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UC Davis Experimental Winery Open for Business

UC Davis has built the winery of the future, and is offering its state-of-the-art equipment, along with top flight researchers, to winemakers interested in exploring the intricacies of making wine.

Lance Cutler

Lance Cutler has been a working winemaker in Sonoma County for 35 years. He has been a contributing editor for *Wine Business Monthly* for more than 10 years. His unique perspective on winemaking has led to our Industry Roundtable series and Varietal Focus series. Lance is also the author of four books, including *The Tequila Lover's Guide to Mexico*.

FOR MORE THAN THREE decades, **Roger Boulton** had a dream: a state-of-the-art research facility specifically designed to analyze any winemaking or viticultural variable. He dreamed of a facility that could carry out precise and accurate experiments by testing in small lots and in triplicate. He wanted a place so advanced that it would attract the best and the brightest researchers and bring in the grant money necessary to fund the projects. He wanted a place that would serve as an exhibit hall for the wine industry with the most advanced instrumentation, a place that was so energy and water efficient that it would leave the smallest possible CO_2 footprint and serve as a paradigm for the future.

Of course, if you asked Boulton—the brilliant, enigmatic professor and chemical engineer, Stephen Sinclair Scott-endowed Chair in the **Department of Viticulture and Enology** at the **University of California at Davis**—he would likely say, "It wasn't a dream really. It simply needed to be done." His Australian accent and cadence would flavor his speech as he would tell you that the wine industry should have funded the venture years ago, but they wouldn't, in spite of repeated appeals; so Boulton and the team at UC Davis secured private funding and went ahead with the project.

Building the Dream

Beginning three years ago, Boulton's dream became reality. There is still no formal name for the building that houses both the winery and the **August A. Busch III Brewing and Food Science Laboratory**. It is known simply as the Teaching and Research Winery, but it is the first LEED Platinum winery in the world and the highest scoring LEED Platinum building at any major university. (LEED stands for Leadership in Energy and Environmental Design, and Platinum is its highest certification.)

The building is energy and water positive, using rooftop photovoltaic panels and collected rainwater. Six rainwater collection tanks capture rain from the entire **Robert Mondavi Institute** complex to provide the annual water supply for the winery. The building houses advanced commercial systems for reverse osmosis filtration of rainwater and uses a **Cogenra** solar hot water system, along with a solar-powered icemaker for the cold water system. All hot and cold water for temperature control of fermentation and general winery operations is made and stored in the building.

In the winery, cleaning protocols are based on potassium hydroxide and potassium bisulfate buffers, with added hydrogen peroxide. This eliminates

Roger Boulton and T. J. Rodgers

any sodium, chlorine, ozone or organic compounds, enabling the recovery of all cleaning solutions by nano-filtration. Using these membranes allows for 90-percent recovery of all water, no matter the usage. The winery uses less than one-fifth the normal water requirement for most wineries.

The building itself is a passive structure capable of maintaining temperatures below 80° F even during a heat event of five consecutive 100° F days. The walls have R-values of 60 and the roof clocks in at an R-value of 75 (the R-value is the capacity of an insulating material to resist heat flow. The higher the R-value, the greater the insulating power). The slab floor can be cooled or heated by the winery's process water system. Another system sequesters carbon dioxide produced during fermentation and converts it into calcium carbonate. Plans call for the eventual production of hydrogen on-site to operate a hydrogen fuel cell for nighttime energy needs. "The building is designed so that each of these systems can be removed and replaced with a newer model, making it an evolving test-bed and demonstration site," Boulton explained.

Funding and Design

The adjacent $3.5 million **Jess S. Jackson Sustainable Winery** building, made possible by a $3 million contribution from **Jess Jackson** and his wife **Barbara Banke** of **Jackson Family Wines**, is the newest piece of a visionary project that began in 2001 when **Robert Mondavi** gave the Viticulture and Enology Department what eventually turned into a $20 million gift. That gift was enhanced with $50 million in state bond and university money to design and construct the $70 million complex that became known as the Robert Mondavi Institute for Wine and Food Science. In all, more than 150 individuals, alumni, corporate friends and foundations have contributed to the new facility.

David Block, the current department chair, and **Jim Wolpert** (who was department chair at the time) worked with architects and served on the building committee to design a space that would fit the needs of the Viticulture and Enology Department. Design for the first three Mondavi Institute buildings took place from 2003 to 2005, and construction started in late 2005 with completion in September 2008.

An additional $5 million from the original Mondavi gift, along with another $11.5 million raised from private donors, was earmarked to construct another building that houses the Teaching and Research Winery and the August A. Busch III Brewing and Food Science Laboratory.

