

Hints on the processes of wine-making / By Dr. Mucculloch [sic], Woolwich. In a letter to Mr. Neill, Secretary of the Caledonian Horticultural Society.

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HINTS

ON THE

PROCESSES OF WINE-MAKING.

By Dr MUCCULLOCH, Woolwich.

In a Letter to Mr NEILL,
Secretary of the Caledonian Horticultural Society.

[1818]

HINTS, &c.

IN compliance with the wishes of some of the members of the Caledonian Horticultural Society, I have attempted to sketch the general principles and practices used in the manufacture of wine, with a view of assisting the efforts of those whom the Society, by its annual premiums, has encouraged to cultivate the art of making this liquor from fruits of domestic growth.

In laying down these rules, and in describing these usages, I have been chiefly careful in selecting, and solicitous in enforcing, those which could most readily be brought to bear on our domestic manufacture; being desirous rather to point out such analogies as were applicable to the practices which the Society has so laudably patronized, than to enter either into the chemical history of this most interesting process, or to give a detailed



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account of the art, as it is practised in those more favoured climates, where the grape is the sole fruit in use for this purpose. The magnitude of the subject, would have otherwise led me into discussions, of a length incompatible with the limits of the Society's publications. In condensing and abridging the materials originally collected for this purpose, I have perhaps reason to fear that I have omitted matters essential to the perfect understanding of this subject. Yet I hope that I have not neglected any thing which will prove a material want, in reducing to practice the views which I have held out, and that some light, however feeble, will be afforded to those, who have hitherto been guided by rules of a dogmatical and positive nature.

It is evident that, in the complicated process of fermentation, some rules should be laid down as the foundation of our proceedings, and the test to which we must have recourse in examining the accuracy of our manipulations. I cannot too strongly enforce the necessity of familiarizing ourselves with *general principles*, which alone can assist us through the obscure paths, which this, as well as every art connected with chemistry, is obliged to pursue. And it is the address displayed by the artist in converting these general principles to his changing processes, that will give him a certain pre-eminence over those who are governed by invariable rules. In fact, however these

rules may appear fixed, they cannot be generally applied, because, under the mutable circumstances in which the application is made, they must frequently be rendered futile, and sometimes even injurious.

The constituent parts of the fruits used in the experiments now under consideration, are malic acid, either in a state of purity, or one of combination with potash, (a circumstance not yet perfectly ascertained) ; vegetable mucilage, or extractive matter ; supertartrite of potash ; sugar ; water ; the sweet principle ; the colouring principle ; tannin ; super-oxalate of potash ; and the principle of flavour. The proportions of these, vary much in different fruits, and it sometimes happens that one or more of them is entirely absent. In the white currant for instance, the colouring substance is often deficient, whilst it abounds in the elder-berry and red grape. So the super-oxalate of potash is rarely found ; and, on the contrary, those salts to which the tartarous, or malic acid appertain, are more frequent. So likewise, the sugar is much less abundant than the sweet principle, which is indeed the general cause of the sweetness of the greater number of our fruits. The vegetable mucilage is, if any, the only principle whose presence is invariable ; and this principle is one of the most essential in the fabrication of a vinous liquor, as we shall see hereafter. The main diversities of character, in the products of the various fruits, is owing to the varying pro-

portions of the several ingredients which they contain. It is true, that difference of management may produce different effects ; but no contrivance can give to the gooseberry the constituent elements of the grape, nor can any mode of procedure extract the flavour of champagne from the juice of gooseberries, although many, who have not been much accustomed to the flavour of the foreign wine, have been deceived by that made from our humble fruit.

Among the principles enumerated, tartar, water, sugar, the sweet principle, and the vegetable extract or mucilage, are the most essential in the conversion of fruits into wine. Colour and flavour may be considered as adventitious ; and the principles which yield them, are in nowise essential to the process of wine-making. The effect produced by the super-oxalate of potash is unknown, as it has not been the subject of experiment.

Tartar, however, seems essential to the formation of a genuine vinous liquor ; and an addition of it where it is naturally wanting, is found, not only to ameliorate the produce, but even to increase the quantity of alcohol, which a given proportion of sugar and the vegetable extract is capable of producing. Fermentation is more easily induced where this salt is present ; and the experiments of some of the French Chemists, seem to shew that it is decomposed during this process. Their opinion, that it

is converted into the malic acid is questionable. The presence of tartar is the circumstance which most strongly distinguishes the grape from all the fruits which have been applied to the making of wine. In this fruit, it exists in the greatest quantity before ripening, and a portion of it disappears during this process. From this peculiarity of the grape, the practice has been introduced of mixing tartar with those washes, which makers of *sweets* intend for the basis of their wines; and from it I have also derived the practice of mixing tartar with those native fruits which are deficient in this substance; a practice which has been attended with the best results. The details of this practice will be treated of hereafter in their proper place.

The effect of the *malic acid*, another of the enumerated ingredients in fruits, is very different from that of tartar, inasmuch as it has been found injurious to the fabrication of wine. It is remarked, that all wines which abound in malic acid are of a bad quality, although in many cases it has not been determined, whether this acid was an original ingredient in the fruit, or whether it was not generated during the process of fermentation.

In either case, since its existence in wine is found to be injurious, it is important to attend to this fact, as our native fruits seem all to be characterized by an excess of malic acid. This is perhaps one of the most fundamental and least corrigible defects in our domestic wines. To render the nature of this

defect more obvious, it must be remarked, that the essential distinction between cider and wine, consists in the quantity of malic acid which enters into the composition of the former. From this cause our native wines are more apt to partake of the nature of cider than wine, although these are often rather disguised than changed by the predominance of undecomposed sugar, of brandy, and other foreign matters which enter into their composition.

It is a question, worthy of consideration, whether some chemical means might not be adopted for destroying a portion of this acid, either before or after the process of fermentation. In the manufacture of sherry wine, lime is added to the grapes before this process is commenced. However empirical this practice may be among the manufacturers, it probably acts by neutralizing this acid, as well as a portion of the tartarous acid, and to this is probably owing the peculiarly dry quality of that wine. A hint may probably be borrowed from this practice towards the amelioration of our domestic wines; and I may here venture to point it out as a practice worthy of imitation,—worthy at least of a careful trial. It is only from the results of such, and similar experiments, that we can hope ever to place our domestic manufacture on a sound and rational basis.

Of all the substances which are called into action, during the process of wine-making, *Sugar* must be considered the most essential, being that

on which the strength of the wine depends. Those fruits which contain the greatest proportion of sugar, furnish the strongest wine; the alcohol generated in the act of fermentation, being always found to bear a proportion to the pre-existing sugar. The principal defect in our domestic fruits is the small proportion of sugar which they contain; but it is at the same time that which we are most easily able to remedy; and it is on this basis indeed that the whole system of our domestic wine manufacture is founded. But even in this part of the process, difficulties occur, and lead to the imperfect fermentation of these wines, and the consequent sweetness by which they are too often characterized. The saccharine matter has indeed been considered as existing in two distinct states in vegetables, that of pure sugar and that of the sweet principle; but it is perhaps more correct to consider sugar as an artificial substance formed by chemistry from the sweet principle, the only state in which sugar truly exists in vegetables. The sweet principle is characterized by its want of tendency to crystallize, and by the facility with which, on the addition of water, it runs into fermentation. Sugar, on the contrary, is crystallizable, and has no tendency to ferment, except in as far as it contains a portion of the sweet principle, or of that peculiar substance by which this principle is distinguished from sugar. If a solution of pure sugar in water be allowed to repose, it

crystallizes without fermenting ; nor does even the residuary syrup, or mother water as it may be called, undergo this process. But if it has been imperfectly refined, the remaining syrup, will, after the deposition of the crystals, contain so large a proportion of the sweet principle, that it will readily run into fermentation ; an accident well known to confectioners. The juice of the sugar-cane readily allows of the separation of the sugar from the sweet principle, and has hence become the almost exclusive subject of this manufacture. The residuary matter, known by the name of Molasses, is the sweet principle of the French Chemists, and is a peculiar compound of sugar, with vegetable extractive matter, similar to that which exists in the generality of sweet fruits. In considering this substance, therefore, it will be most consistent with the accuracy of chemical language, to speak of it as a peculiar compound of sugar and vegetable matter, and not to consider it, with Deyeux, Proust, and Seguin, as a simple substance. Hence we should not say with these chemists, that in some fruits, and in some varieties of the grape, sugar predominates, and in others, the sweet principle ; but that the sugar of the fruit is in some cases combined with more, and in others with less of the vegetable extract. These varying proportions of the two substances under consideration, are the cause of the various effects, which are observed in the results of fermentation in different fruits. If

the sugar predominates, the wine will be sweet, unless expedients are used to complete the fermentation of the sugar, and convert the whole into wine. If the sweet principle is most abundant, or, to speak more correctly, if there is much vegetable extract combined with the sugar, the fermentation will be complete, and the wine dry, unless artificial means, hereafter to be described, are used to prevent this effect. The distinction which I have here drawn, though appearing to partake of unnecessary refinement, will be found to lead to practical utility.

Among the enumerated ingredients of fruits, the *vegetable extract* naturally falls next under consideration. Although this substance has not been analyzed, we know that it differs from mere vegetable mucilage, by containing azote, or a substance which on decomposition produces it, since azotic gas has been detected in the produce of fermentation, both in an uncombined state, and in one of its most frequent combinations, forming ammonia. These substances are known to exist in yeast, which is a modification of the vegetable extract. In many vegetables, and conspicuously in the gluten of wheat, it exists in great proportion. It is for this reason that wheat as well as rye, act powerfully as ferments. It is also found in many flowers, in that of the elder for example,—in the leaves of the vine,—in the

grape,—in the gooseberry, and in many other fruits as well as leaves. It is observed to abound in those vegetable juices which gelatinise on boiling. This substance, then, is the true natural leaven of fruits, or that by which the sugar which they contain, is rendered capable of undergoing fermentation: And in the artificial process of vinification, which is the subject of this paper, it is to this substance that we must look for the conversion into wine of that sugar which may enter into the compound. But I shall have occasion to enlarge on this subject, when I consider the process of fermentation.

Water, enumerated among the principles of fruits, simple as it may appear, is a substance requiring consideration. If the proportion of water be too small in the liquor subjected to fermentation, that process is difficultly either established or maintained. This is a matter of constant occurrence in those countries, where the juice of the grape is boiled to a certain consistence, or where the fruit before pressing, is allowed to undergo a partial desiccation. From these practices, result sweet and half-fermented wines, those of Cyprus and other places, as well as that class of wines known in Italy by the name of *Vino cotto*. The *vina cocta* of the antients, appear to have been of a similar quality from the same cause. The wines of Tokay and San Lucar, are known to derive ad-

ditional richness and strength, from a moderate use of this practice. This process can be of no use in the manufacture of our domestic wines, nor does the nature of our fruits admit of it. An excessive addition of sugar may produce a similar effect; but I know not that any of the receipts in use, approximate to that excess. That sweetness which is the prevalent fault of our wines, arises from other causes, which I shall consider hereafter.

