INTRODUCTION

Wines are generally defined in one of three ways: by their country or region of origin, by their colour (red, white, pink) or by their style (still, sparkling, fortified). Only recently have wines begun to be defined according to how they have been grown and made. There is now a clear if over-simplistic divide between modern conventional or 'chemical' winegrowing on the one hand and 'green' alternatives on the other. These include 'natural' wine, an increasingly popular term now in both hemispheres but which is unregulated and banned in, for example, Italy, and organic and biodynamic wine, both of which are independently regulated. Organic and biodynamic vines comprised around 6 per cent (and rising) of the global vineyard in 2015, up from less than 0.5 per cent in 1999. The bulk of the organic vineyards are found in Europe's wine powerhouses of France (the Midi, Provence, Alsace), Italy (Sicily, Calabria, Tuscany) and Spain (Penedes, La Mancha), as well as Germany (Rhine regions, Baden) and Austria. In the southern hemisphere, Chile seriously underperforms for a country claiming to be a wine paradise (perfect winegrowing climate, few pests, free Andean irrigation, no phylloxera), and Australia does not bother to collect national stats on organics. In contrast, New Zealand has set itself the most ambitious target of any wine-producing nation, namely to have 20 per cent of its (currently 33,300 hectare) vineyard certified by 2020.

Nevertheless, sceptics deride biodynamics as an extreme form of organics, with its quasi-religious overtones and possibly even voodoo practices, and at best 'merely organic agriculture with a peculiar twist'.[2] Although neither its reliance on essentially mundane ingredients – like the animal manure, wild plants and minerals incorporated in the nine preparations which are prerequisites for biodynamics – nor its adherence

to lunar and other celestial rhythms appear to harm either vineyard soils or wine drinkers, biodynamics nonetheless lacks, for such sceptics, a proper scientific foundation.[3] For advocates like me, however, biodynamics offers effective, creative, enjoyable, stimulating and sustainable solutions to common problems experienced by contemporary winegrowers, such as reduced soil fertility, vines' diminishing resistance to pests and diseases, and grapes which, despite being increasingly complicated to ferment, risk producing ever more banal wines largely devoid of individuality and interest. If consumers are to be successfully encouraged to change their environmental habits then eco-warriors must play a part by altering their relentlessly downbeat message and offer instead a happy future to look forward to rather than a bleak one to avoid.[4] Biodynamic wine is one of those often everyday yet also conveniently rarefied products capable not just of encouraging that change, but of leading it.

FOUR WAYS TO FARM GRAPES

Traditional subsistence

From around 12,000 years ago hunter-gatherers began domesticating plants and animals. Traditional subsistence farms emerged. In terms of resources, says biodynamic farming consultant Andrew Lorand,[5] subsistence farms make above-average use of what is already available on the farm or grown there, so little needs to be bought in. In wine, for example, rather than purchasing wooden support posts for vines, fruit trees can be planted as supports instead. Their fruit also provides an extra crop. However, because the traditional subsistence system produces even fewer outputs than inputs, little if any of the farm's produce being sold or even bartered, ultimately this system is not economically sustainable. The closest modern-day equivalents of traditional subsistence vineyards – still a feature in some Latin American, Mediterranean and eastern European countries – form part of mixed smallholdings or farms in which wine is a minor activity. Any wine produced is for the family table rather than for sale.

Industrial

Modern industrial farming and winegrowing were spawned by the agricultural and industrial revolutions. In the industrial system any

resources either already available on the farm or grown on it are poorly used. An example would be if prunings or grape residues left over from winemaking each year were burnt rather than recycled as compost, or were left to compost by neglect on the vineyard in ways that might actually increase pest and disease problems later on. Although the modern industrial system is capable of producing huge outputs – lots of bottles of wine – this is only at the expense of even greater inputs. In the vineyard such inputs might include soluble fertilizers to boost yields and man-made sprays to control weeds, pests and diseases. In the winery aids, additives and agents, like enzymes, acids, tannin, sugar, yeast and yeast food, can be purchased to compensate for grapes lacking colour, freshness, texture, ripeness and fermentability respectively. Most contemporary wines, whether sold in bottle or bulk, result from this system. The vineyard and winery become conduits through which myriad materials pass, few if any of which enhance the most precious and irreplaceable resource of all for a winegrower, namely the soil.

Organic

Organic winegrowers have promoted the organic system as producing superior, potentially more authentic-tasting wine because organics stipulates that no synthetic or man-made products may be used. Organic growers maintain that as their system is less likely to leave unnatural residues either in the soil or the wine it must therefore be considered sustainable. The numbers of organic vineyards worldwide have risen consistently since the mid-1990s, albeit initially from a very low base and encouraged initially more by state subsidies than consumer demand (consumer perception that 'all wine is organic' has proved hard to shift) or winegrower altruism. Recently rises have become especially significant in France (Alsace, Beaujolais, Languedoc, Roussillon, Provence, Loire, Rhône, Jura), Austria, Italy, Spain (especially Penedes) and New Zealand. Worries over soil erosion, spray residues in wine causing problems in export markets, reduced groundwater quality, pest and weed resistance to expensive conventional sprays, and potential lawsuits from angry parents (as in Bordeaux in 2015) worried that spray drift near schools is damaging the health of their children have contributed to the fear factor. On the positive side there is increased market demand for more '*terroir*-driven' wines of higher quality both from fusty state alcohol monopolies and trendy 'natural' wine bars, and on the supply

side the domino effect is now clear – the pioneering organic neighbour has morphed from being ridiculed as the lone mad wolf to being something of a break-the-mould pioneer by showing that you can be green in the vineyard whilst staying out of the red in the bank. Market demand has also spurred advances in lighter, quicker and better spray machinery, better sprays and better analysis of climate data to predict pest and disease attacks.