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SIEGEL & STRAIN ARCHITECTS

The goal was to design a winery that would be the most advanced in the world while keeping within a strict budget. Block drew plans that were close to the finished design. A large room for fermentation led to smaller rooms with constant temperature and humidity control, allowing for barrel and closure studies. The plans included high-density bottle storage for research wines, a room to hold clean-in-place equipment, a control room, classrooms, offices and a special collection room to hold commercial wines and impress visitors to the facility. Thanks to a gift from **Jerry Lohr**, the builders were able to make the fermentation room much larger than the original design.

At the beginning of this design phase, Boulton started pushing the idea of making the building the most sustainable winery in the world. He worked very hard to convince the other people from the university that the extra expense of achieving LEED Platinum certification would be worth the money. After more rounds of design, three companies bid on the project. **Flad Architects** and **BN Builders** were chosen for the best design. A donation from the Jackson family allowed the team to include an option that would qualify for LEED Platinum certification. Boulton and the development team raised another $2 million to make that LEED design a reality.

Boulton and Block, along with **Chik Brenneman**, winemaker for the Department of Enology, gave the main input on the final design of the building. **Andy Waterhouse**, department chair at the time, and Jerry Lohr

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(who was a major donor and had been in the construction business) added important input. **Julianne Nola** was project manager for the university. Boulton was the leading force on the LEED Platinum design features and, along with Block, worked on the winery designs and engineering calculations. Brenneman worked with the architects and construction team on final design throughout the project. Construction for the Winery, Brewery and Food Science building started in fall of 2009, and by July 2010 the winery was up and running.

According to Block, "The Jackson Sustainable Winery Building was Roger Boulton's idea. He developed the idea and secured the funding with Andy Waterhouse and the university's development team. Three teams again entered this competition, and the winning design went to **Siegel & Strain Architects/Pankow Builders**. Chik again took the lead in working with the design team on detailed plans and during construction with Roger, giving constant input and guidance for his vision." Construction on the Jackson Building started in fall 2012 and was completed in March 2013.

Brenneman became the manager of the teaching winery and noted that there is a big difference between using the winery for teaching enology students how to make wine and using the winery as a research facility. "Teaching students has to be practical," he explained. "Students need to learn how to hook up hoses, run pumps and operate equipment. They need to understand the nuts and bolts of the industry. The research side is all about precision and understanding the variables. I need to understand what researchers are looking to discover and then help them use the equipment at hand to make those discoveries."

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Six rainwater collection tanks capture rain at the Robert Mondavi Institute, providing the annual water supply for the winery.

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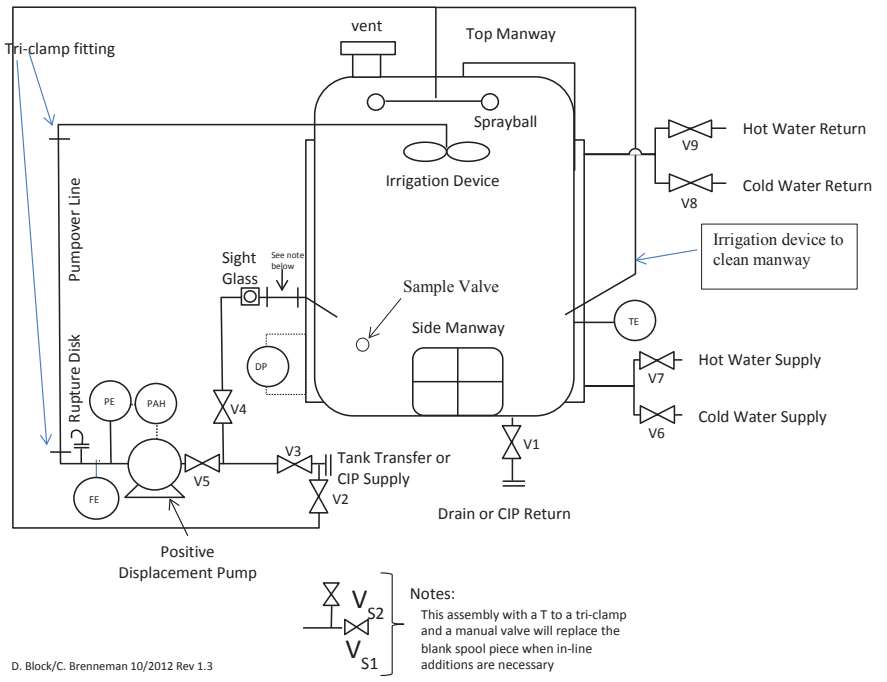
With 152 research fermenters, each with a wireless system, the UC Davis winery can process up to 50 separate grape lots at a time, in triplicate.