The fruits of this country possess so little of the three remaining substances, which were enumerated as constituents, that it is unnecessary to dwell much on them.

Scarcely any *colour* is contained in our fruits, if we except the black cherry and the elder-berry, and as colour may be considered in the light of an ornament, and is easily procured by colouring ingredients, its want is not to be regretted; the essential parts of wine-making in nowise depend on it.

The *tanning principle*, which is the cause of astringency, is contained in the husks and stems of some grapes, and communicates at the pleasure of the operator, that roughness known in Port wines. The sloe and damson possess it, but as it can readily be communicated by kino or catechu, and is not a very desirable quality, it is sufficient to have noticed it, considering, as we may, the imi-

tation of foreign wines by circuitous means, as a fruitless attempt.

The last principle, that of *flavour*, is so uncertain and fugacious, that it is difficult to establish any general rules respecting it. In many grapes, as those of Frontignan, the flavour of the fruit is absolutely identified with the wine which they yield ; but in all such cases the wine is sweet and half fermented. The finer flavours of the superior wines, those of claret, hermitage and burgundy, bear no resemblance to that of the fruit, but are the result of the vinous process. In the manufacture of many wines, recourse is had to flavouring ingredients, such as orris-root, grape-flowers, almonds, mignonette,—a process which is imitated in this country in the making of elder and cowslip wines. If the flavour of fruits could be transmitted with certainty to the wines, we might expect similar results from the strawberry and raspberry ; but the effect of fermentation is generally such as to volatilize or destroy this delicate principle. Hereafter I shall point out a probable method of attaining this object.

If a knowledge of the circumstances which attend and modify the intricate process of *fermentation*, be necessary in the making of wine from the grape, it is still more requisite to investigate the various accidents and causes which may affect it, when the substances exposed to its action, are, like

those used in our domestic manufacture, artificially compounded. It is thus only that we can hope to establish such general rules, as may be applicable to those ever-varying cases, where particular rules of practice would be unattainable. A general notion has already been given of the substances, to whose mixture the process of fermentation is owing, and the essential ones will be found to consist of sugar, vegetable extract, tartarous and malic acid, and water. These are indispensable, and to their varieties in proportion, some of the most remarkable differences in the results of fermentation will be found owing. Among these, sugar is the most essential, since the alcohol of wine is more particularly derived from the decomposition of this substance. The strength of the wine is proportioned to the quantity of sugar fermented, and the most saccharine juices, therefore, afford the strongest wine, or in the artificial process, if so it may be termed, that compound to which the greatest proportion of sugar has been added, will be capable of giving the strongest, if duly managed. But we have already seen, that sugar and water alone do not ferment, if the sugar be pure, and that this process only takes place in clayed sugars, or in those which contain a portion of that vegetable extract which characterizes the sweet principle. In the juices of fruits, the sugar and extract exist in a state of combination, to which, as I before remarked, the term of Sweet Principle has

been applied. If the juice of the grape, for example, be exposed to heat and rest, a coagulable substance is separated. The juice then ceases to ferment with the same facility, but may again be induced to undergo that change, by a re-addition of a matter similar to that which was separated from it. This matter is found in all vegetables, in some, as in wheat, conspicuously ; and it appears to constitute the greater proportion of yeast, as well as of the lees of wine and beer, or other fermented fluids. Here, then, we have the theory of this process, as it is applied to artificial compounds. It consists of mixing with a solution of pure sugar in water, a certain proportion of this unknown substance, which, to distinguish it from common yeast, I shall hereafter call by the name of *leaven*. It is on the proportion, quality and management of the leaven, that the most important consequences in vinification depend. I must therefore describe at more length, the various modes under which it appears.

The natural leaven of fruit, is coagulable, and partially separable by heat, but it is not entirely rendered inert. From this cause, as well as from the partial dissipation of the water and concentration of the sugar, boiled juices produce a sweet wine, the process of fermentation being rendered incomplete by a partial separation of the leaven. When the process of fermentation is suffered to proceed in any of the natural compounds formed in the

grape or other fruits, a portion of the leaven is separated from the wine, and is exhibited in two forms of yeast and lee, part rising to the surface in froth, and the remainder subsiding to the bottom of the vessel. It is essential to attend to this distinction, and to understand the true nature of these substances, as some of the most important practices in wine-making depend on it. I must add, that it still remains uncertain, whether any portion of the leaven enters into combination with the vinous produce, or whether it acts solely by exciting the requisite changes in the sugar, and is then finally and entirely separated. The yeast and lee form the artificial leaven, which, in some important particulars, differs from the natural. It is soluble in hot water, whereas the natural is not. But it is insoluble in cold, and it is thus separated by the act of fermentation. I may add, that, notwithstanding the numerous experiments to which yeast has been subjected, its composition, like that of many other vegetable matters, remains obscure. It is important, however, to recollect, that it contains ammonia, or at least the principles of this substance, as Proust has shown. Those who have been engaged in the manufacture of domestic wines, must know, that one of the most frequent defects of these wines, is an ammoniacal taste; and there is little reason to doubt, that it arises from some mismanagement in the process of fermentation, or an improper introduc-

tion of artificial leaven. Although I cannot point out a precise remedy for this evil, these remarks may perhaps turn the attention of wine-makers to search for one.

It will from these considerations be evident, that if certain proportions of sugar and of leaven, whether natural or artificial be taken, and the process of fermentation be suffered to proceed to its natural termination, the result will be a fluid perfectly vinous, containing neither sugar nor acid, and analogous either to beer or to wine, according to other circumstances hereafter to be considered. If the proportion of leaven be deficient, the produce will contain unchanged sugar ; and the same effect will take place, if the fermentation be prematurely stopped by artificial means. If, on the contrary, the leaven is in excess, or the fermentation has been designedly protracted by artificial means, a new product will be formed, and the whole, or a portion of the alcohol, will disappear, and acetic acid will be found in its place. Sweet wine, therefore, is an imperfect wine, or one in which the leaven has borne so small a proportion to the sugar, as to have been incapable of converting the whole into a vinous liquor. This is the case with our domestic wines, when a large quantity of sugar is added to so small a proportion of fruit, that the compound does not contain natural leaven enough to convert the whole into wine. This evil may be corrected by the use of

the artificial leaven *yeast*, but the quantity added is generally inadequate to this object. It is from this cause, that the makers of domestic wines so often attempt in vain to produce dry ones. When this is attempted by diminishing the sugar, the result is a liquor both feeble as a wine, and at the same time, tending strongly to the acetous fermentation. If, on the contrary, recourse is had to an increase of the yeast, the consequence is an increase of the bad flavour, which this substance almost invariably communicates. The true remedy, is so to balance the vegetable juice and the sugar, as to produce a fluid analogous to the juice of the grape, or one in which there shall be a proportion of natural leaven, sufficient to convert the whole of the sugar into wine. Where a sweet wine is desired, this caution is not necessary. I shall hereafter shew how wines even of this quality can be procured from such a fluid, by an artificial suspension of the fermentation. I cannot too strongly caution the artist against the use of the common and pernicious practice of exciting the fermentation, by the yeast of beer. I have already made it appear, that when a due proportion exists between the leaven and sugar, either in a natural or artificial fluid, a regular fermentation takes place, and a perfect conversion of the whole into wine. It is therefore unnecessary to add yeast to a fluid properly compounded ; and it is further injurious, since the use of this substance not only communi-

cates the bitter flavour which it derives from the hop, but a peculiar and nauseous taste, apparently derived from its ammoniacal quality. It is well known to brewers, that a single spoonful of putrid yeast, will spread its contagion through many tuns of beer. If an artificial yeast is ever wanted, it may be found in the lees of wine, in which it is mixed with tartar, or else it may be reserved from the fermentation of former parcels of domestic wines. But a proper management of the fermentation itself, may be made to supply the want of natural leaven. I have already shown, that this leaven is rendered insoluble by the act of fermentation, and that it partly rises to the surface, and partly falls to the bottom of the fermenting fluid. By restoring this separated matter, the process may be protracted at pleasure, till the wine has acquired the degree of dryness that may be desired. It is only necessary for this purpose to break the *head*, and disperse it through the fermenting fluid, or to agitate the whole in such a way, as to mix the lees and scum with it, until the desired effect is produced. The apparently obscure process of rolling wine, or of returning it on the lees to *feed*, as it is technically called, is founded on this principle ; it renders the wine stronger and better, by re-exciting the languid fermentation. The converse of this practice will be equally intelligible. If a sweet wine is desired, the fermenting process may be at any time artifi-

cially suspended, by separating the wine already produced from the ferment with which it is mixed. The operations in use for this end, consist in decanting, in clarifying by means of glue or albumen, or in the use of certain chemical substances which decompose the leaven ; processes which I must consider more at length hereafter. From this view, it will be easily deduced, that sweet wines cannot turn sour, because their leaven has been expended. Another remark of equal importance may also be deduced, that all wines will have this tendency, if the whole of the sugar of the fluid has been converted, and if at the same time care has not been taken to separate completely the leaven which may remain in them. Hence the necessity of fining wines for their preservation, as well as their beauty. It will also be apparent, that if any fluid to be fermented, is of such quality, that the leaven predominates over the sugar, it will be necessary to stop the process by chemical means, to prevent the occurrence of the acetous stage, which would otherwise take place.

I have already stated, that both the malic and the tartarous acids take a share in the process of fermentation. Where the former naturally predominates, as in apples and pears, the produce is cider or perry ; where it abounds in the juice of the grape, it is supposed to lead to bad qualities in the wine. The practice of liming wine vats, and

that in use with sherry wines, seem to have been founded on some views of this nature.

It appears from the experiments of the Marquis de Bouillon, that tartar contributes to the formation of alcohol, and that it is partially decomposed during this process, a portion of it being converted into malic acid. But even sugar and tartar require the presence of vegetable extract, before they can be induced to ferment, although the addition of tartar materially increases the facility with which a compound of sugar and extract only is brought into fermentation. Hence we are enabled to explain the reason why moderately acid grapes run much more readily into fermentation than sweet ones.

From this view of the presence of tartar in the grape, and its utility, we may now deduce rules applicable to the art of domestic wine-making.

The juices of our fruits are known to be deficient in saccharine matter, and experience has long established the well known remedy,—that mixture of common sugar on which the whole art depends. But it has not generally entered into the views of makers of wine, to supply this other important defect, although the means are equally easy. The makers of *sweets* are indeed acquainted with it, although, from the defective nature of their process in general, it has not produced in their hands

the effects which might have been expected. Their principal error consists in the use of yeast and molasses,—articles, whose vicious nature is incorrigible; but in the experiments which I have directed to be made on this subject, ample reason has appeared to consider the addition of tartar to the juices of our fruits, as a valuable improvement in the art of making domestic wines. In the use of this ingredient, no very accurate limit seems necessary, since the wine of the grape may generally be considered as a saturated solution of tartar; and I may add, that by using crude tartar instead of the purified salt, we derive other advantages from the leaven contained in the lees attached to it.