However, Lorand argues that even though the organic system produces bigger outputs than the traditional subsistence system, this is only at the expense of more inputs too. For example, whereas in the industrial system a vine pest can be eradicated with just one pass of a tractor spraying pesticide, the organic system may require three passes of the tractor spraying herb-based pest irritants like neem, so more tractor diesel is burnt. However, the organic system at least makes better use of on-farm resources than its industrial counterpart, meaning, for example, that rather than being sent to landfill, any grape residues left over from winemaking might be composted and returned to the soil, albeit perhaps with some purchased compostable material like animal manure or straw. Although the organic system is more sustainable than its industrial counterpart, the organic vineyard nevertheless remains a conduit through which materials pass in a way likely to create an imbalance between what the organic vineyard produces and what it consumes to remain economically viable.

Ecological

Balance is achieved only in the ecological system because this is the only system in which outputs are at least equal to or are greater than inputs. This is because any available resources are always efficiently used. One example would be harvesting rain to irrigate crops or provide water for livestock. These livestock would provide both food for farmers (meat, milk, cheese, yoghurt) and enough food via their manure for both the soil and the crops. This manure would be combined with other farm waste in compost in a way that promoted sufficient soil fertility in the short term, with long-term soil enhancement overall. Crop and soil health could be maintained via medicinal teas and liquid manures made from wild plants growing around the farm. Maintaining surrounding biodiversity would encourage beneficial insects to participate in self-sustaining pest control across the farm. All these measures combine to help crops stay healthy and well fed at very low

environmental cost. The ecological system imitates nature, and has four major principles as identified by Lorand.

1. Appropriate production, which means common-sense farming. From a wine perspective, appropriate production means growing the right grape variety on the right soil in the right climate in the right way. This may seem blindingly obvious, but in Europe, for example, it took centuries for first the Greek and Roman colonizers of antiquity and then religious (Cistercian monks) or secular medieval vineyard owners (sixteenth-century Bordeaux *parlementaires*) to match the right grape to the right *terroir*: Riesling to the Mosel, Pinot Noir and Chardonnay to Burgundy, and Cabernet Sauvignon to Bordeaux's warm left-bank sandy gravels and Merlot to its cooler right-bank clays and limestones. Vines which adapted to their local surroundings grew more healthily, were easier to work and cheaper to farm. They also produced the best and most valued wines. This is appropriate production. An egregious example of inappropriate production might be the Murray Darling basin in Australia, a desert artificially transformed into a green vine oasis thanks to near-hydroponic fertigation. The results of this are huge yields of cheap, characterless grapes offset by salination and silting of the once mighty Murray Darling basin so catastrophic that the government is spending billions repairing the environmental damage whilst buying back the usufructuary water rights it once all but gave away to farmers. This unusually uncuddly version of winegrowing appears especially inappropriate whilst fresh water supplies are diminishing worldwide and global wine consumption consistently falls short of global wine overproduction. Australia is also, lest we forget, the world's driest continent.

2. Biodiversity,[6] which means avoiding the monocultural approach of putting all your eggs in one basket. Biodynamic growers take a holistic view of nature, working with it rather than against it to promote the kind of biodiversity which helps establish a natural equilibrium between the farm and its surroundings. Biodiversity helps maintain a broad enough gene pool to render carriers of illness less potent,[7] reducing the risk that any single pest or disease can destroy entirely the farmed crops. Biodiversity is seen as a hard goal to achieve by those growing perennial crops like vines or fruit trees because these are usually grown as monocultures, meaning that in any given field just wine grapes or apples and no other crops are grown, sometimes for decades on end. The rotation arable farmers practice – whereby fields