The Winery of the Future

With Brenneman in charge of operations, Boulton led the way on getting equipment. He contacted **T.J. Rodgers** at **Cypress Semiconductor Corporation** and, with input from Brenneman and Block, they teamed up to design and build the remarkable fermenters for the research winery. Rodgers' involvement reads like a fairy tale. He had a passion for red Burgundy, but he knew nothing about winemaking. Undaunted, he decided to plant a Pinot Noir vineyard. Out of the blue, he called Boulton to question him about a research paper he had written. Boulton was generous with his time and knowledge and eventually put Rodgers in contact with UC Davis graduates, who helped Rodgers learn how to make wine. Now, along with his wife **Valeta Massey**, he operates **Clos de la Tech Winery** in the Santa Cruz Mountains where he specializes in Pinot Noir.

"When I had the opportunity to help the school that helped me, I took it," explained Rodgers. Rodgers repaid that opportunity to help to the tune of $2.5 million, creating the first wireless fermentation system. Another $1 million went into creating the 200-liter electro-polished, stainless steel fermenters that are individually equipped with automated, wireless temperature control. A built-in system handles pump-overs, and precise sensors monitor fermentation progress, reading Brix down to 0.25 degrees. Data from each fermenter is transmitted wirelessly to a computer control room in 15-minute intervals and automatically graphed on the monitors. Boulton can even access the data from his smartphone.



Simplified diagram of CIP-Capable Fermentors

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"This radically new fermentation system is unlike anything available at the moment to commercial or research wineries," said Boulton, "T.J.'s donation gives UC Davis a wine research ability capacity that has no equal. It equips us, for the first time, to perform reproducible fermentations with precise temperature control and uniform mixing, which is critically important for consistently producing reliable research conclusions for quality wines."

T.J. Rodgers has a doctorate in electrical engineering from **Stanford University**. He is the founder, president and chief executive officer of San Jose, California-based Cypress Semiconductor. Not only did Rodgers design, invent and fabricate the new fermentation system, he helped install it with a team of engineers from Cypress Semiconductor. Then they spent time teaching students and faculty how to use the system correctly. Rodgers and his team have also upgraded the system each of the three years it has been in use.

The key to viable research lies in controlling variables. If you can't isolate and measure individual variables to study, then you can't really be sure that your particular variable is the one causing whatever you see happening. With 152 research fermenters, each fitted with the wireless system, the UC Davis winery can process up to 50 separate grape lots at a time, in triplicate. They are now able to control, study and accurately measure any variable that they want. As Boulton predicted, "These fermenters that we now use for teaching and research will one day become an essential component at every commercial winery. They will play an essential role in helping us understand, in a way never before possible, how all viticulture, grape cultivars, climate, vineyard sites and practices are critically linked to research on wine flavor and chemistry."

These fermenters won't be available in commercial sizes to wineries for some time. Until then, Boulton hopes to provide a contracted research wine-making service. He has a very ambitious goal of acquiring enough research contracts to bring in $20 million of annual funding. Faculty and graduate students would work with growers and winemakers to design research projects that test any specific factor the client wants studied. The experiments are carried out in triplicate to ensure accurate results. Fermentation data is collected every 15 minutes, and participating companies can even access the information on their computers or smartphones. Fees would be determined by the complexity of the research provided.

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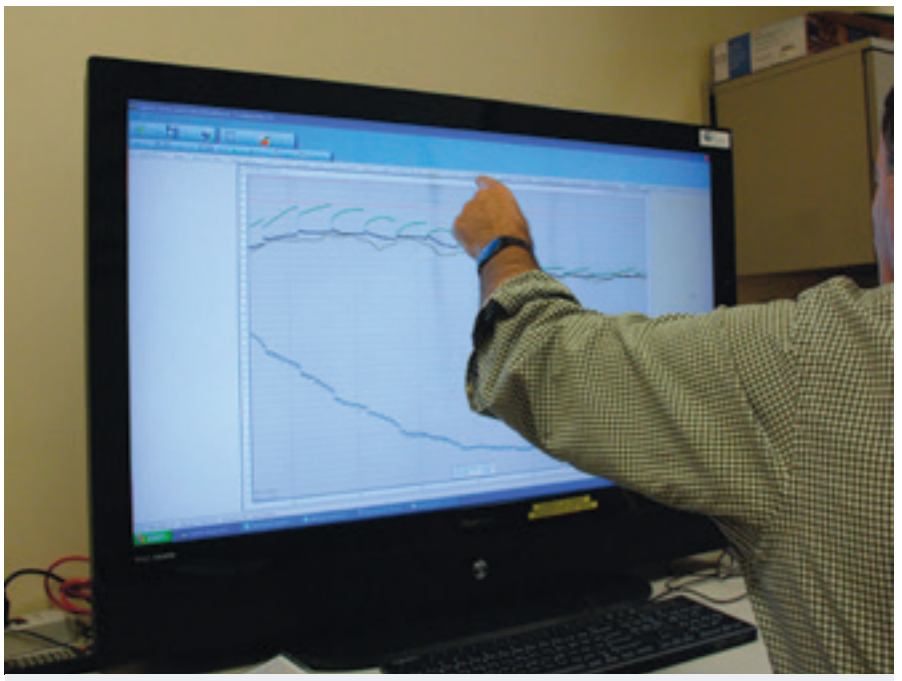