From the preceding remarks, we shall be at no loss in understanding the true theory of this art. The formation of a liquor truly vinous, is the first object, and the adventitious circumstances of colour and flavour will be considered hereafter. It is almost superfluous to say, that the wine of the grape is superior to every other vinous liquor, and we have, in the foregoing remarks, a detail of the circumstances on which the formation of wine from that fruit depends. These are sugar, the extractive matter, and tartar. If now we compare our common fruits with the grape, we shall find, that, in common with it, they possess the extractive matter or natural leaven, but that they are deficient both in sugar and in tartar. Our first object, therefore, should be to assimilate them as nearly as

possible to the grape, by the addition of the requisite proportions of those two substances. The whole process is, therefore, from its commencement, artificial, and capable of considerable precision. It is only required so to proportion the adventitious ingredients to the natural juice, as to form a fluid resembling the juice of the grape. To the peculiarities of the several fruits employed, we must afterwards look for the flavour or other accidental properties which they may be capable of giving. It is necessary also to consider, that as the several fruits may differ in their quantity of leaven, as well as in their proportions of sugar and acid, some attention to their various compositions will be required, before any accurate rules of practice can be established. We can also see, that we are limited in the application of our own fruits, and that we cannot avail ourselves of all the use which we might derive from their natural sugar, nor in some cases from their leaven, lest we should introduce too large a portion of their malic acid; that acid in which they are too apt to abound, and which I have already stated to be ill adapted to the formation of genuine wine. They who shall attempt to make wine from the juice of the currant or gooseberry alone, will feel practically the force of this statement. We also may see from these general principles, that we are not necessarily limited to the use of fruits; since, being indebted to the fresh

vegetable for very little more than the extractive and fermenting matter, we are permitted to seek it, even among leaves and roots.

But to return to the agents engaged in fermentation ; water is one of these, and we have seen, that a certain degree of fluidity is essential to this process. If a mixed solution of sugar and leaven is concentrated to a certain degree, it refuses to undergo the act of fermentation, or enters into it with difficulty. For the same reasons, its progress is so slow, that the result is generally a sweet wine ; since the operator, accustomed to regulate his processes by time, rather than by the changes which the liquor experiences, is apt to conceive it finished before it is well established, and thus to suspend it, by the operations of decanting and clarifying, before the liquor has suffered all the changes of which, in due time, it is capable.

When the juice to be fermented, contains, on the contrary, too large a proportion of water, the fermentation is equally slow and difficult, but the produce is weak, and runs readily into the acetous stage. Thus, weak currant juice exposed to fermentation, is converted into vinegar, by a gradation so regular, that it can scarcely be said to form wine, during any part of its progress. In wine countries, these opposite evils are remedied, either by dilution or concentration. The artificial composition of the fluid used in the domestic manu-

facture, admits of more ready remedies, already sufficiently obvious from the preceding remarks.

Having examined the nature and re-actions of the ingredients to which the process of fermentation is owing, it is now proper to attend to the external circumstances which affect and regulate it, before any rational processes can be adopted for its conduct.

Temperature is one of the external circumstances which has the greatest share in influencing the act of fermentation, and that of 54° has been considered the most favourable. Some latitude is however to be allowed ; but in a temperature either very high or very low, this process does not go on at all. Attending to this circumstance, we are enabled to regulate the process when it does not proceed regularly, either by cooling the fluid to check its too rapid progress, or by warming it when it proceeds in too languid a manner. By this we can also explain a phenomenon of common occurrence in wine-making, a renewal of the fermentation which takes place in spring, after it has been partially or entirely suspended by the cold of winter. This is a subject worthy of attention, as some important practices in the art depend on it. Thus, if we are desirous of making a wine to imitate *Champagne*, it is necessary to watch for the period when the fermentation is re-excited by the arrival of spring. By bottling in this stage, we

insure a brisk wine, which, if bottled, either in the cold of winter, or after the second fermentation has been exhausted by the heats of summer, would be dead or still. This renewal of fermentation, or *fretting*, as it is sometimes called, is also a favourable time for the addition of flavouring matters, as they then give out their flavours and combine with the wine. It is at this time also, that spirits should be added to the wine, if it is ever allowable to make this addition. It is the only time at which alcohol can safely be added without destroying its vinosity, as it then enters into a kind of chemical combination with the wine.

It is necessary likewise to consider the effects which the *air* produces in fermentation, although its presence may rather be considered as favourable than essential. If the liquor is shut up in close vessels, it does not readily ferment, although it still slowly undergoes this process, and is at length converted into perfect wine. It is ascertained, that no air is absorbed during the vinous fermentation, although this happens in the acetous, but that the free and ready disengagement of the carbonic acid, is the principal circumstance in which fermentation in open vessels differs from that in close ones. One important fact, however, is established,—that the wine is stronger when the fermentation has been either partially or totally carried on in close vessels, and that the flavour is

also better preserved ; and it appears that a great part of the alcohol produced is dissipated by the carbonic acid, which holds it in solution, and which produces a well known effect, both on the organ of smell, and on the nervous system in general, when this disengagement is made in the stomach. It is not yet well explained, how the carbonic acid is disposed of when produced in close vessels. Many of the practices followed in making particular wines, depend on a consideration of these two modes of conducting the fermentation ; but it rarely happens that an exclusive fermentation in close vessels is used. This is generally reserved for the last and most tranquil stage. A consideration of the effects produced by these different methods, and of the product which we wish to obtain, will be necessary to guide us in our choice of either of these two processes, or of a certain admixture of both. If the wine is meant to be still, and if it is not desirable to husband the strength and flavour, the whole fermentation may be carried on openly. This will be the case with strong and sweet wines. If, on the contrary, a wine of the character of Champagne is intended, which must retain its briskness, flavour and strength, we must be guided in our practices by rules similar to those in use in that, and other districts of France, and adopt a partially close mode of fermenting. In all cases, it appears to

be a useful practice, even if the first fermentation is carried on in an open vat, to exclude the free access of air, by covering the vessel with boards and blankets. If the first fermentation is carried on in the vessel in which the liquor is meant to continue,—a case which can only occur when no solid matter is fermented with the fluid,—a slight covering will be sufficient. Whatever process has been adopted in the first instance, the bung may after a time be lightly put down, and ultimately tightened, a spill-hole being added, to give an opportunity of relieving the vessel from time to time, of the elastic fluid which might endanger its safety.

The *volume* or quantity of the fluid, is the last circumstance which requires notice, as influencing the act of fermentation. This process is more rapid and more perfect in large, than in small vessels, and is often entirely completed in the course of a few days in a large vat, while, in smaller vessels, it may require weeks or months for its perfection. This question, interesting to manufacturers of *sweets* on a large scale, is of little moment to domestic makers of wine, among whom the quantity made at any one operation is generally small. But it is not quite uninteresting even to them, as it explains some of the difficulties with which they have to contend, and serves to direct and guide their operations. The same materials, for example, will not

experience the same changes in equal times, if they are exposed to fermentation in the quantity of two or ten gallons; and time will therefore be allowed by the operator, in a ratio the inverse of the bulk of the fluid on which he is operating. I may also remark, that if there be a flavour to preserve, it will more readily be secured when the fermentation is slow, and the mass of fluid small; and that the sweeter and thicker juices, require to be treated on a larger scale than the thinner ones. It is easy to make lemon wines in a cask of two gallons, but it is a very difficult task to operate on so small a quantity of thick and sweet raisin wine. This is one of those general principles which, together with the quality of the liquid, the temperature, the proportion of leaven, and the other circumstances which I have inculcated, ought always to be present to the maker of wines, since it is only by conforming to the complicated actions of these various causes, that he can hope to secure certainty or uniformity of result.

I may pass lightly over the phenomena which occur during the process of fermentation, which, however important to a general view of this subject, are, from their minor share of practical interest, more easily dispensed with, than those details which are necessary to the unphilosophical practitioner.

The act of fermentation is marked by the extrication of air-bubbles, and by the agitation and

turbid appearance of the liquor. The turbid matter is shortly separated into two portions, which, in part, rise to the surface in scum, and, in part, subside in the form of lees. Both of these, as I have before shewn, have the power of continuing the act of fermentation; and it has also been shewn, that their separation, by decanting and clarifying, serves to check this process. For the same purpose, the cask is kept always filled to the bung-hole, so as to admit of the disengagement of the scum or yeast as fast as it is formed. The bulk of the liquor is increased during fermentation, partly in consequence of the heat excited, and partly from the extrication of the carbonic acid gas which is separated. It will be obvious, how the practices required in regulating the qualities of all wines, must be deduced from this general fact respecting the management of the yeast during its production, and that the manipulations must be different when either a sweet or brisk, or a still and dry, wine is desired. In the former two, the fermentation will be checked, by filling to the bung-hole; in the latter, the yeast will be allowed to subside.

The *carbonic acid* is not necessarily separated and disengaged from the wine, since the brisk wines of Champagne owe their sparkling quality to a portion of it which is retained by them, either in consequence of the period of bottling being duly chosen, or to a portion of leaven allowed to

remain in the bottled wine, and which has a tendency to renew the fermentation under confinement. This quality is sought after in many wines, and it is often, in the worst class of Champagne wines, the only valuable one which they possess. It is owing to the necessity of having a superfluous quantity of leaven for producing this effect, that a brisk wine is with difficulty made, unless a portion of unripe fruit enter into the composition. This is the case with the wines of Champagne, and equally so with the produce of our gooseberry, which has been conceived to resemble them.

I have already mentioned, that the carbonic acid of fermentation is supposed to contain alcohol, and thus, by fermenting in closed vessels, a great part of the spirit of the wine which would be dissipated, is retained and preserved.

Heat is also generated during fermentation, and to such a degree, as often to require tempering; but as this can only occur in manufactories on a large scale, I need not dwell on it.

The *colouring matter* of the fruit is extracted during this process, since the darkest grapes yield but a white wine, if their skins are not fermented in the liquor; and by attending to this fact, we can regulate the colouring of our wines at pleasure, if the fruit possesses this principle.

The last and most important effect of fermentation, is the *formation of alcohol or spirit*, and this de-

pendes collectively on the proportion of sugar in the entire fluid, on the due proportion of the leaven to that sugar, and on the perfection of the fermentation. The whole of the sugar is seldom decomposed during the first process of fermentation; but a proportion is generally attached even to the wines considered dry, long after they are tunned or bottled. It is only by a slow continuation of the same actions in casks and bottles,—a process often requiring many years for its completion,—that the sugar entirely vanishes, and the liquor is found to consist of alcohol, combined with the other matters which join it to form wine. It is important to consider the effects produced on wine by a portion of undecomposed sugar remaining in it. As long as this exists, the acetic fermentation cannot take place, and it therefore offers a test of security against this result, in our ill made domestic wines. In the natural wines, the balance of principles appears to prevent this occurrence, even when all the sugar has disappeared, and thus Hock, Claret and Madeira, seem to be possessed of the power of endless duration.

