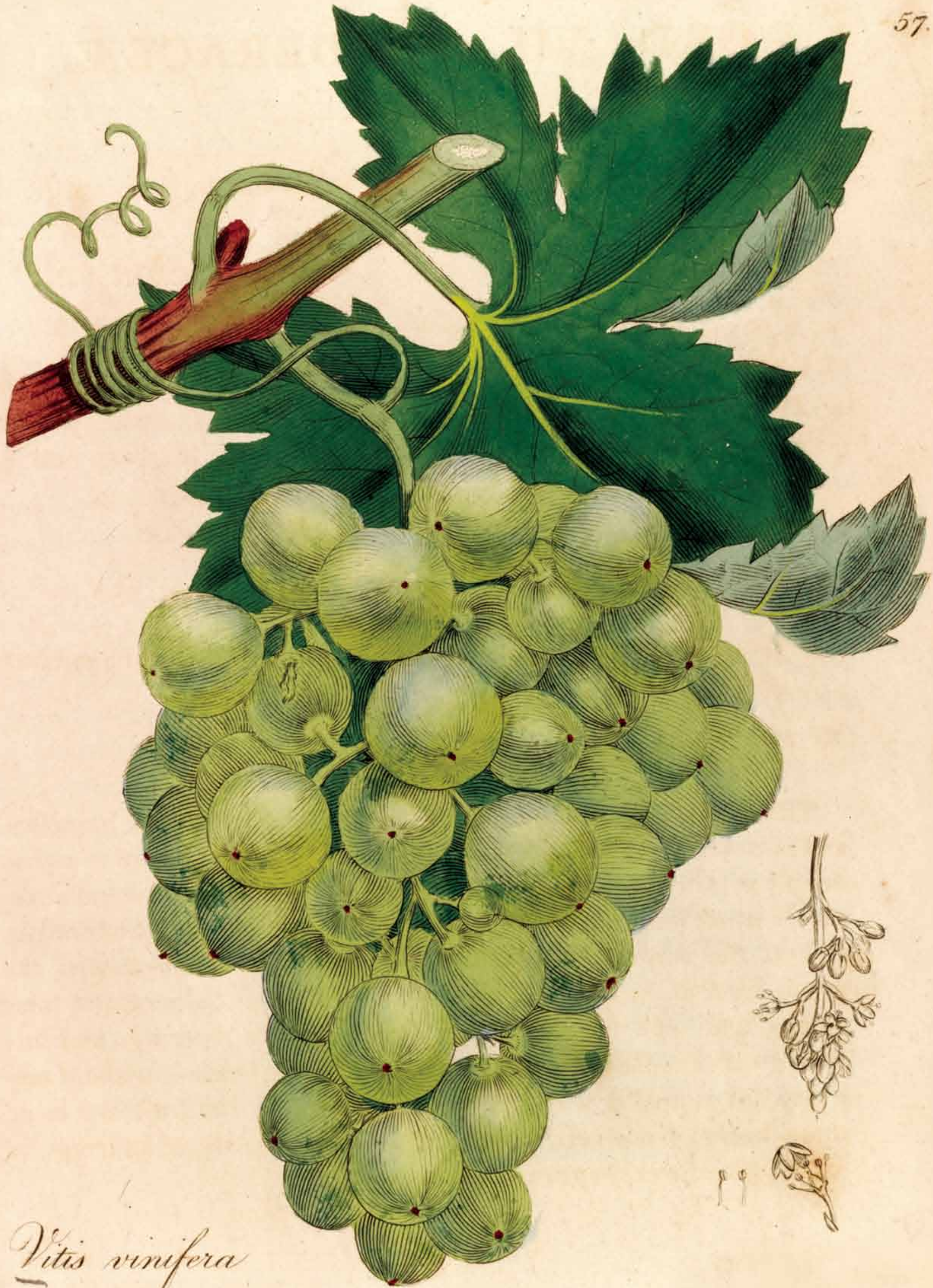
Vitis vinifera. (Linn.) The WINE GRAPE, which follows the steps of civilized man, is rarely found in a wild state in Europe, and never in America.

Of the vine, its fruit, and the wine made from it, the writer proposes to give a brief history, drawn from various authorities.

- Excerpt from *The Vine and Civilisation* by Henry Shaw

The vine is universally known for its fruit, and for producing the first liquor of the world; a liquor, notwithstanding all that is said of its dangerous qualities, that is yet eagerly drunk by all who can procure it, and preferred before all others by those who are unlimited in their means and choice. The Grape is, among fruits, what wheat is among cereals, or the potato among farinaceous roots; and like them, in every country where it will grow, is cultivated with pre-eminent care.

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Vitis vinifera

Published by Phillips & Fardon, Dec 27. 1832.

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