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Sophisticated Research for All

The research winery can work with individual winemakers on any subject, providing precise testing and analysis. Samples can be picked using specific parameters. Variables can be isolated for study. Experiments can be controlled with precision. Each of the research fermenters holds about one-third of a barrel of wine. Since experiments are run in triplicate, there will be one full barrel of each wine when the research is finished. Boulton is working with the **Alcoholic Beverage Control** to make returning that barrel of wine to the participating winery a reality.

The possibilities are staggering. This year they are charting the differences between machine-harvested fruit and hand-picked fruit, with an added test to see the difference between hand sorting and mechanical sorting. Another experiment tracks pump-overs and how they influence temperature in the fermenters. The goal is to learn how specific phenolics are extracted and whether the temperature in the juice or the cap is the critical factor. Not only is research being conducted on phenolic extraction during fermentation, but they are also researching phenolic extraction during cold soak as well as during extended maceration. While every winemaker has an idea about

what happens during a cold soak or an extended maceration, there really is no current study on how phenolic extraction occurs under these conditions.

Boulton sees all of the information gleaned from future research projects as providing indispensable knowledge that affects the way we grow grapes and make wine. The state-of-the-art technology is already up and running at UC Davis. The next problem is to interest enough growers and winemakers to fund the research, which, in turn, would attract the best and brightest researchers.

One of those star researchers was **Fernando Buscema**. Buscema worked as director of research and development for the famous **Catena Zapata Winery** in Argentina. That winery financed his year in graduate studies at UC Davis. Upon his return to Argentina, they appointed him winemaker for the prestigious **Caro Winery**, the joint venture between **Lafite Rothschild** and Catena Zapata. Buscema was one of the first researchers to use the new winery and fermentation system for a unique Malbec study. "It is the winery of the future," he said. "You have to go there with an open mind. It challenges everything you know about making wine in a sustainable way."

Conclusion

Challenging everything you know is a powerful way to learn. In the end, UC Davis is an institution of higher learning. For decades it has attracted some of the most dedicated and knowledgeable people to its departments of Viticulture and Enology. From **Albert Winkler** to **Andy Walker**, from **Maynard Amerine** and **Harold Olmo**, to **Vern Singleton** and **Ralph Kunkee**, the two departments have a long history of excellence. There are plenty of bright, talented professors at UC Davis today, and Roger Boulton is certainly one of them. As **Dave Ramey**, winemaker at **Ramey Wine Cellars**, said, "Since I first arrived at Davis in 1976, Roger has been the Department's dynamo. It's no surprise to me that he spearheaded the university's new winery and roped me into contributing, too!"

In effect, UC Davis imagined the winery of the future, and it's already up and running today. It presents us with different ways to think about how wine is made and then provides us with accurate ways to test our theories. It provides a model to show us how wineries of the future will conserve water, control CO_2 emissions, handle heating and cooling in an efficient manner and reduce the use of harmful chemicals and waste.

It is quite astonishing to realize that this winery of the future, which over time may change most of the things we take for granted in the current wine industry, was created by a small group of visionary professors, faculty and students. Their vision was neither shared nor supported by the very industry it purports to help. Instead, the project was funded entirely through private donations, and most of those monies were donated during a time of economic meltdown for our country.

It may be time for the wine industry to get on board, to thank the people at UC Davis whose imaginative, farsighted vision created something truly remarkable and to support them with the necessary money required to continue research. The hard work has been done. Now is the time for the industry to get involved with major funding. Those grape growers and winemakers who take advantage of the research facility by initiating research contracts stand to get a major head start on the rest of the wine industry. If knowledge is power, then power is simply acquired by affixing your name to a research contract and telling them what you want to learn. **WBM**