WIRED

What Makes a Champagne Vintage Great? Ask a Deep Learning Model

Bollinger is data mining its meticulous records to predict vintage years and weather the challenges of climate change.

IN EARLY 2021, Bollinger's winemakers were able to get their first taste of La Grande Année 2014, a prestige fizz that had been aging in the champagne house's cellars since it was blended. La Grande Année, Bollinger's flagship vintage champagne, is produced only in years when the broad quality is deemed sufficiently high, and enjoys seven years of aging under cork before it's launched.

Ahead of opening up the 2014 vintage, questions lingered over just how strong a year it really was, given a roller-coaster growing season that saw record-breaking heat in June followed by a cold, wet summer that slowed grape maturation. Moreover, for a champagne house known for its forthright pinot noir character, it was a vintage that distinctly favored chardonnay.

But for Denis Bunner, Bollinger's deputy head winemaker (or *chef de cave*), the answer was clear-cut even before the bottles were opened. Having spent two years combing through a mountain of historical data surrounding the interactions of terroir, vines, climate, and wine quality over the seasonal cycle, he was convinced the 2014 would be a home run, despite some of his colleagues' hesitancy. "I told them, 'No, it's going to be a great vintage.' I was trusting the data, and all the parameters were aligned," he says.

As such, Bunner says, the only parameters that really count are those determined in the nose and mouth. And, on taste metrics, La Grande Année 2014, launched to market this year at £585 ($659) a case in the UK, has proven to be a hit: a fresh, elegant, mineral-tempered departure from Bollinger's full-bodied norm, with plenty of further aging potential. The wine critic Antonio Galloni, at Vinous.com, scored it a rare 98/100, describing it as "one of the best recent editions I can remember tasting."

However, Bunner's original conclusions were reached not via the tastebuds, but by applying deep learning to a subject still often regarded, even by its practitioners, as an alchemical craft more than a science-led discipline. The jumping-off point was a determination to understand the likely impacts of climate change on wine growing and quality. The data bank that enabled this was Bollinger's Wine Library, a unique collection of vintages going back generations that had been compiled from stock lying for years in the far reaches of the house's cellars. A decade ago, a six-year project began to gather, taste, assess, and restore the hundreds of dust-encrusted bottles that now make up this liquid archive.

“We started to learn about these wines and how to analyze them, because the more you know about your wines the more you can go deep into the knowledge and craft of the house,” Bunner says. “People were talking about climate change and how it will impact, and I started to think that if I researched some very hot years in the past, and analyzed vintages from those years, I’d be able to understand more about what will happen in the future.”

From there, the project grew. Working with a database specialist and a mathematician, Bunner began building a model that drew together historic meteorological data; soil and plant conditions for each grape variety; timings of key seasonal events like de-budding, blossoming, ripening, and harvesting; and lab analysis (for factors such as sugar levels and acidity) of grape musts and the wine itself.

Bunner had the advantage of drawing on Bollinger’s own assiduous archiving, along with meteorological data from local weather stations and information from industry body (and his former employer) the Comité Interprofessionnel du vin de Champagne (CIVC).

All this data—more than 40 parameters—for the factors going into the making of champagne could now be correlated against the assessment of what had historically come out: Bunner’s tasting notes for a century’s worth of champagne in the Wine Library, effectively a definitive judgment on the quality of each vintage.

“We were looking at the evolution of the vines and the ripening season, segmenting each step to find a correlation between the growing process and the final quality,” says Bunner. “We can see precisely week by week what should be the perfect scenario, and the farther from this you go, the more risk you have.”

The upshot is a model that can, in effect, forecast the strength of a season even as it is unfolding, adding an element of statistical predictability to what is otherwise a slow, intuitive reveal over months of tastings.

In the normal run of things, Bunner says, around 4,000 barrels need to be tasted after the first fermentation before a clear view of the quality of a vintage emerges. “We can have an idea when we cut the grape during the harvest, but to be sure, we have to wait for that tasting,” he says.

