

A wine glass filled with red wine is shown in a dynamic, splashing state. The wine is captured mid-air, creating a dramatic arc. Overlaid on the wine are several terms related to wine faults: VSCs, ethyl acetate, oxidation, TCA, house cage, peanut, H₂S, and wet sack. The background is a light, neutral color.

WINE FAULTS AND FLAWS

A PRACTICAL GUIDE

KEITH GRAINGER

WILEY Blackwell

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Wine Faults and Flaws: A Practical Guide

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To Paula.

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Preface

Wines are produced today in over 65 countries, and it is often stated that production standards are higher than at any time in the 8000 or more years of vinous history. The consumer rightly expects any wine purchased to be of good quality, bearing in mind the price point, and free from fault, flaw, or taint. Wine critics, writers, producers, and retailers are all in the business of selling enjoyment and entertainment, for nobody has to drink wine – it is a beverage to be savoured. However, the incidences of faulty wines reaching the consumer are greater than would be regarded as acceptable in most other industries. It is claimed that such occurrences are less than was the case in recent recorded history, and it is true that the frequency of some faults, flaws, and taints being encountered in bottle (or other packaging) has declined in the last few decades. Gone are the days when a bottle of dry white Bordeaux would have more ‘struck-match’ sulfur odours than the aromas of Sémillon or Sauvignon Blanc, and a white Bairrada exude the ‘Oloroso Sherry-like’ aromas and bitter palate resulting from oxidation. Happily too, in recent years, there has been a considerable reduction in the occurrence of haloanisole contamination (often referred to as ‘cork taint’), which renders heavily affected wines undrinkable, having the musty odour of damp hessian or dry rot. However, incidences of certain faults and taints have increased, and issues that were once unheard of now affect many wines offered for sale. These include ‘reduced’ aromas, premature oxidation (premox), atypical ageing and, very much on the rise, smoke taint.

The reduction in the occurrence of some faults might have been expected with the increased sophistication and

regulation of wine production, and the advance in scientific and technical knowledge of grape growers and winemakers. These, taken together with the utilisation of a vast array of high specification production equipment, might lead the consumer to believe that they are extremely unlikely to be faced with a faulty bottle of wine. This is sadly not the case. The increased incidence of some defects is, *prima facie*, surprising. However, the styles of wines that consumers want, or are perceived by the industry to want, have changed in the last 20 years or so. Grape harvests are often delayed until so-called phenolic ripeness and, together with the effects of climate change, this has resulted in higher grape sugars, higher pH, and lower acidity. Each of these presents dangers. In the case of red wines, and particularly those at so-called 'entry-level', tannins are softer, and levels of residual sugar have often increased. Inexpensive wines are usually brought to the market very quickly, sometimes within a few months of harvest. Time is money, and there may be little time or budget for all desirable stabilisation procedures to take place. Finally, the consumer and especially the serious wine lover, wants wine to be a natural, agricultural product that has been turned into something wonderful by an artisan, not a scientist. Accordingly, many producers strive to make wine as 'natural' as possible, by reducing interventionist techniques and minimising chemical and biological additions, including those that may increase stability and prevent the onset of certain faults. It is also of concern that there is an increase in the incidence of mycotoxins in wines, due to their production by some of the microbial populations on vines. This is perhaps another consequence of climate change. Related off-flavours, which were historically noted only occasionally, have been detected at a much higher frequency during the last 15 years.

This book provides a detailed examination and explanation of the causes and impact of the faults, flaws, and taints that may affect wines. As such, I believe that it will prove particularly valuable to winemakers, especially those at small, boutique wineries, wine technologists and quality control professionals. Wine critics, writers, educators, and sommeliers will also find the topics most relevant. With wine trade students and people venturing into the business of wine production in mind, the content is designed to be easily and speedily assimilated. The interested and knowledgeable wine-loving consumer, including wine collectors and investors, will also find the book highly relevant and the basis for discussion at many tastings with like-minded associates.