All care will be unavailing, if the process of fermentation, and its application to practice, be not thoroughly understood; and I shall therefore deduce from the general doctrines laid down above, some further rules which have been cursorily passed over. If all the favourable circumstances already described are present, the act of

fermentation goes on without any assistance, by the action of natural causes. The circumstances which are capable of impeding these natural actions, exist either in the quality of the liquor, or in the temperature to which it is exposed. When the liquor is a natural *must*, like the juice of the grape, it rarely labours under any other defect than the want of saccharine matter,—a defect which the experience of wine countries has found the means of correcting by the addition of sugar of honey, or of *must* evaporated by boiling, until it has become a thick saccharine fluid. The same defect is also sometimes remedied, by partially drying the grapes, or by adding burnt gypsum, or plaster of Paris, to the *must*, so as to absorb the superfluous water. It is evident, that as the maker of domestic wines has always an artificial fluid on which to operate, he need never be subject to any inconvenience from this cause, as it is in his power at all times so to compound his *must*, as to render it answerable to the requisite conditions. The management of the fermentation, when it has actually commenced, must also be regulated by the views of the artist, respecting the wine which he wishes to obtain. If sweet, the proportion of the water as well as that of the leaven to the sugar, must be reduced in compounding the *must*, or his *working receipt* must be modified to this end; and the management of the fermentation will then be such, as to discharge

the yeast as fast as it is generated, by keeping the cask full to the bung-hole, and by a careful repetition of decanting and clarifying. If, on the contrary, the wine is to be dry and strong, the proportion of the leaven will be increased, and the yeast will be agitated with the liquor, by rolling and stirring, so as to protract the fermentation. If the wine is to be brisk, the proportion both of leaven and water will be increased, and the fermentation will not only be conducted in vessels partially closed, but the liquor will be bottled and secured, before the fermentation is finished. The management of the temperature is easily deduced from the general doctrines. When the fermentation languishes from defect of heat, it is necessary to introduce a stove into the apartment where the process is carried on, or, by heating a portion of the liquor, and mixing it with the mass, the temperature may be elevated to the most favourable point. Injurious changes, arising from variations of the external temperature, may be warded off, by a covering of straw or blankets. These attentions, trifling as they may appear, are by no means unimportant, since they are sufficient to cause the whole difference between good and bad wine. It is owing more to varieties in management, than to radical differences in the qualities of the grape, that the wines of different countries differ so widely from each other, and

that the wines of France, for example, possess a superiority so decided over all others.

The limited nature of this little essay, prevents me from entering on the chemical theory of Fermentation, a subject still very obscure; and I shall therefore proceed to consider the management of wines after fermentation, a subject of more practical interest.

Many popular practices in the after-treatment, and in the suspension of fermentation, are founded on positive precepts respecting the time which the process has occupied. But time is but one out of the many elements which should enter into this calculation; since it has already been seen, that it is modified by the varying quality of the fluid subjected to that process, by the temperature, by the mass, and by many circumstances which it would be superfluous to repeat. Other rules, which are apparently better founded, since they are deduced from the appearances after fermentation, may yet deceive us, if they are too implicitly followed, without a due regard to the ultimate intentions of the operator, respecting the quality of his wine. Neither the smell, taste, or colour of the fluid, nor the activity or cessation of the fermentation, are positive guides. As the prime object is to convert the sugar into spirit, it is evident that the fermentation must continue longer, if the

produce is to be a dry wine, and the reverse if a sweet one. If, on the contrary, it is the wish of the operator to preserve the flavour or *bouquet* of the wine, the period must be shortened. The case will be the same if a brisk wine is wanted, as the carbonic acid on which this property depends, would be irrecoverably dissipated, by an undue protraction of the fermenting process. As all wines are reducible to the four general divisions, of dry and strong, sweet, light and flavoured, or brisk ; it is plain, that a regard to this ultimate object, their quality must determine the mode of proceeding. If it is intended, for example, to make that kind of dry wine which is made in this country from raisins and sugar, the same practices will be necessary which are followed in the countries where wines are made from the grape for distillation. In this case, the wine is suffered to remain in the vat for three, four or more days, until it ceases to have a saccharine taste, and till the whole of the sugar is converted into spirit. If it is intended to make a strong and sweet wine, the fermentation must be discouraged, by speedily removing it from the vat to the cask, and by the further use of processes hereafter to be described, which suspend and ultimately destroy the fermenting process. If it is desired to produce a light and flavoured wine, like those of Burgundy, for example, the practices should resemble those followed in that country. There, the *must*

is allowed to remain but a few hours in the vat, the time varying according to the quality of the *must*, the temperature, and other accompanying circumstances. The period is, *cæteris paribus*, always shortened, when flavour or perfume is expected from the wine; a precaution, however, which the maker of domestic wines may dispense with, as the little flavour he has to expect from the fruits of his own growth, is generally better avoided. Further, if it is proposed to make wines brisk, and resembling those of Champagne, the juice must remain in the vat but a few hours; and indeed when small quantities only are operated on, it is often prudent to conduct the whole process in the cask, even from the commencement.

I cannot conclude these general directions, without inculcating the necessity of cleanliness in the use, and care in the selection of the casks, since results otherwise promising, are often destroyed by this minor sort of negligence.

In removing the wine from the vat to the cask, it is necessary to get rid of all the insoluble and superfluous matter which it may contain. This removal, is in fact the first stage of decanting,—an operation of which the careful conduct is of prime importance in this manufacture. By tapping the vat at a due distance above the lee, and by stopping the flowing liquor before the scum has descended too low, this separation is in general

easily effected. In some cases, straining may be required; but in all, the scum should be carefully removed, as it is from exposure apt to acquire either a musty taste, or acid property, easily communicated to the liquor. In the wine countries, the solid matter is exposed to the wine press. Here it would not be an object worthy of the labour required.

The wine thus far advanced, still undergoes a fermentation in the casks, more languid, yet necessary to its completion. If this process be suffered to go on indefinitely in those wines of which the saccharine matter has been entirely decomposed, it will proceed to the acetous stage, and vinegar instead of wine will be the result; the natural tendency of fermentation being a progress from the vinous to the acetous stage, which, if not counteracted by circumstances in the wine itself, must be prevented by artificial expedients. The natural circumstances which prevent this change, consist in that state of proportion between the leaven and sugar, which allows part of this last to remain undecomposed after the process is completed, or a balance of principles so nice, as to terminate in a perfect neutralization of the two elements which conspired to produce it. This accuracy is perhaps seldom obtained, since the palate is unable to detect the last portion of sugar, masked as it is by the predominant taste of the wine, on the qualities of which it nevertheless produces an

advantageous effect. Knowing that the acetous process cannot take place while sugar remains unchanged in the fluid, we can regulate our conduct in the use of the artificial means of checking fermentation above alluded to, since any anxiety on this head is unnecessary while the wine continues sweet. We can also see from the same consideration, how the addition of sugar to a wine whose durability is suspected, may prevent the acetous process from taking place, although, when this process is once established, it would be, according to circumstances, either unavailing, or the cause of a speedier conversion into vinegar.

I must now describe the artificial means by which fermentation may be checked or stopped, in those cases where a natural termination would not occur. Those most generally used, are racking and fining, of which the object and effects must already be intelligible to those who have read the preceding remarks. Turbid wine is in an unfinished state, as well as in a precarious one, and its brightness and purity is not merely an ornament, but a property necessary to its permanence. It is from being left in this state, that wine frequently becomes *pricked*, this disease being the first stage of the acetous fermentation, but one which may also originate in other causes already explained. But although racking and fining may disengage the wine from all precipitated leaven, it

will not separate that which is held in solution, and of which the tendency is equally to destroy the wine at some distant period. For this purpose, chemical means are required, and the process in common use, is known by the name of *sulphuring*. Many unnecessary and complicated methods are resorted to for this end; the most simple is equally effectual, and consists in filling the empty cask with the vapour of sulphur, from burning matches placed in the bung-hole. The wine is then introduced into the cask, and if this first operation is found insufficient, it may be repeated as often as is necessary. When the *leaven* is so abundant, that a very large quantity of sulphureous acid is required, as in many of the wines of Bourdeaux, a portion of wine, impregnated with the gas, by a process similar to that of the silk-bleachers, is used for mixing with the wine in the cask. The sulphite of potash, offers itself as a convenient substitute for this operation; and in the quantity of a drachm or two, it is sufficient in general for a large cask of liquor. Other chemical agents, capable of accomplishing this end, might be enumerated; but the operation of the whole is similar, and consists in precipitating, and rendering insoluble the leaven which was contained in the wine. It is obvious, that this process must be followed by that of racking and fining. The substances used for fining, are most commonly isinglass, or the white of eggs, and the mode of

applying them is universally known. Sand, gypsum, starch, rice, milk, blood, and the shavings of beechwood, have been found to answer the same purpose.

In the general practice of making wine from grapes, many expedients are in use, to remedy particular defects of colour, sweetness, flavour, sharpness or dullness. As few of these are applicable to wines of domestic manufacture, I shall pass them over slightly. The causes and remedies of excessive sweetness, must already be obvious from what has been said. The causes of offensive sharpness, are either the excessive fermentation of a weak and watry *must*, or an undue portion of malic acid. In the former case, the wine is tending to vinegar, and although the evil may be palliated, it can scarcely be remedied, nor is it perhaps, in the case of our domestic wines, worth the remedy. The use of lead, chalk, and other expedients, must be left to manufacturers. The mode of prevention, is more worthy of our attention, and it is obviously that of using a better *must*, or attending more carefully to the fermentation. That sharpness which arises from excess of malic acid, is well exemplified in hard cider. It is not a fit object of remedy, but may be prevented by a better choice of materials, or by the expedients alluded to in the beginning of this paper.

A disagreeable quality opposed to the former, is flatness, or a mawkish flat taste, which, though

sensible to the acuter palates of those who are habituated to good wine, is scarcely perceived by those who are accustomed to the strong dull wines, so generally used in England. The light and quick flavour, so preceptible in the wines of France, disappears under the treatment by which the more fiery wines of Spain and Portugal, are made marketable in this country. At times, flatness may arise from age, or from the complete annihilation of the fermenting process ; but the most common cause is the admixture of brandy or spirit. This addition, when used in excess, is not only injurious to the liquor, but to the constitution, as it introduces an additional quantity of ardent spirits, into a beverage already perhaps too strong. Its use is also in some measure founded on a mistaken principle, as it is resorted to, at least in this country, among the makers of domestic wines, for the imaginary purpose of checking fermentation, and preventing the occurrence of the acetous state. It has been shown by recent trials, that alcohol does not check the acetous process, unless added in a much greater quantity, than it is ever used for wines ; and I have already pointed out the true principles on which the tendency to vinegar may be prevented. An idle notion is prevalent among makers of domestic wines, that they are deficient in durability. The unfounded nature of this belief, must appear from every thing which has been stated respecting the true theory of wine ; and I

may here add, that the durability of these wines, is in fact shortened by the admixture of brandy, since it ultimately decomposes them, driving off their carbonic acid, destroying their brisk and sprightly taste, and rendering them vapid and flat, while at the same time, their salubrity is diminished, and their price increased.