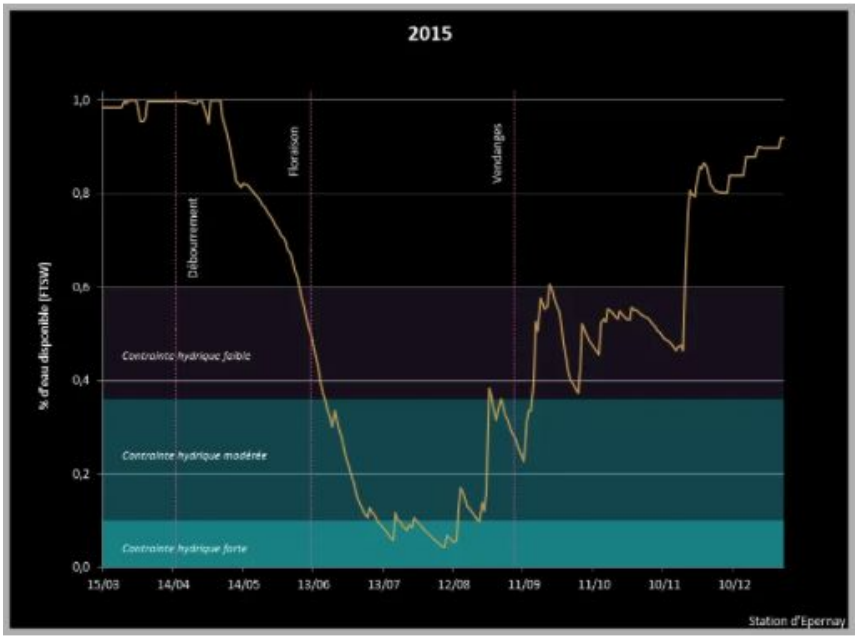
No longer, though. But, even if Bunner’s model will never replace that traditional, deeply nuanced and skilled tasting process, he says it can help solidify key decisions the winemakers must take: whether to declare a vintage year; whether to make a limited edition if a smaller number of villages perform well; what the blends will be; and—crucially—how well a vintage might age.

As proof of this data-driven classification, Bunner declares that, after 2021’s non-event of a summer in France had been widely viewed as a disaster, Bollinger’s new model suggested it would still be above average. Sure enough, the tastings have since confirmed this.

But assessing the outcome is one thing. The next step is to apply the learning to seasons in real time, as decisions are made over the management of the vineyards themselves. “If you know the perfect itinerary for the best quality, it gives us the tools to adapt practices and manage the risks,” Bunner says.

And the biggest fundamental risk, of course, is climate change, Bunner's original stimulus for the project, and something that is already causing noticeable changes in the champagne industry.

Warmer temperatures are leading to much earlier harvests: Between 2015 and 2020, all but one harvest began in August rather than September, something that hadn't occurred in the previous 100 years. On average, 18 days have been shaved off the growing season, which means a shorter ripening period, but also a more concentrated, full-bodied fruit and lower acidity, one of champagne's crucial characteristics. In other words, a potential long-term alteration in the profile of champagne itself.



As Bunner points out, houses such as Bollinger have no shortage of tools with which they can adapt: lowering the sugary "dosage" that is added to each bottle after disgorgement; changing the grape varietals and the rootstock; even the time of day that grapes are picked. The point of the data model, he says, is to pinpoint the events that most clearly impact the quality, in order to make the best adaptations. To that end, two climate-driven elements, previously relatively unconsidered, have stood out in the data.

Firstly, it turns out that nighttime temperature is far more critical than anyone suspected. "If it's over 13 or 14 degrees Celsius (55.4 to 57.2 Fahrenheit) at night, the secondary metabolism of the vines is not efficient, and the correlation with quality is noticeably negative," says Bunner. In fact, a profusion of cool nights in 2014 (despite the blazing hot June) was one of the factors suggesting a stronger year.

Secondly, the issue of hydric stress—the effect either of a lack of water, or too much in a short period—is, according to Bunner, more impactful than some have imagined, and set to increase as weather patterns become more unpredictable.

Similarly, drier winters that deny adequate water in the soil at the very start of the cycle, before vines have even been de-budded (the kick-off for the growing season), can have a clear impact on quality later down the line, according to Bollinger's model.

“The best situation is a little bit of rain each month, but not too much,” says Bunner. “But in 2020 it didn’t rain for two and a half months. It’s the lack of consistent repetition that’s new, and when you combine it with hot temperatures, we have no experience of that. If you’re running a marathon and the temperature suddenly shoots up, you need to drink—and if you can’t, you’ll have high stress on your body in order to finish the race. Our model shows that it’s the same with the vines.”