are ploughed and sown every few months with different arable crops like clovers which put food in the soil and grains which then take this food out again – is impossible. In a perennial vineyard monoculture the same vine grows in the same place for many years and therefore is forced to live in its own waste, its leafy detritus, increasing the potential risk of disease. To make vineyard mechanization and spraying easier usually only one single variety of wine grape is grown in any one field, because planting an early ripener like Merlot with a late ripening one like Cabernet Sauvignon would complicate pest and disease control, canopy management and picking decisions. Single grape monocultures are often enshrined in national wine laws in Europe, e.g. 100 per cent Chardonnay in Chablis, 100 per cent Sauvignon Blanc in Sancerre, 100 per cent Sangiovese Grosso or 'Brunello' in Montalcino and so on. The most extreme example of a monocultural vineyard results if just one single clone of the same variety – clone 114 of Pinot Noir, for example – is planted in a single plot. Vineyard monocultures can be described as 'environments without companionship'. Transforming them back into more diverse habitats is hard but worthwhile work which requires thought. Beneficial insect predators and parasites are attracted by pollen and nectar, so sowing companion plants like cover crops or leaving native plants (weeds) *in situ* to provide these things saves money on both weeding and pest control. The wrong type of biodiversity, however, can cause problems. Lucerne (*Medicago sativa*) or alfalfa can be sown as a cover crop because its deep tap root loosens soil compacted by tractors, releasing trapped boron (a trace element vines need to set fruit), but in California lucerne can act as a host plant to sharpshooters vectoring Pierce's disease, which is deadly to vines.

3. Soil fertility, which means having healthy foundations. Until recently soil used to be thought of essentially only in terms of its physical properties such as how well it drained or warmed up, or its chemical properties meaning how acid or alkaline it was (pH), or which minerals it contained. The vital role of soil biology was somewhat overlooked, ironically given Louis Pasteur's work in identifying the role different living organisms played in converting grape juice to wine and thence to vinegar.

In a living soil visible organisms like worms and beetles and microscopic ones like bacteria, fungi, nematodes and protozoa form part of a soil food web. Vines must be very active members of this soil food web to stay healthy. Vines capture the sun's energy via the chlorophyll

in their leaves and use this to transform atmospheric carbon dioxide into food in the form of carbohydrates. Some of these carbohydrates end up in the grapes as sugar for wine, and some the vine releases via its roots. Soil micro-organisms like mycorrhizal fungi which live on the roots then feed off these carbohydrates. The mycorrhizal fungi return the favour by allowing vines to locate and capture soil nutrients. Plant roots can only assimilate soil nutrients in solution. By liquidizing or dissolving soil around the vine roots mycorrhizal fungi not only allow vines to feed, they also create spaces for vines to put down deeper, thicker roots. Thus vines and soil micro-organisms have a symbiotic relationship, each being reliant on the other. However, mycorrhizal fungi are killed by weedkillers and are made redundant by inorganic (soluble) fertilizers which, once dissolved by rainwater, can be taken up directly by plants. Vines which can no longer feed from the soil because of shallow, stunted or redundant root systems are more prone to pests, diseases and climatic disorders (drought, floods). They are also unlikely to be able to transmit that 'somewhereness' which drinkers of top Bordeaux, Burgundy and other *terroir*-driven wines expect to experience (see Chapter 6, on compost teas) and often increasingly if erroneously describe as 'minerality'.

4. Immunological response capacity, which means 'not getting ill'. If the right vine variety is being grown on a vineyard site to which it is suited and if the site/vine are maintained in a biodiverse way above ground with additionally a living soil below ground, then the vines should exhibit an immunological response capacity. In simpler terms this might be termed the 'apple a day' approach. Humans who rarely fall ill could be described as having self-sufficient immune systems by virtue of living in stimulating, unpolluted environments appropriate to their lifestyle (right *terroir*), eating a balanced diet (biodiverse, worm-rich soil), and exercising regularly (strong roots). Similarly, vines able to draw from the atmosphere via photosynthesis and from the soil via their roots exactly what they need to grow healthily exhibit self-sufficiency. If every vine in the vineyard were self-sufficient, then by definition the vineyard would be too; and if the vineyard were self-sufficient with minimal or no external inputs needed, but was still able to produce a net output of wine and possibly other crops as well and as part of its biodiverse orientation, then there would be a net gain both for the winegrower and the natural ecosystem. Growers would be able to produce

a high quality product – healthy grapes produce the best wine – whilst putting more back in than what had been taken out as grapes. This is what biodynamics sets out to achieve: healing the earth while producing healthy, vital and flavourful crops.

The 'don't get ill' approach can be summed up by Graeme Sait, a globally renowned expert in sustainable agriculture and horticulture. He says, 'Crop resilience is multi-faceted. There are no magic bullets. If you can work towards managing your minerals and microbes, eliciting an immune response, boosting photosynthesis and strengthening cell walls with calcium and silica you will reduce your requirements for increasingly expensive farm chemicals. More importantly the mechanisms governing resilience are the same things that govern yield and quality. An holistic approach like this can also boost production and profitability.'

It is my firm belief, based on practical experience working first in conventional, then in organic and finally in biodynamic vineyards and wineries on and off since 1984, that biodynamics remains the best tool with which to make *terroir*-driven wine of the highest quality while enhancing rather than depleting the vineyard it came from. The very first biodynamic vineyard I visited in 1993 in Bordeaux's Canon-Fronsac sub-region convinced me of this. For me the biodynamic tool remains as valid now as it was then. Not all biodynamic winegrowers use the tool as well as they might, not all biodynamic growers make great wine, and quite a few newer converts clearly see it as a potent marketing tool in our ecologically aware, environmentally challenging but still cynical times – but that's the fault of human beings, rather than of the biodynamic idea itself.