If, notwithstanding this view, makers of wine are still determined to have recourse to the practice of adding spirit; I will now point out the least injurious manner in which it may be effected. It may be added to the liquor before fermentation,—a method in use in the manufacture of sherry. It may also be added, during the subsequent renewals of the fermentation, which have a sort of periodical recurrence in the cask; the operation being founded on the practice known to wine-coopers, by the term *fretting in*. When for any purpose it is found convenient to mix two varieties of wine, that time of spring is selected, when a slight fermentation is renewed, or this process is brought on by rolling or heating. A perfect union of the wines mixed at this period then takes place, a slight fermentation being induced, which serves to unite the whole into one homogeneous fluid. It is under similar circumstances, that brandy may be added, and it then enters into a combination with the wine, more nearly resembling that natural union in which alcohol exists in this fluid; while

at the same time it produces less injury, either to the flavour of the liquor, or to the health of the consumer.

The sketch which I have now given of the general principles of wine-making, may possibly suffice for the purpose of practice, and enable the practitioner to guide himself by rules, both more correct and more generally applicable, than the positive ones on which he has hitherto proceeded. I shall now proceed to a cursory examination of the several practices in use in our domestic manufacture. The receipt books abound with details, which it is unnecessary for me to examine, as it would be a waste of time to comment on manipulations, which have been guided by no principles, of which a great number is manifestly absurd, and of which many others appear incapable of giving results at all resembling wine. I shall content myself with noticing the most prominent errors, and with pointing out those general practices in which the most rational receipts can be made to agree.

When we read in many of those books of receipts, directions for sulphuring the casks before fermentation; we must be convinced, that such directions have arisen from an utter confusion of ideas on the subject. The same remark may be made on another rule, of which the object is equally misapprehended; the mixing of white of egg with the fluid about

to be subjected to fermentation. The proportions of sugar seem to have been allotted with equal want of consideration ; and it seldom appears to have entered into the minds of the inventors, that the strength of the wine was to depend on this ingredient. The proportions of the fruits to the total compound, seem to have been dictated by similar caprices ; their natural properties, whether of sugar, acid or flavour, not having been considered in the views of the artist.

Those ingredients which are added for the avowed purposes of flavour, have been managed with similar want of judgment, and they have indeed often been supposed capable of communicating the strength, or vinous quality, to the liquor. Instead of being introduced at the decline of the fermentation, they have been exposed to all its effects ; in consequence of which, their flavour has often been volatilized or destroyed. This is the case with cowslip wine, where an enormous quantity of flowers is used, to obtain an effect which might be procured with a much smaller allowance. Such also is the practice with raspberries,—a practice worth noticing, since it affords an opportunity of stating the more correct and useful mode of proceeding. If an attempt is made to form wine from raspberries and sugar, a liquor will be produced with little or no flavour of the fruit ; but a small quantity of syrup or juice of raspberries added at the decline of the fermentation,

or a little fresh fruit suspended in the cask at the same period, will be sufficient to communicate a taste, more likely to prove excessive than defective.

But the most striking defects of the common proceedings are visible in the vacillation and uncertainty, with which both the fermentation and the subsequent processes are conducted. By using the yeast of beer,—a practice founded on ignorance of the nature and causes of fermentation,—a false and bad flavour is introduced, which is often sufficient to render the produce tainted and even nauseous. By want of attention to the process itself, and the circumstances by which it is affected, the artist is unable to advance or retard it, to alter or amend it; while, guided solely by rules founded on fixed periods, inattentive to his subject or its concomitancy, and undecided respecting the future character of his wine; it is not surprising if he meets with perpetual disappointment, producing still wine when he wished for brisk, or sweet when he intended to form dry. The same want of principles prevent him from taking advantage of the practices of sulphuring, racking and bottling, as will be obvious to those who shall compare the practices in daily use, with the more correct ones which have been laid down.

I must now proceed to give a view of the methods in common use, as far as they offer differences worthy of notice, confining myself to those

varieties of domestic wines, which are either in themselves good, or capable, under proper management, of being rendered so. I shall take no notice of the projects to make wines from esculent roots, as I believe that they are misplaced ; but limit myself to fruits, from different kinds of which, the several wines take their names. I shall also omit the grape at present, because, considering it as almost exclusively worthy of attention, I wish to treat of it in a separate paragraph.

The fruits chiefly in use are the quince, cherry, strawberry, sloe, elder-berry, damson, mulberry, black or bramble berry, raspberry, orange, lemon, gooseberry, and the three varieties of currant. Dried raisins, although not ranking among our fruits, are extensively used, and require also to be noticed.

A wantonness of experiment seems to have, in some measure, led to this great and superfluous number of articles as the nominal bases of wines, although the practices have also been in a great degree, founded on false views of the real nature and objects of this manufacture. It is evident, on the principles already laid down, that when no peculiar and agreeable flavour follows the adoption of any individual fruit, it can have no legitimate claim for use, beyond that which is founded on its several proportions of sugar, leaven, acid, colour or astringency. As the two last of these can be communicated with the greatest certainty

by adventitious ingredients, it is bad policy to have recourse to weak expedients for the same, and particularly, if, for the sake of these minor objects, we must sacrifice others of greater importance.

Since also the sugar is, confessedly, and in all cases, an adventitious ingredient, capable of being proportioned with the greatest nicety, completely in our power, and of a moderate price, it is unnecessary to consider that ingredient in fruits, as the one which is to guide our choice. It is to the due admixture of acid, and of leaven (the fermenting principle), that we are chiefly to look for the causes which are to determine us in our selection. If a good flavour can be obtained from any fruit of our own growth, we have then the whole data which should rule our determinations. The object of price, is a consideration which will naturally be added to these more important ones.

The Quince appears to have usurped a place in the foregoing list, to which it properly has no title. Its similarity in principles to the apple and pear, is sufficient to assure us, that its produce can only be a species of cider, characterised, according to circumstances, by the astringency and flavour which distinguish it from these two fruits. Its price and rarity also increase the objections to its use.

Vinous liquors, of no very particular character, may be made from the several varieties of Cherry ; but the operator should be cautioned against the the common practice of pressing the kernels in

quantity, as, however agreeable a slight flavour of the bitter may be, a taste amounting to bitterness, is always unassimilating and injurious to the wine.

From the Strawberry, wines of agreeable quality, both dry and sweet may be produced ; but the peculiar flavour of the fruit is generally dissipated in the process. The cautions which I have given respecting flavour, will suffice to point out in what way that is most likely to be obtained.

I make the same remark on the Raspberry, with this additional hint, that as very little in point of flavour or produce is gained by the use of these fruits, which are in most places of a high price, it behoves the operator to balance the advantages against the disadvantages, before he enters on the undertaking. A simple infusion of this fruit, as before noticed, in any flavourless currant wine, will, with greater cheapness and certainty, produce the desired taste.

Having no experience in the Brambleberry or Mulberry, I am unable to say, whether any flavour can be communicated by their use. The cheapness of the former is a recommendation ; and there is no doubt that they both contain the substances, leaven and acid, most essential for this purpose. They also afford what so few fruits do to the same degree, the colouring principle. In managing them, so as to derive the greatest advantages from their colour, it is necessary, that the fermentation be allowed to go on with the skins, until the co-

lour is extracted, which will also be accompanied by the slight degree of astringency, which, at a certain period of ripeness, accompanies both these fruits.

The Sloe and Damson are so associated in qualities, that nearly the same results are produced from both,—a bitterish and astringent liquor, capable of being converted into rough wine of a good character, care being taken duly to proportion the quantity of fruit to the sugar, or to modify that liquor by the addition of other fruits of less decided properties. This is a case, in which it is necessary to protract the fermentation, so as to make a dry wine, as the peculiar astringency of these fruits, forms a very discordant association with sweet wines. By a due admixture of currants or elder-berries, with sloes or damsons, and with proper care, wines not much unlike the inferior kinds of Port are often produced. Since receipts are in the hands of every one, I need not detail the proportions, which ought, in fact, to vary, both according to the ripeness of the different fruits, and the particular views of the artist.

In naming the Elder-berry, I have mentioned a fruit whose cheapness and abundance have long recommended it to notice ; and from which, with attention, excellent red wine can really be made. It seems to possess in great perfection, that portion of the extractive principle, which is requir-

ed to produce a free and full fermentation ; and its admirable colour, communicates to the wine a tint as rich as can be desired. It appears to be deficient in acid ; and its produce is consequently much improved, by the addition of tartar as an ingredient in the artificial *must*. Its natural sugar is so small in quantity, that it requires an ample addition of this fundamental ingredient. If it has no good flavour, it is at least free of any bad one,—a virtue which does not appertain to many of the fruits of current application in wine-making.

In apportioning the two several ingredients of tartar and sugar, the following rules may be of use.

Considerable differences in the dose of tartar may be allowed without producing any correspondent changes in the result, and the proportion of this ingredient has consequently been made to vary from one to four, and even six *per cent*. The causes of this admissible laxity will appear, when it is considered that the greater part of the tartar is deposited in the lees. I may also remark, that from two to four *per cent*. will be found a sufficient dose, and that in proportion to the greater or less sweetness of the fruit, the sweetest requiring the largest quantity of tartar, and *vice versa*. The dose of tartar ought also to vary in proportion to the added sugar, increasing as this increases. Although pure tartar, or cream of tartar, may answer the intended purpose, the crude salt

is to be preferred, because it already contains a portion of yeast conducive to the more perfect fermentation of the artificial *must*.

In proportioning the sugar, the following general rule may also be taken as a guide. Two pounds of sugar, added to a gallon of a compound, containing all the other ingredients requisite to a perfect fermentation, produce a liquor equal in strength to the lightest class of Bourdeaux white-wines. Three pounds produce one equal in strength to the wine known by the name of White Hermitage: and from four, if fermented till dry, a wine resembling in strength the stronger Sicilian wines, that of Marsala, for example, or the Cape Madeira, is produced, supposing these wines to be free of brandy. Where a fruit already contains sugar, it is obvious that the quantity of added sugar must be diminished in proportion to that which the natural juice may be estimated to contain, if we are desirous of accurate results. If in any case wine is to be left sweet, it is clear that this general rule cannot be applied, since sweetness and strength are, in the same wine, and from the same quantities of sugar, incompatible. The rules thus laid down, render any formal detail of proportions unnecessary, since they are readily deduced from the general view; and the circumstances which ought to regulate the fermentation and after-management, have already been so fully investigated in the first part of this essay, that it would be superfluous to repeat them.