It is assumed that the reader has, at least, a basic knowledge of winemaking. Those who feel the need to brush up on the methods and techniques of wine production, from vine to bottle, are referred to '*Wine Production and Quality 2nd Edition*' by Keith Grainger and Hazel Tattersall, also published by Wiley. However, this book is very suitable for those with limited scientific knowledge, and I have made every effort to maximise readability, with many anecdotes and expressed opinions, including my own. The chasm between general and scientific wine publications is both wide and deep, and I have attempted to bridge this as soundly as possible. There are several excellent books on viticulture and oenology, written in scientific language. Some of these are listed in the Further Reading. Alternatively, the easy to read articles and books penned by wine writers are seen by the scientific community as overflowing with anecdotes and lacking rigour. Of course, both approaches are valid, and I have made every effort to integrate them. I have tried to speak in terms that the general reader can understand. Although the number of studies and quality of research into chemical

and microbiological faults in wine has increased considerably in the last couple of decades, most of this work remains within the confines of journals, which are largely unread outside of scientific and academic communities. On many occasions, results are inconclusive, conflicting, or the focus of some studies is seen as so narrow as to be of little relevance in the real world. Indeed many of the winemakers I have spoken to whilst researching this book have not been aware of the outcomes of recent research in important areas. Accordingly, there is still much misinformation and misunderstanding of the topics by producers, students and, of course, consumers.

Sections of individual chapters cover the science behind each fault, and for these, a very basic knowledge of organic chemistry and microbiology would be valuable. However, the scientifically challenged reader will find the text includes helpful explanations, and the Glossary contains easy to understand definitions and descriptions of many scientific terms. I have included, at the end of each chapter, references to relevant publications and research papers (over 800 in total), concentrating on those in English and published within the last 20 years. I have also included references to earlier research that was particularly groundbreaking. I have not included structural drawings, and there are very few chemical equations. I have not generally detailed isomers (isomers are where compounds have the same formula but differ from each other in the way the atoms are arranged). As the title of this work suggests, the focus is very much on practice - the book is certainly not aimed at the research scientist. In other words, I wish it to be a helpful manual for those who have little interest in the activities of the research lab, but to whom the excitement and challenges of the real world of wine are a way of life.

Keith Grainger

Saint-André-de-Lidon
19 August 2020

Introduction

This book comprises a detailed examination of faults, flaws, and taints that can affect the quality and merchantability of wines. Technically, there is a distinction between a taint and fault that will be discussed in [Chapter 1](#). However, wine consumers, merchants, and the press rarely observe such distinction, simply referring to the affected product as faulty. Some faults render affected wines unsaleable and undrinkable. Others that have a negative effect upon quality, enjoyment, or potential for ageing.

There are no reliable figures regarding the total global financial cost of faulty and tainted wines to producers, agents, distributors, and retailers. However, there can be no doubt that it runs into many £/€ billions annually. A recent estimate of the economic costs to EU wine producers of haloanisoles taint in wines (so-called 'cork taint') is 700 million euros annually [\[1\]](#). Product recalls due to matters other than incidences of physical contamination are relatively rare in the wine industry. When bottles of faulty wines do reach the consumer, the impact upon the producers' and suppliers' reputations is incalculable. Although the purchaser may not have the knowledge or skill to identify the fault in question, it is unlikely that they will repurchase any other bottles of the same wine, and may avoid the brand or producer in question. In other words, the consumer will believe the faulty wine to be very low quality. If they have no recourse to financial redress, as will most likely be the case for wines purchased many years previously and which they have been patiently nurturing in their 'cellar' in anticipation of the complex delights of full maturity, consumers may well feel somewhat cheated.

Wine is, without doubt, the most discussed food or drink in the world, and wine lovers readily communicate their experiences to friends, colleagues, and those who share a love for what can be the most exciting and individual of products. Today, such discussions are livelier and more influential than ever. With the proliferation of blogs and social media postings, the opinions of a consumer's peers are, for better or worse, as or even more important than those of professional critics and reviewers. Wine writers, authors, and journalists are generally hugely supportive of the wine industry, without which their profession would not exist. Most are 'deeply in love' with wine, or at least 'fine wine'. However, it is the nature of writing that certain topics become 'hot' and are then developed and pursued for as long as the readership retains an interest. Amongst the wine faults that have received considerable coverage in specialist consumer media in the last decade or two are so-called 'cork taint', 'reduced' aromas (often referred to as reduction or reductivity), premature oxidation (premox), and the aromas produced by *Brettanomyces* yeasts. When such topics are discussed in a global context, articles can be informative, but they can also weaken confidence and influence buying habits. However, if the coverage relates to individual producers, the damage inflicted can be both instant and ongoing. Reputational damage may be done simply by naming faulty wines submitted for assessment at comparative tastings conducted by specialist magazines, or for tasting competitions. By way of example, during the early years of this century, the influential USA published magazine *Wine Spectator* revealed the identity and details of several 'high-end' Californian producers who had marketed wines tainted by 2,4,6-trichloroanisole (TCA) and 2,4,6-tribromoanisole (2,4,6-TBA). These compounds are usually, and particularly in the case of 2,4,6-TBA erroneously, referred to as 'cork taint'. The negative impact

upon the reputations of producers that had taken decades to build is apparent.