But, while on the subject of the juicy fruits, I may as well notice a part of the current practice which appears ill founded, and often attended with bad consequences. This is the large proportion of water, and consequently small proportion of fruit, which is generally used, an usage apparently originating in a misplaced economy. If we attend to the common practice of making wine from grapes, that which ought to be the model for all our imitative operations, we shall see that no water is used, but that the whole fluid is composed of the juice of the fruit itself. If we now attend to the current practice, as recommended in our own domestic receipts, we shall find that the juice of the fruit rarely forms more than one-fourth of the whole liquor, and often much less, the proportion of fruit being seldom more than four pounds, including the solid matter it may contain, to eight pounds of water, and three or four pounds of sugar; and this proportion is fixed with no regard to the ripeness of the fruit, a circumstance of considerable importance. The consequences resulting from this sparing use of the fruit are highly injurious. It is plain, that the artificial *must*, thus compounded of water, sugar and juice, must contain a much less quantity of the vegetable extractive matter, and of the native acid, than that which I have formerly shewn to be absolutely essential to a perfect and

efficient fermentation. To put this case in a stronger light, let this proportion of juice be still further gradually diminished, and the *must* will soon consist of little else than sugar and water, a compound incapable of forming wine. Let it, on the contrary, be increased, and a vigorous and perfect fermentation, with a produce perfectly vinous, will be the result.

If green fruit is used, in which little or nothing exists but acid and extract, of which the former is in this case always in much greater proportion, bulk for bulk, than in ripe fruits, the acid would be too predominant were the juice of the fruit used in undue quantity. There dilution is absolutely necessary, and of this practice I shall take occasion to point out examples hereafter. But if the fruit be ripe, the acid is diminished in quantity, and cannot therefore bear to be still further diminished by excessive dilution. It will accordingly be found, as I shall again have cause to shew, that a much more perfect wine is produced by diminishing the water, or increasing the proportion of fruit.

As the *orange* and *lemon*, although not native fruits, are familiar to us, and scarcely differ in their chemical composition, I may safely consider them in one view. So little difference exists between the citric acid which is found in these fruits, and the tartarous which characterizes the grape, that it is natural to expect their produce to

be of a good quality. They are, however, deficient in extractive matter or leaven, and for this reason are incapable of being converted into wine, even with the aid of sugar, unless yeast or some other leaven be added. As it is impossible to add the yeast of beer in sufficient quantity for the perfect fermentation of the fluid, without spoiling the flavour, these wines are generally imperfect and sweet. They are likewise almost always corrupted in their flavour by the infusion of the peel, giving a taste, which, however grateful abstractedly, does by no means coalesce with the taste of wine. It would tend to the improvement of these wines, if the peel were to be omitted, and if any vegetable matter could be added capable of inducing the complete fermentation, without communicating a bad flavour. I have attempted it by means of gum, and with partial success. The principles I have already pointed out, will lead experimentalists to the search of proper substitutes for the natural leaven. It is not unlikely that they would be found in wheat; either in the flour or gluten.

The *gooseberry* is one of the fruits most commonly used, and is in particular well known as an ingredient in brisk wines, which are made to resemble, in appearance at least, the wines of Champagne. For this purpose, it is used in an unripe state. It is well known in the wine countries that, independently of those causes of briskness in wines

which consist in the management formerly described, this property always results from the use of unripe fruit, and is readily produced by mixing unripe grapes with the ripe ones. The case is the same with the gooseberry. The fault of this wine, however, if it be considered as an imitation of Champagne, is a bad flavour, which is almost invariably communicated by the fruit, and that in proportion to its ripeness. To avoid this evil, so generally injurious to the brisk gooseberry wines, the fruit can scarcely be taken in a state too crude, as at this period the flavouring substance has not been developed. At the same time the expressed juice alone should be used, care being taken to exclude the skins from the fermentation, as being the part in which the flavour principally resides. With these precautions, the noxious flavour may generally be prevented. It is true, that the produce is then without flavour, or nearly so, but this is by much the most tolerable fault in domestic wines, whose leading defect is almost invariably a disagreeable taste. Various proportions of fruit and sugar are used by different persons; but the most common consist of three pounds sugar and four of fruit, to eight pounds of water. Here the proportion of fruit is too small compared to that of the sugar, and the fermentation is consequently in general so imperfect, as to leave the wine disagreeably sweet. At the same time, the proportion of sugar is such, as to render the wine stronger than

the strongest wines of Champagne. If, therefore, this wine is to be amended in composition, it is either by reducing the sugar, if we are contented with a weaker wine, or by increasing the fruit, if we are desirous of retaining the greater strength. In managing the fermentation to a constant and successful result, the rules laid down as practised for Champagne wine are strictly applicable in the present case ; and with these precautions and practices carefully attended to, the produce of the gooseberry will be invariably successful. I may also add, that it is perfectly durable ; as much so as Champagne wines of corresponding quality, provided equal care be taken in the bottling, the cellarage, and other management ; all of them, circumstances in which our domestic fabricators are too apt to fail, thinking that when they have mixed together a portion of sugar and fruit, their labour is finished, and that the rest may be trusted to chance. They should consider, on the contrary, that it has but then commenced.

From the gooseberry in a ripe state, wines may also be made, for which no rules are required, as they are precisely conformable to those before laid down. But the produce of the ripe fruit is commonly ill flavoured, and, whether sweet or dry, is scarcely to be rendered palatable, unless perhaps, by a most careful exclusion of the husks.

The three varieties of the *currant*, are perhaps even better known, and more in use as ingredients

in wine-making than the gooseberry ; and as the produce of each is attended with some difference, I shall notice them separately. Both from the *white* and *red* sort, wines are made, which differ principally in colour, but also vary slightly in flavour, though the flavour of neither is very characteristic. I have ascertained by repeated trials, that a principal defect in these wines, as commonly fabricated, arises from the sparing proportion in which the fruit is used, which otherwise contains a sufficient quantity of natural acid, as well as extractive matter, to ensure a perfect fermentation, if properly managed. Partly from this cause, as well as from the imperfect management of the fermentation, these wines are usually made sweet. They are also, not uncommonly, nauseous, as well from the combination of a natural bad flavour with this mawkish sweetness, as from the other improprieties of management before noticed. By increasing the quantity of fruit, (which is generally proportioned like that for gooseberry wine,) and by avoiding the use of the husks, the flavour is materially improved, and the quality of the wine further ameliorated, the fabricator at the same time acquiring the power of making his wine sweet or dry ; whereas, according to the present mode, he is generally unable to produce the latter variety. The natural tendency of this fruit is to form a wine analogous to the lighter white wines of the grape, and it is a rational object to

follow the tendency which is pointed out by the nature of the fruit. I have also reason to think that much advantage would result from the use of tartar in this case, by which, among other defects, the ammoniacal taste so common in this wine seems to be prevented. The proportion of tartar need not be specified, as it has been mentioned before, and that of sugar is to be regulated by the principles already laid down. With careful management, wines are thus produced from currants not easily to be distinguished from the Colares of Portugal, which, although not in the first class of wines, is certainly superior to most of our domestic manufactures. A considerable improvement may be made in the fabric of all those wines produced from fruits of which the flavour is either bad, or which possess no flavour at all; and this is by boiling the fruit previously to fermentation,—a practice which I have caused to be adopted in currant wines with decided success. From this treatment many tasteless fruits acquire a flavour, as is well known, and many bad flavours are converted into agreeable ones. In no case, perhaps, is this more remarkable, than in the *black currant*, which, harsh, and comparatively insipid in its natural state, acquires by boiling a powerful, and to most persons a highly agreeable flavour.

In making wine from this variety of currant, the effects of this process are very remarkable; the

produce of the raw fruit being scarcely distinguished by any particular property from the herd of domestic wines, while that of the boiled fruit may with careful management be brought to resemble some of the best of the sweet Cape wines. In the white and red currant, the same precaution has been attended with results equally successful, though not marked by a contrast so decided. The same varieties of proportion are admissible in this case, as in the others lately mentioned, and I need not therefore detail receipts which are to be found in the hands of every one. To what extent the practice of boiling may be tried with advantage, I do not know ; but I may venture to point it out as an improvement worthy of further investigation.

Although the dried *raisin* cannot be considered as a domestic fruit, yet as, like the orange and lemon, it is largely used in the manufacture of domestic wines, I may here take notice of it. The history of the art of wine-making, in the countries where the vine is an object of common cultivation, has already shown, that the grape is in many places used for this purpose in a state, if not actually that of raisins, yet approaching towards it. Thus, the wines of Cyprus and Tokay, among many others, are produced from grapes which have undergone a partial desiccation. Analogy, therefore, would lead us to expect, that wines of good quality, might, in this country, also be pro-

duced, by using the dried grapes for that purpose, as they are imported in the state of raisins. Yet the success which has followed the innumerable attempts to make raisin wine, has by no means justified that expectation, although the expensive scale on which the manufacture has been, and is still carried on by the makers of *sweets*, should long ere this have brought it to perfection. It is not apparent to what causes this failure is owing, nor is it possible, without repeated and expensive experiments, to investigate the process in such a way, as to lay the foundation of a more successful practice. But an examination of the processes in common use, may perhaps suggest some hints conducive to a more rational and improved mode of proceeding.

In manufacturing this wine on the large scale, whether for the purpose of open sale as *sweets*, or for the fraudulent imitation and adulteration of foreign wines, a quantity of raisins varying from two as far as seven pounds to the gallon of water is used, together with a proportion of common clayed sugar or molasses, reaching from half a pound to three or four pounds. In many cases from four to six pounds of crude tartar per cwt. is added. Yeast is not in general employed to assist the fermentation, nor should it ever be used, for the reasons already assigned. It is asserted, that the product of this process is a pure and flavourless vinous fluid, capable of receiving any

flavour which may be required, and thus, of imitating many wines of foreign growth. Whatever the case may be when such fluids are used for the fraudulent purposes above-mentioned, the wines themselves, which are common in the market, and which are confessedly made in this way, are almost always nauseous, whether sweet or dry, and however they may be called by the various names of Lunel, Teneriffe, Sherry, or Canary, they have all the same disagreeable and overpowering flavour. It is probable, that a great part of this peculiarity is owing to the quality of the sugar employed ; but it is also to be suspected, that the complete drying of the grape develops in that fruit, some obnoxious taste which is communicated to the produce. I cannot pretend to throw any more particular light on the subject ; but should recommend to those who are inclined to make trial of raisins, a nice attention to all the circumstances in the mode of fermentation and management, which have already been detailed. If these fail to produce the desired effect of purity in the wine, we shall then be entitled to consider the manufacture of raisin wine as incapable of further improvement.

I have thus given such a brief general view of the several varieties of wines which may be made in this country, as will be sufficient to render more intelligible, the principles and practices on

which they are founded, without which, all attempts must either be futile, or must at least be regulated by chance, giving results, which will seldom obey the previous intentions of the manufacturer. The reader, who shall be at the pains of comparing what has now been said on our domestic fruits, with the more detailed theoretical and practical views laid down in the first part of this essay, will easily form for himself a correct set of rules of practice. It is in vain to say, that correct rules can be laid down in an abstract form, and capable of easy application, or that the practice may be rendered perfect, independently of the theory. Circumstances of a most evanescent nature, and, although important, often unheeded, necessarily interfere with all positive rules, and new cases are continually occurring, for which no previous rules can be given. He who is acquainted with the theory of the art, is always in possession of that light which will alone guide him through the intricacy of new cases, and of unexpected results. With the small apparatus of a theory, he has it in his power to do that without difficulty, and without labour, which he, who is destitute of theory, can seldom execute, even with the cumbrous and generally unintelligible apparatus of a set of fixed canons.

In making wines, as it is to be supposed that the fabricator has previously adopted some general views regarding the species of wine he proposes

to make, and does not intend to trust the result to chance, he should consider of what kind he wishes his wine to be, or which of the several modifications of foreign wines he means it to resemble. By these considerations, he must be guided in his practice ; and to assist his views, I will briefly enumerate the several varieties which it is in his power to imitate, in their general and fundamental qualities.

The first and simple class, are the *sweet wines*, of which the fermentation is incomplete. This incompleteness may arise from two sources, either the disproportion of sugar in the *must*, or the artificial means adopted for suspending the fermentation, and which have been already described. It is to this class that our native wines bear the greatest resemblance ; a resemblance indeed so general, that few makers of this article appear to possess sufficient knowledge of the art, to enable themselves to steer clear of that which may be fairly called the radical defect of domestic wines. But a consideration of the causes of sweetness in wines, already amply laid down, and of the modes in which it may be avoided ; will, I trust, enable the manufacturer to choose, whether his wine shall be sweet or not,—a choice, which in the present mode of management, is rarely left to him.

The next leading description of wines, is that to which, either in a state of sweetness, or comparative dryness, is super-added the effervescence.

on uncorking, which produces *briskness* or *sparkling*. The causes of this phenomenon, and the mode of ensuring, preserving and regulating it, have been also fully detailed ; and it has been seen how it is compatible, either with a very considerable sweetness, or with a limited degree of the same property. As this modification is also esteemed among the made wines, it is desirable that an accurate knowledge of the method of producing it should be attained, since it is frequently missed, in consequence of negligence or ignorance in the conduct of the process. It is from gooseberries almost solely, that this variety has in this country been made ; but it is by no means limited to that fruit, since, with due attention to the period of maturity, and with careful management, it may be equally well made from any other fruit. I must not, however, quit this subject, without cautioning the operator against a bad expedient, to which recourse has been had for producing the effect of sparkling. It is the introduction of a small portion of carbonate of potash or soda, into the bottle immediately before corking it. The consequence of this, is doubtless, a disengagement of gas at the moment of pouring out. But the gas speedily flies off, almost before the wine can be drunk, since it exists but in a loose state of combination, and in but small quantity. Nor does it communicate to the palate, that agreeable and lively sensation, which follows from the disengage-

ment of that carbonic gas, which is in a real state of combination with the wine. Moreover, the neutral salt formed by the alkali, with the natural acid of the wine, is always sensible to the taste ; while at the same time the native acid of the wine, so essential to the composition of this fluid, is destroyed ; not to mention the danger of this acid taste being replaced by an alkaline one, from an over-dose of that ingredient.

The third variety of wine, is that, of which Hock, Grave and Rhenish, may be taken as examples. In these, the saccharine principle is entirely overcome by a complete fermentation, while their after-change is prevented by a careful application of those processes laid down for the preservation of the wines of this class. Makers of domestic wines have rarely succeeded in imitating these wines. The reasons are obviously two-fold, the great disproportion of the sugar to the subsequent fermentation in the first instance, and that want of the after-management, the neglect of which soon consigns these wines to the vinegar cask, if chance should even at first have produced success. I may venture to point out the imitation of these wines, from my own experience, not only as readily attainable, but as among the very best of those which can be made from domestic fruits. It is evident from what has been already said, that the relative proportions of the fruit and sugar in most common use, must be materially altered, and that

the fermentation must be conducted in a much more perfect manner, before we can hope to produce wines of this character. It is equally evident, that the processes of racking, sulphuring and fining, must be practised with great assiduity, to preserve these wines after we have succeeded in making them.

The last class of wines, are those which are both dry in their quality, and strong in their nature. Such are Madeira, Sherry, and the stronger wines. The theory of these, is equally apparent ; and it is certain, that with due attention to the the fermentation, wines of this strength and quality may be made without the addition of brandy. Yet the operator has it in his power by means of this ingredient, under the restrictions already laid down, to produce wines of any required degree of strength ; and I trust, that with the light which I have thus endeavoured to derive from the legitimate processes of wine-making, I have established a beacon to guide him through the trackless route of his hitherto conjectural art.

British Grape Wine.

I have chosen to throw into a separate section of this essay, the remarks which I had to offer on the art of making wine from *Grapes* of British growth, on account of the greater importance of this part of the subject, and also on account of the neglect which seems to have attended that branch of domestic wine-making. I hope to make it appear that wines, not to be distinguished from those of foreign growth, can, in this country, be made from *Grapes*, and at a moderate expence; and that the success of this process is not at all affected by the uncertainty which attends the ripening of the grape in our climate. It is not too strong an expression to say, that the use of this fruit is calculated to supersede that of all others, and that it is, in fact, almost the only species of domestic wine which is worthy of serious attention.

The essays of Mr Pegge in the *Archæologia*, with the subsequent controversies which originated in the opposition of Mr Daines Barrington, have established beyond doubt the fact, that vine-

yards were cultivated in the monasteries of Britain, for the purpose of making wine. It appears, however, by the records of Ely, that the grapes did not ripen every year, but that the vineyards, as might be expected in this climate, were subject to occasional failures. We have therefore no reason to conclude, from the establishment of this fact, that our climate has undergone any material and steady alteration,—a supposition which is often hazarded by discontented horticulturists without sufficient grounds, and apparently from no other cause, than that ill humour which delights, as it has at all times delighted, in praising the past at the expence of the present.

The physical history of Europe, indeed, shews, that its climate has, for many centuries, been in a state of amelioration. Whether this amelioration may not now have attained its *maximum*, is another consideration. If it has so done, it is certainly within a period comparatively very recent. As far as we are capable of judging, no material variation in the success of our horticultural speculations has occurred for the worse, provided we choose periods of sufficient length to admit of an average result. Occasional seasons of peculiar severity, or unusual irregularity, can afford no ground for judgment. The suppression of the monasteries, the great and splendid changes which our whole system of agriculture has undergone

since those days, the increase of trade, the more economical division and application of capital to objects of commerce, and to those of domestic manufacture, the multiplied demands which wealth and prosperity have made on the consumption of wine, and the increased discrimination and taste which this has produced, have combined together to change materially both the objects of commerce and cultivation, and have jointly operated in producing the decay of this art, if (as is by no means proved,) it was ever actually practised to any great extent. But this question does not concern our present purpose. It is sufficient to prove, what in fact there is no reason whatever to doubt, that the grape, as it is or may be cultivated in England, is capable of making wine; whether with advantage, considered in an agricultural view, and with what advantage, must depend on other considerations into which I need not now enter. However diminished this practice is in modern times, it is by no means extinct. The cottagers in Sussex are in the habit of making wine almost annually from the produce of vines trained on the walls of their houses. Many individuals through various parts of the southern counties, and even as far north as Derbyshire, practise the same with success. But the experiment is well known to have been made for many years on a large scale, and with complete results, at Pain's Hill, by the Honourable Charles Hamil-

ton, in a situation, with respect to soil and exposure, of which parallel instances are to be found almost every where throughout the country, and produced from land of no value whatever for the ordinary purposes of agriculture.

It is true, that the uncertainty of this climate will sometimes prevent the grapes from ripening : But this case is not without remedy.

Of the numerous varieties of grapes, it is well known to gardeners, that some are much more forward than others, and ripen their fruit at least a month earlier. It is obviously necessary to select for our purposes those which are the most early, if it is our desire to produce in every season a ripe crop. Of these, the Auvernat, the Miller, the White Muscadine, the White and Black Chasselas, the Black Sweet-water, and the Black Hamburg, are among those which ripen earliest, and with the greatest certainty. But I need not enter on this part of the subject, since it is fully known to gardeners.

It is more important to consider, what improvements may yet be made in the naturalization of this foreign plant, and whether care and attention may not, in time, produce new varieties, still more hardy and capable of ripening, with the same certainty as the currant or gooseberry. In a paper read before the Caledonian Horticultural Society, I slightly alluded to this subject, and pointed out

the methods to be followed in naturalizing exotic plants in general *. The observations of all gardeners have long since shown, that a tender exotic, rarely, if ever, becomes habituated to a climate, if it be propagated by layers, grafts, or cuttings; since the new plant is always perfectly identical in all its habits and properties with the parent, of which indeed it forms a part. But a material change in the constitution of plants is produced by sowing the seeds, and the seedlings are invariably more hardy than the plant from which they were derived. I quoted in that paper some observations made by Sir Joseph Banks, on the naturalization of *Zizania aquatica*, and related an instance still more remarkable of a similar effect produced on *Canna indica*, a native of the West India islands, by successive sowing of the seeds in Guernsey. From these two remarkable facts, and perfect examples of success, as well as from innumerable more imperfect trials, it seems clearly established, that any plant may be naturalized to this climate, provided its seeds can be made to grow in succession. This, however theoretically true, is obviously attended with much practical trouble, in consequence of the difficulty of descending equally, and for a given length of time, through a given range of temperature; a difficulty which would, in fact, in most cases, be insuperable. But no such obstacle prevents the further naturali-

* Published in vol. i. p. 284. of the Memoirs of the Society.

zation of those which produce seeds already in our summer temperature, and which are not destroyed by our winter frosts. Among these, the vine may be enumerated. To a certain extent it may indeed be considered as already naturalized, since it flowers every summer, and the winter frosts do not destroy it. So may the common laurel be looked upon as naturalized; yet a severe winter will kill this shrub, as a cold summer will prevent the vine from bringing its fruit to maturity. It is by a sedulous culture of seedling vines alone, that we can hope to overcome this obstacle, and to produce varieties which shall ripen in all summers. For this purpose it is not sufficient to make trial of one or two successions of seedlings. Experience has shown, that numerous generations in a direct descent from the parent are required for the production of this effect. What that number is, has scarcely yet been ascertained, except in the cases of the *Zizania*, and the *Canna* above quoted; but it probably varies according to the previous tenderness of the parent. In the vine, already considerably hardy, the object would probably be attained in a few generations. As I consider this object as one of prime importance, I venture to point it out to the serious attention of horticulturists, and as one which is likely to reward their labours. The production of new varieties will naturally follow these attempts, and by combining with them, the process of impregnating the flowers

with the *pollen* of different grapes, new and valuable ones may ultimately be produced. By the choice, therefore, originally, of proper varieties of the vine, and by such naturalization on these principles as we may be capable of producing, we shall have gained one great step in the art of making wine, from grapes of British growth.