On the other hand, there are ‘under the radar’ faults that are seldom discussed in the popular wine media or amongst professionals. A prime example is ‘atypical ageing’, by which white wines very rapidly lose varietal character and develop undesirable aroma and palate characteristics. This fault, often confused with premature oxidation, has been described as ‘one of the most serious quality problems in white wine making in nearly all wine producing countries’ [2]. It has been estimated that up to 20% of USA wines might be affected [3].

The financial impact upon producers and distributors who have sold faulty product can be immediate and direct. Supermarkets and merchants impose chargebacks upon suppliers when customers return wines. On an individual basis, this may be the cost of the bottle in question, the cost of analysis of other bottles, the cost of replacement bottles and a ‘fine’, or service handling fee. On a volume basis, the trade customer may demand reimbursement for pallets or even containers of affected wine, shipping and warehouse costs, handling, and possibly also excise duties which, in some countries, can amount to several times the value of the wine in question. If there are problems with subsequent shipments, the merchant may well blacklist the producer or supplier. The longer-term financial impact can be massive. For example, winery contamination with haloanisoles has, on occasions, necessitated the destruction and rebuilding of cuveries and chais, as discussed in [Chapter 3](#).

In Chapters 3–14, I discuss in detail individual categories of wine faults. I do not claim the list of faults included to be exhaustive. The discussion of each fault generally includes:

- What it is, in basic terms;
- How it can be detected by:
sensory recognition, including sensory detection thresholds;
laboratory analysis;
- What the cause is;
- At which stage/s of production, maturation, or storage it can occur;
- How it might be prevented;
- Whether an affected wine is treatable, and if so how;
- The detailed science applicable to the fault.

The 'history' of the individual faults is also covered. Throughout the book, particularly [Chapter 18](#), there is a general discussion of the implementation of what constitutes good procedures and practices in the vineyard and winery to enhance quality and minimise the likelihood of faults from occurring. Carrying out audits of premises, equipment, and inventory to identify microbial or chemical contamination can be costly and taking steps to address issues identified even more so. The cost of being unaware of problems, or doing nothing to rectify them, is incalculable. I am acutely aware of budget constraints that are an everyday challenge, particularly to the small producer, and such implementation may be generally achieved at minimum expense. Information on the identification of faults by laboratory analysis, and how faults may be rectified is given in general terms. However, producers seeking to address specific issues are advised to seek advice from any of the laboratories, consultants, and companies specialising in the identification and treatment of oenological problems. It is the responsibility of producers to check the legality of any method suggested,

or the addition of any oenological products, in the country/region of production and market.

There are several challenges posed in undertaking any discussion of wine faults and flaws. These include matters of definitions, boundaries, concentrations, and the matrices of individual wines. From a sensory perspective, determining when a microbial or chemical issue is a fault is not necessarily straightforward. In addition to the issue of a taster's sensory detection thresholds, there can often be a dispute whether a particular characteristic is perceived as beneficial, harmless, a flaw or a fault. These perceptions are even subject to the vagaries of fashion. In 1982, Master of Wine and Burgundy expert Anthony Hanson wrote in the first edition of his critically acclaimed book *Burgundy*: 'great Burgundy smells of shit' [4]. If there were any raised eyebrows at the time, these were only because of Hanson's choice of language.

Indeed many Burgundies exuded the odours of stables and farmyards. By 1995, Hanson was already finding such a nose objectionable and blamed microbial activity [5]. We now know that these odours have nothing to do with Pinot Noir (the variety from which pretty much all red Burgundy is made). Nor do they stem from any of the myriads of Burgundy terroirs, but result from volatile phenols and other compounds produced by the yeast *Brettanomyces* (or to be technically correct *Dekkera* although it is rarely so-called in the wine industry). Today, *Brettanomyces* is generally regarded in the wine industry as a rogue yeast, and odours of farmyards, stables, or BAND-AID® are generally considered to be undesirable and regarded by most winemakers, oenologists, and critics to be a fault. This means that aromas in 1982 regarded by an expert taster as a sign of quality are today usually seen as a fault. However, *Brettanomyces* (often referred to as 'Brett') remains a controversial topic. Many producers, critics, and wine

lovers believe it can, at low levels, add complexity to a wine. This poses the question as to where the boundary should be drawn. Purists perceive Brett always to be a fault and define it as such. Some lovers of 'natural' wines consider it to be one of nature's distinctive aroma and flavour giving yeasts. In some countries, the number of wines showing Brett characteristics is increasing, due in part to winemakers trying to satisfy perceived consumer demands. As Jockie Bakker and Ronald J. Clarke note, 'changes in winemaking culture as a result of changes in consumer preference for the required style of wine has led to an increase in some off-flavour formation, for example volatile ethyl phenols (which are by metabolised by *Brettanomyces*) [6]'. I examine the topic of *Brettanomyces* and related volatile phenols, in [Chapter 4](#).