The next step is the choice of that soil, exposure, and method of treatment, which is adapted, not only to the habits of the vine, but to that particular climate in which the cultivation is attempted. Our guide here must be the practice of those countries, whose climate most resembles our own; of certain parts of Germany and Hungary. An elevated situation, a southern exposure, shelter to the north and north-west, rocky and southern precipices, are peculiarly adapted to the situation of a vineyard: so are gravelly and rocky soils; a circumstance in another view advantageous, since these soils are of very little value for common agricultural purposes. But I forbear to enter into details, which are to be found in many essays on gardening, and in others which have been written expressly on this subject.

It is the more direct object of this essay to show that the making of good wine from grapes of British growth, does by no means depend on their maturation, and that this is not a necessary circumstance. The process of making wine from grapes will be reduced to a much narrower question, if

we can succeed in making it at all times, unchecked by seasons or accidents. A vineyard may thus be conducted with almost as little care as a gooseberry garden, with the certainty of a constant produce applicable to the purposes in view; and it will be in every one's power, in almost any situation. However precarious the ripening of the grape may be, its produce is not so. We are sure of an annual crop of grapes, but not of an annual crop of ripe ones.

It has been fully proved, by the facts and principles laid down in the first part of this essay, that a compound and artificial *must* can be fabricated from due mixtures of sugar, with the extractive matter and saline substances of fruits, capable of undergoing a regular fermentation, and of forming good and perfect wine. The case is as applicable to the grape as to the gooseberry. Long ago, experiments were made in France, by several chemists, with green grapes and sugar, and with complete success. I have repeated these experiments, and varied them with the best effects. The produce has varied with the management, and the results of the trials have been wines resembling Champagne, Grave, Rhenish, and Moselle, and of qualities so perfect, that the best judges and wine-tasters have not been able to distinguish them from foreign wines. The grapes may be used in any state, however immature. When even but half grown, and perfectly hard, they succeed

completely. It is evident that wines made on this principle, will be more expensive than when made from ripe grapes, as a sufficient quantity of sugar must be used, to compensate for the deficiency of the natural sugar of the grape. But even then, they are no more costly than currant or gooseberry wines, while, at the same time, their superiority is beyond all comparison. The hardest grapes will produce a wine of the strength of white Hermitage, with a proportion of three pounds of sugar to the gallon; and the expence will be trifling compared to the value of the produce.

It might be supposed that these wines would necessarily be devoid of flavour. But this is by no means the case, since all the specimens which were made under my direction, were characterized by flavours, as genuine and decided, as those of the foreign wines to which they approximated. I have little doubt, that under due management, on a large scale, and with sufficient age, wines of the Hock quality, could equally well be produced here in the same way.

Many trials must yet be made before we can hope to appretiate the extent of our resources in this manufacture. It is more than probable, that different grapes, even in this immature state, would produce different wines; but these trials must be left to the efforts of individuals, and to the necessarily slow progress of experiment.

With regard to the management, it must be founded on the operations followed in the wine countries, and of which a sufficiently full account for all the purposes of practice has already been given. It is in the first place obvious, that the grapes should be suffered (from motives of economy) to remain on the vines, while there is any hope of gaining an accession either of strength or sweetness. They should then be carefully separated from the stems; those which are mouldy or rotten, being at the same time rejected. Some judgment will be required in proportioning the fruit to the water in the first instance, and to the sugar in the second. I have before said, that the grape, when ripe, consists of sugar, combined with vegetable extractive matter, or the fermenting principle, and certain salts, besides the astringent and flavouring matter. As the colour is not developed in the immature grape, it need not be noticed here. But the proportions of these ingredients vary materially, according to the state of maturity of the fruit. As a great part of the saline and other constituents of the grape, appear to be converted into sugar, during the process of maturation; it is plain, that, weight for weight, there will be more of the principles contained in the immature, than in the mature fruit. To form, therefore, a *must* of such a quality as shall resemble the natural *must* of ripe fruit, it is necessary that water should be added to the immature juice,

for the purpose of diluting, and thus diminishing the proportions of those saline matters, which would otherwise confer on the wine a degree of harshness, difficult to overcome.

As it is impossible to give positive rules to meet the infinitely varying and undefinable degree of maturity, in which the grape must often be used, and as such rules would in fact but tend to mislead, I shall content myself with laying down some general principles, as I have done on former occasions, leaving the application to the ingenuity and observation of the operator.

If the object be to produce a wine which shall resemble Champagne, or the white wines of Bourdeaux, a small proportion of crude grape, will be required. Grapes barely half grown, require, for the production of wines of this class, to be used in the proportion of equality to water. If they are more grown, the proportion may be increased; if less, it may be diminished. If the intention be to make a wine resembling Hock, the proportion of grapes must be materially increased, and the wine at first harsh, austere, and not drinkable when new, will, by a few years residence in the cask, undergo that amelioration which time alone can give. To the proportions which I have described, varying quantities of sugar may be applied. A proportion of two pounds in the gallon of mixture, will yield a very light wine, of no great durability, resembling (under the proper treatment), the

inferior classes of Champagne wines, and under a different mode, a wine resembling Barsac, and the lighter of the Bourdeaux wines. An increase of the sugar to three pounds, will yield a wine equal in strength to the best sorts of Champagne, or if fermented to dryness, to the strongest of the white wines of Bourdeaux. Larger doses of sugar, will doubtless yield wines of different qualities, but of such proportions I cannot speak from experience. I may only caution the operator who shall undertake these trials, that larger quantities of sugar require larger proportions of fruit, if it be his intention to work the wine to dryness, as the quantity of fruit above-mentioned, is but barely sufficient to convert the proportion of three pounds above named. With regard to the durability of these wines, I may add, that I have kept them for seven years, and during all that time with evident improvement. I should consider them to be as little liable to destruction, as foreign wines of the very best *fabrique*.

While, on the subject of sugar, I may also say, that the general cause of failure in those wines which are made in this country from ripe grapes, is the deficiency of sugar, and that even these would be much improved by an addition of it. It is owing to this deficiency that these wines are perishable, and easily converted into vinegar, the natural *must* being too aqueous to produce a durable wine. The proportion of sugar need not

be larger in these cases; but, as before remarked, no positive rules can be given for it, since it must vary with the maturity and saccharine quality of the fruit,—circumstances which differ in almost every season.

Two modes of management may be adopted with regard to the fruit, either subjecting the skins to the fermentation, or not. In the first case, a greater degree of austerity will be the consequence; and the wine will consequently vary in its qualities. If the object be to make a wine resembling Champagne, the skins may be separated previously to the fermentation. If this manufacture be conducted on a large scale, the result of the second pressing may be reserved to make a distinct wine. If, on a small one, it may either be mixed with the first, or rejected altogether.

The methods of conducting the fermentation, as well as all the after management, need not be repeated here, as they are to be found in the beginning of this essay. From these, the operator will be directed to the several sorts of wine he may wish to make. It is equally unnecessary to repeat, that wines produced in this way, may be modified either in flavour or colour, by the several expedients already detailed. But let me again inculcate, that the wine is not made when the ingredients have been introduced into the vessel. It is then that the labour begins, and nothing but

Care and attention to every part and every minute circumstance of the subsequent processes, can ensure satisfaction, and produce valuable results.

To such uses may the immature fruit of the vine be converted ; but the capacities of that plant are not even yet exhausted. Situations may be found in this country where the vine may not produce even immature fruit ; yet still it can be directed to the end of wine-making. Chemical examination has proved, that the *young shoots* the *tendrils*, and the *leaves* of the vine, possess properties, and contain substances exactly similar to the crude fruit. It was no unnatural conclusion, that they might equally be used for the purposes of making wine. Experiments were accordingly instituted in France with this view, and they have been repeated here with success. From vine-leaves, water, and sugar, wines have thus been produced in no respect differing from the produce of the immature fruit, and consequently resembling wines of foreign growth. The few experiments which I have tried have been eminently successful. No further rules can be given respecting the management of the leaves, in addition to those I have laid down for the treatment of the unripe fruit. Similar proportions and similar management will, in both cases, produce similar effects. The leaves, however, scarcely yielding any thing to the press, require to be in-

fused in the water for some days before they are subjected to fermentation, and they seem to yield their soluble parts most readily to boiling water, without any material alteration in the result. The leaves of the Claret vine thus treated, produce wine of a delicate red colour. Tartar appears also to be a useful addition in this case; and it may be added in the proportion of half a pound, or even one pound, to ten gallons of the *must*. One advantage results from the use of the leaves. This is the facility with which they are reproduced during the growth of the vine; and thus, the produce of a small vineyard in leaves alone will be abundant; and that even of a single vine will be as great as is required for the use of most families, should they make this wine for their sole consumption. Let it always be remembered, that in all these cases, the price of the sugar is the price of the wine. The expence of utensils and labour is comparatively trifling, and, when the manufacture is upon a small scale, scarcely worthy of regard.

I have thus brought to a conclusion the remarks which I purposed to make on the art of fabricating wines in Britain. That I have offered so little from my own experience, will be pardoned

by those who consider that each experiment must extend to a period of one or two years, and that the labour of a life would be insufficient to reduce every one of these suggestions to practice. It will be enough, that they are all readily deducible from the labours of others, or from fair analogies taken from established rules of practice in the wine countries. The co-operation of many, to which I may hope that this essay will afford additional facilities, will in time improve this practice to that degree of perfection of which it is capable, and establish it on a sure and solid basis.

WOOLWICH, }
May 1815. }

NOTE.

THE Council of the Caledonian Horticultural Society strongly recommend the foregoing essay to the attention of all who wish to promote improvement in the manufacture of domestic wines. They suspect, that to many, who are in the habit of making such wines, the general *principles* on which the process depends are nearly unknown, and that others, though in some measure acquainted with these principles, still trust too much to chance.

As the Society will continue to give every encouragement in their power to the improvement of the manufacture of domestic wines, they have earnestly to request every one who may be engaged in it, to keep a memorandum of the whole process which was followed, even the

most minute manipulations. It is intended, when a very superior wine is produced in competition, to bestow a distinguished honorary reward, provided it shall appear that the maker has fully understood, and carefully acted upon, the scientific principles, the only certain guides to success.

The Council may remark, that some individuals in this place have already made considerable progress in naturalizing the vine from the seeds of plants kept in the open air; and, as there is no difficulty in sowing seeds, (which will vegetate though the grape be unripe,) and in watching when the plants thus produced yield a few grapes in the open air, the seeds of which are again to be sown, proceeding in this way to several generations; hopes may be entertained of some varieties of the grape being obtained, which will never fail to give abundant crops of tolerably ripe fruit; and *that* in no long time, since, under proper management, the vine may be expected to shew fruit in three or four years. In the mean time, the *leaves* (as suggested by Dr Macculloch) may be tried; but it ought to be observed, that some shoots, from which fruit may be expected, should not be stript of a single leaf. Indeed, for the purpose of making wine from the leaves, it would be better to plant vines of any sort, and to preserve the seedlings with the greatest care. To give a pleasant colour to wines, the Claret grape may be cultivated for its leaves.—Premiums will be given for Scottish grape wine, and a Gold Medal for the first good Scottish grape raised from seeds produced in the open air in Scotland.