We may draw another example of definition/boundary/concentration challenges when discussing volatile sulfur compounds, which can be a consequence of agronomic conditions or reductive winemaking techniques. Some of these compounds may, at modest concentrations, give notes of minerality, a hint of struck match, 'gun-flint', and of savoury 'lamb fat'. Such characteristics may be considered positive in, for example, white Burgundies and the white wines of the Central Vineyards of the Loire Valley. However, at high levels, volatile sulfur compounds can give most undesirable odours, including bad eggs, onion, garlic, skunk, town gas, and faeces. But at just what point is the desirable concentration exceeded? A risqué comedian may be very funny until a boundary is crossed, beyond which they are perceived to be obscene.

A further illustration of these boundary challenges may be made when discussing excessive volatile acidity (VA). Many Italian red wines have high levels of VA, which in wines from other countries might be considered to be at very

least a flaw, but which contributes to the 'Italian' character of the wines. Whilst a high level of VA in the red wines of Bordeaux is not acceptable today, times and palates change. The 1947 vintage of Château Cheval Blanc, Saint-Émilion, made before the advent of temperature controlled fermentations and described by some critics as the greatest wine of all time, possesses such high VA that by today's thinking it would be perceived as not just flawed, but seriously faulty. The topic of excessive VA is discussed in [Chapter 7](#).

The final example of these challenges in this Introduction relates particularly to mature Riesling wines. Many producers in Germany and Alsace have long lauded the diesel or kerosene nose that examples can exhibit after several years in the bottle. Most New World producers and wine critics regard such a nose as indicative of a flaw at least, caused by 1,1,6-trimethyl-1,2-dihydronaphthalene (TDN), a norisoprenoid. At other than very low concentrations, they consider the wine to be faulty. In common with many other European-based wine writers and authors, I disagree with the defining TDN as a flaw or fault, unless the level is overwhelming (another boundary challenge). The aroma characteristics imparted by TDN can add exhilarating notes that in wines from some regions form part of the individual, sensuous character of this most distinctive of varieties. This topic is discussed in [Chapter 15](#). Bearing in mind that sensory characteristics change according to when in a wine's life-cycle it is assessed, and using the examples I have given, a particular compound and resulting odour or taste may be considered to comprise a fault or flaw, when in the wrong concentration, in the wrong wine, in the wrong place, and at the wrong time!

There are apparent contradictions in how we assess and define wine quality. One wine can be analysed chemically and microbiologically and be declared technically very

good and free from flaws, yet may taste distinctly uninteresting. Another may show technical weaknesses or even flaws, yet when tasted, it can be so full of character and true to its origin that it sends a shiver down the spine, and must be regarded as of the very highest quality. Returning briefly to the topic of *Brettanomyces*, Château de Beaucastel, a Châteauneuf-du-Pape from France's southern Rhône valley, and Chateau Musar from the Bekar valley in Lebanon are two examples of brilliant, distinctive, and exhilarating wines that historically showed considerable 'Brett' characteristics. Many lovers of these wines are still nurturing their mature stocks, as recent vintages have been much tamer. Such characteristics are not to everybody's palate, but using analogies from the music and art worlds, a person who loves Puccini is perhaps not that fond of the works of Ed Sheeran, and somebody overwhelmed by Titian may be distinctly unmoved by Paul Klee.

Perceptions of faults and flaws are subject to the sensitivity of individual tasters, and humans vary considerably in their sensory detection thresholds and their reactions to individual taints. For most of the faults discussed in this book, detection thresholds (in wine) are stated. These sometimes split into odour detection and taste detection thresholds when researchers have quantified such information. The figures stated are not always straightforward or beyond dispute. Sensory perception thresholds are usually different for red, rosé, white, sparkling, and fortified wines. Further, the level at which a compound that may constitute a fault becomes apparent may vary according to the wine matrix, which includes grape variety or varieties, style, alcoholic content, structure and balance, and is not simply a matter of quantification of the compounds responsible. The topics of sensory perceptions, detection thresholds and consumer